Abstract

Hannah P. Smith. Revisiting the Port of Brunswick: A Research Design for the Waterfront of Brunswick Town/Fort Anderson State Historic Site, Winnabow, North Carolina. (Under the direction of Dr. Charles R. Ewen) Department of Anthropology, 2014.

Since the fall of 2010, a series of colonial period wharves and other features have been revealed as a result of erosion along the banks of the Cape Fear River at Brunswick Town/Fort Anderson State Historic Site in Winnabow, North Carolina. These features have produced a considerable quantity of artifacts, but no formalized conservation plan has yet been developed for this area of the site. This proposed plan discusses the role of conservation at all stages of the archaeological processes, but focuses on the conservation needs of artifacts following excavation. Treatments for wood, ceramics, glass, leather, and textiles are discussed, as these are the major material types recovered along Brunswick's waterfront. The treatment of a knit cap and two leather shoes are discussed in detail as three case studies for the application of this conservation plan. The treatment options discussed will provide a possible course of action for the treatment of artifacts from this site, as well as similar sites elsewhere in the United States and abroad.

Revisiting the Port of Brunswick: A Research Design for the Waterfront of Brunswick Town/Fort Anderson State Historic Site, Winnabow, North Carolina

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By Hannah P. Smith

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Revisiting the Port of Brunswick: A Research Design for the Waterfront of Brunswick Town/Fort Anderson State Historic Site, Winnabow, North Carolina

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Note: All artifact images provided courtesy of the North Carolina Department of Cultural Resources.

Chapter 1: Introduction

The History of Brunswick and Its Archaeological Past

Important components of North Carolina's history and the development of techniques employed in historical archaeology can be linked to one spot on the banks of the Cape Fear River, halfway between Wilmington and Southport. This spot is now referred to as Brunswick Town/Fort Anderson State Historic Site (BT/FA) (Figure 1).

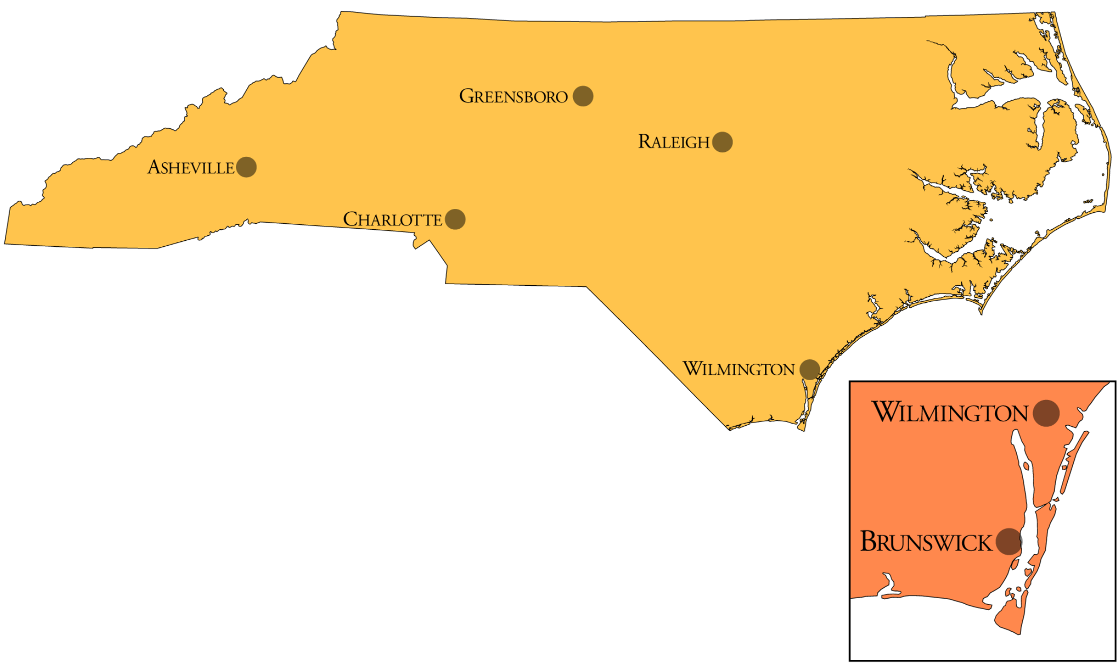

Figure 1. Map showing Brunswick's location, relative to major North Carolina cities. Image courtesy of Bryan Wiggins.

The colonial town of Brunswick (1726-1776) was a major port in the colony, exporting considerable quantities of the naval stores – tar, pitch, and lumber – needed by the British to keep their Navy afloat (Lee 1951:65-66). The town also imported plenty of things needed by the colonists, including tools, some food and drink, and clothing (Lee 1951:65-72). Despite the town's involvement in trade, it was eventually overshadowed by Wilmington upriver. Brunswick was burned by the British in 1776, with few people remaining in the town after the American Revolution (Lee 1951:145). Later, this same area was the site of Fort Anderson, a Confederate fort protecting the city of Wilmington from attack by Federal forces by sea (Fonvielle 1999). Almost a century after that, archaeological investigations by Lawrence Lee and Stanley South helped provide insight into life in this colonial town. In addition to this site specific information, data recovered during these investigations helped shape the Brunswick Pattern of Refuse Disposal, the Carolina Artifact Pattern, and Mean Ceramic Dating, which are still in use by archaeologists today (South 2007:111, 113-114, 126, South 2010:62). It also influenced South's explanations of how historical archaeology should be conducted, as discussed in *Method and Theory in Historical Archaeology* (1977).

Because of the limited occupation period, the documentary evidence available through colonial records, and relative lack of disturbance after the town was abandoned, archaeologists are able to undertake detailed studies of life during this period. Indeed, E. Lawrence Lee and Stanley South began this study, and others have continued it into the twenty-first century. However, much of the investigation of Brunswick has focused on the terrestrial aspects of the site. The waterfront part of the site is equally important, and has not been investigated to the same degree as the rest of the site. Additionally, factors impacting the Cape Fear River have been causing considerable erosion along the waterfront. This erosion has revealed a number of features, and a multitude of artifacts, mostly believed to be from the colonial period of the site's history. As part of the plan to excavate this part of the site, a program needs to be developed to deal with the conservation needs of the artifacts recovered during the excavations as well as those that have already been revealed.

Research Directive: A Waterfront in Crisis

By February 2011, a barrelhead and some timbers were visible along the waterfront at Brunswick. Conditions necessitated recovery of the barrelhead, making it the first organic artifact recovered. By the middle of 2012, a number of organic artifacts had been recovered. Several hundred artifacts in all had been recovered, and were in need of some sort of conservation, even if it was just proper cleaning. It also became apparent that no set procedure or plan existed to deal with these finds. Something needed to be done.

The purpose of this thesis is to present a possible plan for the conservation of artifacts recovered from the waterfront of BT/FA. Because conservation should be included at all stages of planning for archaeological investigations, a discussion of the steps leading to the recovery of artifacts requiring conservation will occur, including site location and excavation. Information gleaned from these steps identifies the specifics of the conservation process for a given site's artifacts. A discussion of the treatment methods available for the conservation of ceramics, glass, wood, leather, and textiles will also be discussed. These are the materials that have been recovered to date on the waterfront at Brunswick. While many of the treatment options available to conservators today will be discussed, preference will be given to conservation methods that produce stable artifacts, are well-tested, do not require a lot of specialized equipment, and are cost- and time-effective. While the plan is designed for implementation at the beginning of archaeological investigations, the fact that conservation is not always discussed until fragile artifacts have been recovered is taken into account. Therefore, emphasis is placed on treatment to allow conservation to be undertaken as soon as artifacts are recovered.

Additionally, three case studies in conservation will be discussed. These case studies involve artifacts recovered from Dry's Wharf on the BT/FA waterfront, and include the Brunswick Cap and two leather shoes. The discussion will focus on the methodology employed to conserve these artifacts, as well as an assessment of the outcome. These case studies provide a means to test the efficacy of aspects of the proposed conservation plan for the waterfront at BT/FA.

Chapter Outline

This thesis will begin with a discussion of Brunswick Town/Fort Anderson State Historic Site's (BT/FA) history in Chapter 2. A discussion of the previous archaeological investigations will follow in Chapter 3. These two chapters provide the historical and archaeological context for the research that follows. Chapter 4 outlines the conservation considerations for the types of artifacts that have been recovered to date along BT/FA's waterfront. These artifacts have been composed of ceramics, glass, wood, leather, and textiles, which each have different requirements for cleaning and long-term care. A conservation plan for BT/FA is proposed in Chapter 5. This plan begins with the survey of the waterfront, moves through a discussion of the possible excavation needs for this part of the site, triaging artifacts recovered, and proposes an order of treatment for waterfront artifacts. This chapter also includes some of the information known about the existing wharves, as a means to put the artifacts recovered into a more detailed context. Three conservation case studies provide a means to test the proposed conservation plan in Chapter 6. The artifacts treated include a knit cap, referred to as the Brunswick Cap, and two leather shoes. These artifacts were treated as case studies due to their need for conservation, as well as providing a means to test the treatments used on two of the more difficult to treat materials that archaeological conservators encounter: textiles and leather. The final chapter, Chapter 7, includes a review of the proposed conservation plan and three case studies. It also includes a brief discussion of possible future research both along BT/FA's waterfront, as well as at other sites. For those interested, a more detailed discussion of the conservation treatments employed on the cap and shoes are included in Appendices A through C. Please note that all artifact images contained within this thesis are courtesy of the North Carolina Department of Cultural Resources.

Conclusion

Waterfront sites, such as Brunswick, are less well known than many types of terrestrial sites. This may be due to their survival over time (many are filled in, destroyed, or built over), or simply because there is so much territory to survey, and they have not yet been found. Additionally, the types of artifacts being recovered provide insight into the past. Conserving these artifacts provides the means to continue their study into the future, as well as provide a tangible means for the public to connect with those who have gone before.

Chapter 2: Brunswick's History

Brunswick's history is tied to the Cape Fear River, on whose banks the town rests. From the first explorations of the Cape Fear region, through the settlement and abandonment of the colonial town, to the construction of Fort Anderson during the Civil War, water access provided a reason for this site's occupation. As such, an investigation of the interface between river and town can provide valuable information about the town itself.

The Early History of the Cape Fear Region

European exploration of the Cape Fear River region began in 1521. A Spanish expedition originating in Hispaniola, sent by Lucas Vasquez de Ayllon, reached the Cape Fear River while exploring part of the North American continent, searching for a place to establish a new colony (Lee 1951:1). The explorer landed at the mouth of a river at 33°40' north latitude, which he named the Jordan. While there, Ayllon may have constructed the first ship built by a European in the region, in order to replace one lost when entering the river. However, after finishing his new ship, Ayllon sailed south approximately 125 miles, reaching another river, the Guadalupe, where a settlement was established (Lee 1951:2-3). In addition to the Spanish, John De Verrazano, sailing for the French, explored the Cape Fear in 1524.

Although explored previously, the first settlement on the Cape Fear was not established until 1660, when a group of settlers from New England sailed up the river. This first settlement was short-lived, with settlers leaving in such a hurry that they left behind their cattle, and warned others to not settle in the area (Lee 1951:3).

In 1663, Carolina was granted to supporters of Charles II, known as the Lords Proprietors, and a settlement was established along a stream that empties into the Cape Fear, known now as Old Town Creek. These original settlers were joined in 1665 by others from Barbados, including Colonel John Yeamans, the Proprietor-appointed governor. While the colony achieved modest size, about 800 people, a lack of support from the Proprietors led to the colony's abandonment in 1667 (Lee 1951:4).

After a period of time in which the Lords Proprietors focused on settling the Albemarle region farther north, the pine forests of the Cape Fear led to a renewal in interest. The British required significant quantities of naval stores – tar, pitch, and lumber – to keep their navy afloat and enable them to protect the country during the numerous wars of the period. With European sources, such as the Baltic region, vulnerable to political disagreements, the British needed to secure their own sources. In order to encourage the production of naval stores, the British Parliament implemented a bounty on naval stores in 1705 (Lee 1951:4-5). This helped the fledgling colonial industry take off, with colonial imports reaching almost 94% of British naval stores imports by 1724. Though the poor quality of the colonial naval stores caused the bounties to lapse the following year, bounties were reinstated in 1729 (Lee 1951:6).

The Cape Fear River and its numerous tributaries provided a means for settlers to exploit the long leaf pine forests in the region. It was easier to transport these bulky goods by water, rather than overland. These transportation routes also shaped settlement of the region, keeping most of the settlers along the rivers during the region's early years (Lee 1951:8). And, while this river traffic was needed to ship naval stores to the coast, ocean access was equally important for transport abroad. However, the Cape Fear only ran deep enough to accommodate the large ocean-going vessels from its mouth to a point known as The Flats, which was 23 miles upriver.

At that point, ships larger than 50 to 60 tons could not pass due to shallower water. Above The Flats, 18 to 20 ton ships could continue a further 80 miles up the river, and the smallest boats could navigate as much as 150 miles upriver (Lee 1951:10).

Beginning in 1725, wealthy individuals from other British colonies decided to return to the Cape Fear in order to expand their wealth and influence. Governor George Burrington declared that land in Bath County would be granted in the same manner as the land in Albemarle County. Because Brunswick was a part of this county, some of the legal aspects preventing the settlement of the Cape Fear were removed. Burrington also sounded the river inlet and channel, helping to make the region more accessible to others who followed (Lee 1951:11). The governor did this exploratory work with his own funds, and found the work difficult, especially because supplies had to be transported by water rather than over land. He also had a road marked between the Neuse and Cape Fear Rivers to make overland travel slightly easier (Lee 1951:12).

The leading settler of the Cape Fear region was Maurice Moore. Moore had first come to North Carolina in 1713, when bringing troops up from South Carolina to support his brother Nathaniel, who was leading troops assisting the North Carolinians in putting down a revolt by the Tuscarora Indians. That same year, Maurice Moore acquired land in North Carolina and began forming political ties with many of the other leading individuals in North Carolina. In 1715, Maurice headed back to South Carolina, passing through the Cape Fear while leading troops to assist that colony in the Yamassee War (Lee 1951:12).

In 1725, the first grants for the settlement of the Cape Fear were issued. These included grants to Maurice Moore (2140 acres total) and Governor Burrington (5000 acres), along with grants to other men who would become leaders in Brunswick and other settlements along the Cape Fear (Lee 1951:14). These land holdings would become a point of controversy after the

Crown purchased much of the Carolinas from the Lords Proprietors in 1729 (Lee 1951:15). Due to the large tracts of lands purchased along the Cape Fear, Burrington, now the royal governor, informed the Council in 1731 that new settlers were unable to find land on which to settle. Although he too had acquired more land in the Cape Fear, Burrington attacked Maurice Moore and others for the amount of land and the way that they had acquired it, which included the issuing of blank patents. These documents did not contain the acreage that an individual had acquired, preventing the appropriate quit-rent from being calculated, and therefore limiting the annual income the Crown could receive from the use of the land (Lee 1951:17-18).

Conflict over land in the Cape Fear continued under the next royal governor, Gabriel Johnston. He raised concerns over the burning of unoccupied Crown lands for the production of naval stores by individuals in the region. This action made the land unsalable, while individuals were able to benefit from the naval stores trade without filing a claim to the land, preventing the payment of quit-rent to the Crown. Johnston accused the Moores, including Maurice, and his associate, Edward Moseley, of being the worst offenders on this point. Although no legal proceedings occurred as a result of these accusations, it produced long-standing resentment between the wealthy settlers of the Cape Fear and the government of the colony (Lee 1951:18-19).

Brunswick: The Settlement of a Colonial Port Town

Historian E. Lawrence Lee describes the town of Brunswick as the most important port in colonial North Carolina (Lee 1951:1). To understand the importance of this port, one should appreciate the history of the town itself. Soon after acquiring 1,500 acres in the Cape Fear, Maurice Moore set aside 360 acres for the establishment of the town of Brunswick, named for one of the titles of the House of Hanover, of which King George II was a part (South 2010:2; Lee 1951:21). By June 1726, the first lot in this new town had been sold (Lee 1965:101). When choosing the location of his town, Moore chose a point 5 miles below The Flats, putting the town halfway between the mouth and forks of the Cape Fear River. The Cape Fear at this point was deep enough to allow ocean-going vessels to dock, and was (theoretically) far enough from the ocean to be protected from storms and pirates (Figure 2). This would allow the town to benefit from both the shipment of naval stores, as well as ship traffic upriver (Lee 1965:117; 1951:22).

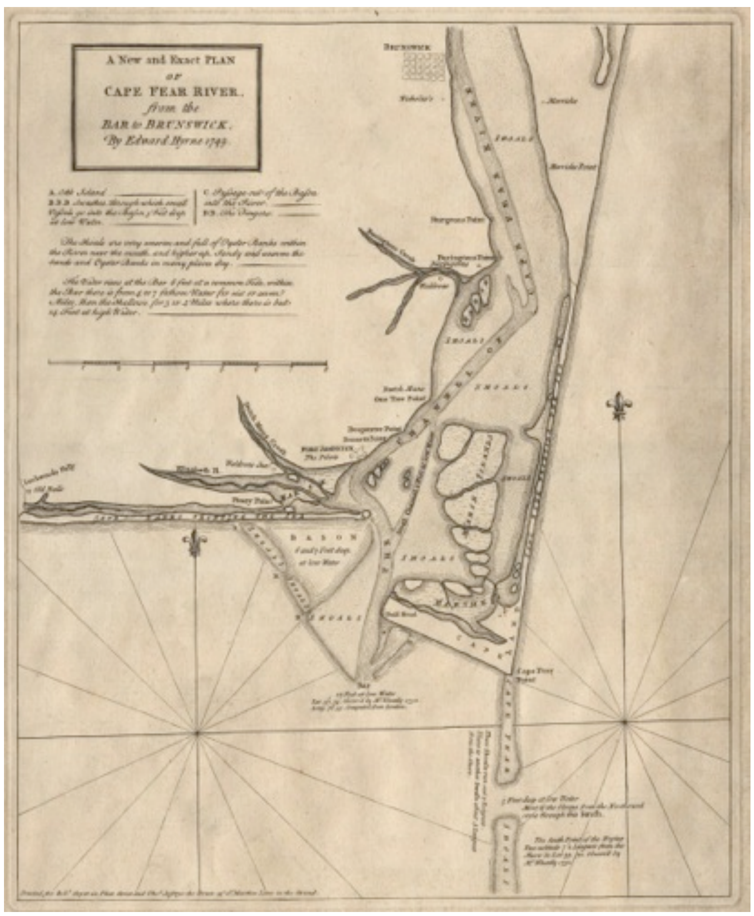

Figure 2. Excerpt from *A New and Exact Plan of Cape Fear River, from the Bar to Brunswick*, by Edward Hyrne (1749), illustrating the width of the Cape Fear up to Brunswick. The river width is approximately 2 miles off Brunswick. Map 368 in *The Southeast in Early Maps, 3rd edition.* by William P. Cumming (1998).

Of the 360 acres that composed Brunswick, a section was set aside as town commons. These common areas were divided into 24 “squares that were 7 lots wide and 2 deep”. Lots were also reserved for a church, cemetery, courthouse, and goal (jail). The remaining land was divided into 336 half-acre lots, which measured 82.5 feet wide and 264 feet deep. The only roads laid out in the town were Front Street and Second Street (Lee 1965:118).

The first to buy property in the town was Cornelius Harnett, Sr., on June 30, 1726. A tavern keeper, Harnett, Sr. had left Chowan County after being accused of invading Governor Everard’s home. After purchasing land in the town, Harnett went on to open a tavern, and also received a license to operate a ferry at the “Hauleover” on the eastern bank of the Cape Fear. This ferry connected the northern and southern portions of the only road in the region, and Harnett’s license kept others from being able to operate a ferry within 10 miles (Lee 1951:22-23).

In 1729, an act was passed which established New Hanover precinct, and made Brunswick a township and the precinct’s seat of government. As a result, a courthouse, jail, and church were to be built there, and all public and church elections were to be held at Brunswick. This said, the laws establishing these points were passed in November. The Lords Proprietors had already sold much of the Carolinas to the Crown in July of that year (Lee 1951:23-24). After Burrington returned to North Carolina as royal governor in 1731, he challenged these laws, alleging that they “were passed to defraud the Crown” and implicating Everard in this action, though no action was taken after the matter was referred to the Board of Trade for settlement (Lee 1951:24). Lee suggests that this dispute may have slowed Brunswick’s growth, and influenced political conditions there. It was not until 1733 that representatives were sent to the General Assembly and 1734 before the Registrar’s Office began recording deeds (Lee 1951:24).

Though Hugh Meredith described it as “a poor, hungry, unprovided place” in 1731, the town saw an increase in lot sales that same year (Lee 1951:25).

Within a few years of returning to North Carolina, Burrington helped encourage the founding of a settlement at the forks of the Cape Fear by recommending to the General Assembly that a town should be built on the river. This recommendation ignored the existence of Brunswick and was probably part of the continued conflict between Burrington and many of the landowners living in Brunswick (Lee 1951:27). This town was called Newton, and continued to grow after Gabriel Johnston became royal governor in 1734, as he focused his attention on the new town, rather than Brunswick. The focus may have been due to a belief that Newton was better situated on the river than Brunswick, but it may have been a result of Johnston’s conflict with the residents of Brunswick as well (Lee 1951:27-28). Though Newton had not yet grown much by the time Johnston took office, he bought land adjacent to the settlement. And in 1735, Johnston ordered that the land office be opened in the town, and that the Court of Exchequer and the court of Oyer and Terminer, along with the Council, meet in Newton. Attempts to make the village of Newton into a town seem to have failed when a bill died while in the Upper House of the General Assembly.

In 1740, a bill incorporating Newton, now Wilmington, passed (Lee 1951:29). This bill caused considerable conflict within the colonial government, as one faction, including a number of Brunswick residents, questioned the second vote cast by the president of the General Assembly in order to break the tie on the vote. They also argued that the bill had been approved by the governor without their knowledge after it had been pushed through the Lower House (Lee 1951:30). The measure stood, and Brunswick “was stripped of every vestige of political power” (Lee 1951:31). Government officials were moved from Brunswick to Wilmington, and local government and representation for Wilmington in the General Assembly was set up (Lee 1951:31). Unsuccessful attempts were made in 1745 to raise Brunswick to the status of a town (Lee 1951:33).

A commission, including William Dry, John Wright, Richard Quince, Edward Moseley, and Roger Moore, was appointed to take control of the remaining lots in Brunswick after a conflict arose among the heirs of Maurice Moore and John Porter as a result of a gift of half of Moore's interest in Brunswick to Porter. After taking control of the property, the commission was to lay out the land along the river into half-acre lots. The rest was to be used as a town common, and a plat of the area was to be filed with the Secretary of the Province. This work was to be funded by the sale of lots in Brunswick (Lee 1951:33). One third of proceeds from land sold were to be given to St. Philip's Parish, of which Brunswick was a part, and the rest to whomever had been established as the owner of the property sold. As a condition of sale, the owner had to construct a house at least 20 feet long and 16 feet wide on the lot or prepare to do so within two years. If this did not occur, the sale would be void, and the lot able to be resold. Proceeds from subsequent sales would go to St. Philip's Parish. Policies were also put in place to deal with lost or destroyed titles, as well as the sale of abandoned or unclaimed lots (Lee 1951:34).

In addition to these property duties, the commission was also responsible for removing nuisances, and enforcing regulations pertaining to the moral conduct of residents and seamen in port. Any fines collected in the enforcement of the regulations were to be divided between the Parish and the person who sued for the violation. The act that established the commission for Brunswick also provided for the construction of St. Philips Church at Brunswick (Lee 1951:35).

Despite these concessions, it was not until 1754 that Brunswick was able to send representatives to the legislature. This was granted due to its role as a port town, but the town was never actually represented, as the act that allowed for this representation was repealed by the King (Lee 1951:35-36). At this time, all of the rights to membership were removed, and a number of provisions that created local governments were overturned. Due to the wording of certain laws, the creation of New Hanover County was not disputed, and Brunswick again became the seat of the county between April 1754 and October 1756, when Wilmington was reestablished (Lee 1951:36-37). Representation of Brunswick in the Assembly didn't occur until 1757, after the town had successfully applied to the governor.

In 1764, Brunswick County was created by dividing New Hanover County. The new county, which was roughly the same size and shape as St. Philip's Parish, included portions of New Hanover county west of the river, and extending to the east side of Lake Waccamaw. The northern boundary of the county was Bladen County, and the southern boundary was the edge of North Carolina (Lee 1951:39). The same act that created Brunswick County made Brunswick the county seat, and granted it the appropriate privileges. The creation of an act in 1766 allowed for the annual election of the members of the commission first established in 1745 (Lee 1951:40).

During its short history, Brunswick was home to two Royal Governors, Arthur Dobbs and William Tryon (South 2010:71-73). Governor Dobbs moved from New Bern to Brunswick in 1758, in order to avoid the "unhealthy situation of his former residence" and high rent in New Bern. He settled into Russellborough, a property he had received from leading individuals in the area. Despite the governor's residence in town, the small size of the town and quality of accommodations available meant that the Council usually met elsewhere, usually New Bern or Wilmington (Lee 1951:40-41). In 1765, Dobbs was not the healthiest of individuals, and after working too hard while packing for leave to recover in England, he died and was buried in St. Philip's Church. William Tryon became governor. He had arrived in North Carolina, intending to act as Lieutenant Governor while Dobbs was in England, a short time earlier (Lee 1951:42-43). Despite plans to move the government to New Bern, Tryon took up residence in Brunswick at Dobbs' former residence of Russellborough until the New Bern Palace was completed in May 1770 (Lee 1951:43).

In addition to the important political history, there are three major events in the history of Brunswick. One event involved foreign powers and politics, one domestic politics, and one natural disaster. These events were the Spanish Attack of 1748, the Stamp Act Revolt of 1766, and the 1769 hurricane.

On September 4, 1748, three Spanish vessels approached Brunswick, among them the *Fortuna*. As they came close, the ships opened fire on the town, and Spaniards who had been put ashore attacked the town from land. The inhabitants fled, and William Dry, captain of the local militia, made attempts to muster a repelling force. On September 6, a force of eighty men, not all armed, moved towards Brunswick. After a scouting force opened fire on the Spaniards, the main force moved in, and captured some of the Spanish. Those who escaped fled back to their vessels. While firing on the town as they attempted to flee, the *Fortuna* exploded and sank off Brunswick (Sprunt 2005:50; Lee 1965:232-233). The ship however, did not sink completely, and a variety of goods were recovered from the wreck (South 2010:48-53).

The second major event in Brunswick's history was tied to events throughout the rest of the American Colonies. As a major port in the colonies, the Stamp Act of 1765 had a significant impact on Brunswick and its residents, many of whom were merchants or somehow connected to shipping. On November 1, 1765, the act went into effect. Stamps were required for ship's clearance papers, legal documents, newspapers, tavern licenses, and other paper products. If these stamps were not used to conduct business, guilty individuals would be prosecuted through the vice-admiralty courts. Stamps were to be paid for in cash, which was scarce in the Lower Cape Fear. Demonstrations against the Act occurred in Wilmington, and on November 16, the Stamp Receiver, William Houston, was forced to resign his position. No one would take up this post after Houston's resignation. As a result, the stamps were not received for use in trade, presenting problems for the Port of Brunswick. Two vessels, the *Dobbs* and *Patience,* entered the Cape Fear in January 1766, and were seized by Captain Jacob Lobb, of the H.M.S. *Viper* because they did not have stamped papers. The papers were turned over to William Dry, Collector of Customs, who passed them along to Robert Jones, attorney general of the province, for a decision on the ships' fates. It was decided that the two ships would be sent to Halifax, Nova Scotia for prosecution. Dry received a letter complaining about the Stamp Act from the local citizenry. This did not satisfy the people, and a large group marched on Governor Tryon's home to express their displeasure with the decision. On February 19, papers were seized from Dry's home for the *Patience* and the *Ruby,* as the *Dobbs* had already been turned over to its owner (Lee 1965:244-50). Although the two vessels were eventually allowed to unload their cargo without stamped papers, the issue over stamps was not yet resolved (South 2010:97). On February 20, the Governor's home was again surrounded, as the crowd wanted William Pennington, the Comptroller of Customs, who was inside. The crowd was ready to take Pennington by force, if he did not willingly go with them. Pennington was only allowed to leave after resigning his position. The governor did not want to allow a Crown official to be assaulted. Shortly afterwards, the crowd from the governor's residence required Pennington, Dry, and all court clerks and lawyers to swear an oath that they would not issue any stamped papers in North Carolina. The

Stamp Act was repealed later in 1766, but the people of the Cape Fear had openly opposed the British (Sprunt 2005:94-100, 104-105; Lee 1965:244-250). Sprunt suggests that this was the “first open resistance to the British Stamp Act in the American colonies” (2005:59). If it was not the first, it was certainly one of the first.

The third major event in Brunswick’s history also began spelling its end. A massive hurricane hit North Carolina in September 1769, causing extensive damage in the town. The storm is believed to have made landfall somewhere between present day Southport and Cape Lookout. As a result, Brunswick would have taken an immense hit from the storm. Based on descriptions of conditions and the storm surge, this hurricane was likely one of the worst of the eighteenth century. (Beaman and McKee 2011:90-95). Six structures, including the courthouse, may have been destroyed by the storm. The lack of reconstruction of these structures, along with Tryon’s move to New Bern the following year, may be an indicator of Brunswick’s decline (Beaman and McKee 2011:102, 108).

In addition to these pivotal events, a number of incidents led to Brunswick’s demise during the American Revolution. In 1776, the North Carolina constitution omitted representation of Brunswick in the lower house of the legislature, called the House of Commons. The size of the town may have been a factor, as it was rather small, even in its heyday. In February of that year, rumors were spreading that the British aboard the British sloop *Falcon* were planning to burn the town and kill the inhabitants (Lee 1965:270; 1951:44-45). Indeed, within the year, part of the town, including William Dry’s home, Bellfont (Russellborough), and St. Philip’s Church was burned by British troops commanded by Captain John Collet (South 2010:223; 2007:107). Though abandoned before the town was burned, Brunswick continued to be used by both sides as a landing point throughout the war (South 2010:223). In 1779, the county seat was moved to

Lockwood's Folly. By 1804, the town had all but ceased to exist, though the port continued to be used for a few years (Lee 1951:45).

Brunswick's Economic History, as Tied to the Cape Fear

Formed by the confluence of the Haw and Deep Rivers in Chatham County, the Cape Fear River flows southeasterly through Harnett, Cumberland, Bladen, Brunswick and New Hanover counties. The river flows 173 miles from its confluence to Wilmington, where it is joined by the Northeast Cape Fear River. From there, it flows another 30 miles to the Atlantic Ocean. At this point, the river ranges in width from 1 to 3 miles (see Figure 2) (Sprunt 2005:6-7).

Despite the limitations to Brunswick's political power throughout its existence, the importance of the port for trade was maintained due to the restrictions for large ship traffic on the Cape Fear (Lee 1951:32). In 1731, Governor Burrington had named Brunswick "the place of the greatest Trade in the whole Province". All vessels entering and leaving the Cape Fear had to clear at Brunswick (Lee 1965:119; 1951:49). However, importance in trade did not correspond to significant growth of the town. By 1769, when C. J. Sauthier mapped the town, the town spread out only about a half mile along the river, and did not reach more than a third of a mile inland. It only occupied the northwest corner of the area initially set aside for the creation of the town (Lee 1965:140).

In 1731, Bricknell mentions in his *Natural History of North Carolina* that Brunswick "[had] a great trade, and a number of merchants and rich planters" (Sprunt 2005:39). It is especially interesting to look at the number and size of ships that entered the Port of Brunswick over the life of the town. Between 1748 and 1754, Dobbs reported the yearly averages as 98 ships and a total tonnage of approximately 5,500 tons. Based on these numbers, Brunswick accounted for about a quarter of the total exports from North Carolina ports during that seven-year period. But Lee suggests that this may not be more than half or two-thirds of the actual tonnage, due to tonnage computation methods. Depth was usually stated as half the width of the ships beam, though many ships had deeper holds to alter the amount of tonnage duties paid (Lee 1951:50-51). As a result, real estimates may be higher than what was reported. By 1763, Dobbs reports shipping numbers that indicate that Brunswick was the leader in tonnage shipped out, though second to Port Roanoke in total ships in port (Lee 1951:51). This higher tonnage reflects the larger ships that often entered Brunswick. In 1768, reports indicate that much of the ship traffic leaving Brunswick headed to Great Britain, and the port indicated that of 121 ships that entered port, 48 exceeded 60 tons (Lee 1951:52-3). Thirty-nine of these ships headed to Great Britain, loaded with tar, pitch, and turpentine.

It seems that Brunswick existed mostly to service the naval stores trade with Great Britain, and Lee refers to Brunswick as "one of the vital ports of the British Empire" (1951:54, 65). By January 1773, 612,793 barrels of tar, pitch, and turpentine had shipped from the American Colonies to Great Britain. Over half the barrels came out of North Carolina, with 255,576 barrels shipping from Brunswick. The New England and Middle Colonies also imported a large portion of the 200,000 barrels imported from North Carolina, though most of the inter-colonial trade came from other North Carolina ports. Brunswick was focused on transatlantic trade (Lee 1951:65-66).

Tar, pitch, and turpentine are all produced from long leaf pine, but require different processing methods to be created. Tar and pitch were used in ship construction and waterproofing. Distilled turpentine was used in cleaners, solvents, and medicines. The rosin byproduct of turpentine distillation was also used in waterproofing (Robinson 1997:52-57).

The harvest of gum for the production of turpentine began in the winter, when trees were partially debarked and cut. When the weather warmed, the resin in the tree began to flow, and was collected from the slashed trees. When distilled, this resin yielded turpentine and rosin (Lee 1965:150). Raw gum was shipped out of Brunswick and other colonial ports for processing in the West Indies or England. The "turpentine" produced and shipped out of Brunswick was likely crude or raw turpentine. (Robinson 1997:55).

Tar was produced by burning felled trees in saucer-shaped kilns. The kiln was excavated, lined with clay, and had a drainage pipe placed in the bottom, which led to a pit just beyond the kiln. Wood was then cut and stacked in the kiln, covered over with turf, and set on fire. As the wood burned, the fluids from the wood flowed down the drainpipe and were collected in barrels. Though kilns varied in size and production quantities, a 30-foot diameter kiln with wood piled 14 feet high would yield 160 to 180 32-gallon barrels. The type of tar that these kilns yielded was based on the type of wood burned. Green tar, which was higher quality, was produced from still living trees, whereas common tar was produced from dead wood (Lee 1965:151). Generally, the tar kilns would be built in the forests, close to the raw materials needed to produce tar, and far enough away from habitation to avoid problems if the kiln caught fire (Robinson 1997:56).

Pitch is produced from further processing of the tar. The more volatile parts of the tar were evaporated or burned off, producing a thicker liquid. This heating occurred in two to five foot diameter clay lined pits or iron cauldrons (Robinson 1997:57). The resulting product was then scooped into barrels, with 2 barrels of pitch produced from 3 barrels of tar (Lee 1965:151).

Over 1.7 million board feet of lumber, a significant quantity, was exported to the West Indies in 1768. Though many of the lumber mills may have been producing below capacity, this level of production ranked North Carolina just behind the leading exporter of sawed lumber, Massachusetts (Lee 1951:67). In addition to sawn lumber, the Cape Fear region also produced shingles, barrel staves, and small quantities of handspikes, posts, and house frames (Lee 1951:68).

In addition to naval stores, Brunswick shipped smaller quantities of pork and beef, mostly to other coastal ports and the West Indies. Flour and rice were shipped in even smaller quantities (Lee 1951:68).

It is also important to note that naval stores were “enumerated” goods by 1705, restricting their trade to ports within the British Empire, and had to be shipped on British or British colonial ships. In order to assist in controlling trade with the colony, Brunswick was made one of five official ports. As part of that appointment, a port naval officer and customs collector had to reside in the port town, though these positions were moved to Wilmington in 1739 (Lee 1951:56, 58). These posts were soon moved back to Brunswick, as delays due to river conditions could lead to confiscation of the vessel, and the potential for smuggling were seen as problems for locating the trade officials in Wilmington (Lee 1951:58-59).

Laws that regulated pilotage on the Cape Fear, inspection of exports, and provided import duties for certain products affected the Port of Brunswick (Lee 1951:59). Laws in 1738 and 1751 specified the regulation of Cape Fear pilotage fees through the creation of regulating commissions that shaped shipping in Brunswick. Both commissions included a number of influential Brunswick residents. While the first law was ineffective and repealed in 1748, the second restricted the number of river pilots, specified fees, and held pilots accountable for their actions (Lee 1951:50-61).

Inspection of exports was begun due to the description of North Carolina tar as “hot” because of over-burning during production. The first law to set export standards was passed in

1751, and covered tar, pitch, turpentine, rice, pork, and beef. Inspectors were designated for Brunswick and Wilmington from the inception of this law. As seems to always be the case, local politics influenced these positions, and led to plenty of conflict over appointments (Lee 1951:62).

Customs duties helped to fund local projects, and were often payable to the Customs Collector. A 1715 law required a duty of powder and shot or money to be paid by all ships of non-North Carolina origin in order to provide ammunition for public use in the colony. This was collected at Brunswick by the Naval Officer. Proceeds from this Act also provided for the construction of a fort at the Cape Fear River's mouth marking the channel from Brunswick to Wilmington (Lee 1951:63). A 1746 law enacted a three-year duty on imported wines, liquors, and rice to finance the printing of the colony's laws. William Ross was appointed to collect these duties at Brunswick (Lee 1951:63-64).

Some of the leading citizens of the town were merchants and ship owners, such as Roger Moore, William Dry, and Richard Quince. Moore was one of the first merchants in town, though his primary focus was planting. Dry arrived in Brunswick in 1735 at the age of 16. He went into business with John Porter, who died in 1743, and left Dry with the bulk of the firm's debt. He became Collector of Customs in 1750, after which point he was not very active in business. Richard Quince arrived in Brunswick in 1740, and owned a number of ships that traded with settlements upriver, as well as in trade with the West Indian colonies (Lee 1951:46-48). It is possible that these individuals possessed their own docks in order to lessen costs and make the unloading of cargo easier.

These merchants and ship owners were also involved in business dealing with imported goods. Clothing items, mainly made of linen and wool, were the leading imports. Unlike in many of the other colonies, almost no cloth, or homespun, was made in Brunswick. In the early years, most goods came from other colonies, but as the naval stores trade increased, more goods were shipped directly from England. Goods shipped from England included cloth, shoes, hats, gunpowder, household goods, glass, tea, medical supplies, spices and salt (Lee 1951:70-72).

The port was heavily tied into the mercantilist system that Britain used to supply its various needs. While plenty of goods travelled in and out of Brunswick, actual cash flow was limited, and merchants had to rely on the extension of credit and payment with paper money as the means to conduct business (Lee 1951:83-85). As naval stores production increased, despite the low prices goods were sold for, the region became "increasingly dependent upon a narrow and risky enterprise" (Lee 1951:73, 79-80). And after the beginning of 1775, when relations with Britain became increasingly strained, the number of ships entering Brunswick dropped sharply. Between February and April of that year, only 3 British vessels entered port (Lee 1951:72). Without British trade, the town ceased to have a reason and financial ability to exist.

Fort Anderson

The importance of this section of the banks of the Cape Fear River did not end after the American Revolution. A bit more than 75 years after the town was abandoned, the ruins of the town saw the return of inhabitants for a short while. The former town became incorporated into the Confederate works of Fort Anderson. Fonvielle (1999:III's) states that this series of works was "second in size and strength only to Fort Fisher among the forts and batteries guarding [Wilmington]".

Brig. Gen. Samuel Gibbs French first inspected the site of Fort Anderson in March 1862. The site was ideal for the construction of fortifications, as the bluffs were close to the narrow channel in the Cape Fear, and could therefore protect both land and river approaches to Wilmington. After French's inspection of the site, Lieutenant Thomas Rowland was directed to construct a battery and entrenchments on the site (Fonvielle 1999:8). The initial works that Rowland constructed included an artillery battery flanked by 6-foot high earthen walls that ran to the edge of Orton Pond, a mill lake almost a mile away. Where colonial ruins were encountered, Rowland attempted to cover as much of the foundations and chimneys as possible, fearing that they would become shrapnel if hit by artillery shells. However, the ruins of St. Philips Church were left intact, and provided the name of the first incarnation of this fort, Fort St. Philip (Fonvielle 1999:9, 11).

The small garrison initially stationed at the fort included one infantry and two artillery companies, commanded by Maj. William Lamb from May to July 1862 (Fonvielle 1999:10, 12). A number of other men commanded the works between Lamb's departure and July 1, 1863, when Major General Whiting issued an order renaming a number of forts in the Cape Fear Region, including Fort St. Philip. The fort atop Brunswick was renamed Fort Anderson, in honor of Brig. Gen. George Burgwyn Anderson, who died of wounds received at the Battle of Sharpsburg (Fonvielle 1999:14-17).

After renaming, the works underwent considerable additional construction. Roughly L-shaped, the short end runs along the Cape Fear and the long end is perpendicular to the river. At the corner of the L, Rowland's initial battery was enlarged into a 24-foot high structure with five gun emplacements, known as Battery B. Rowland's original battery, with its 6-foot walls, abutted the end of Battery B. Light artillery was placed here. The short part of the L was enlarged as well. Referred to as Battery A, the emplacement here also had five 32 pound cannons. The batteries were linked with three sand walls, two of which were about the same size as the batteries they linked. In addition to these earthen fortifications, torpedoes (today called mines), pilings, and stone-filled cribs protected the works from the river (Fonvielle 1999:17-19).

Very little military activity happened at Fort Anderson throughout much of the war. Though blockade runners and mail packets stopped at the fort, few other visitors stopped by (Fonvielle 1999:21). The blockade-runners were required to stop at Fort Anderson to have their papers, cargo, and personnel checked. The fort also became a quarantine station after the 1862 yellow fever epidemic in the Cape Fear. Otherwise, duty at Fort Anderson was fairly dull (Fonvielle 1999:23).

Once Federal forces decided to take Wilmington, this situation changed. The first task to ultimately accomplish this mission was to take Fort Fisher at the mouth of the Cape Fear River. The first attempt on Fort Fisher was made on December 24 and 25, 1864. The Confederates held the fort, despite heavy bombardment (Fonvielle 1999:30). A second successful attack was carried out on Fort Fisher from January 13 to 15, 1865. Bombardment by naval vessels, as well as attack by 2,200 soldiers landed by the Federal Navy, led to the fall of the “Gibraltar of the South” (Fonvielle 1999:31).

With the fall of Fort Fisher, other forts and batteries near Smithville (now Southport) were abandoned, with their garrisons falling back to Fort Anderson, on the west side of the Cape Fear, and General Hoke’s encampment at Sugar Loaf on the east side of the river (Fonvielle 1999:31). With the influx of men from downriver, Fort Anderson was manned by over 2,000 soldiers who were short on food and shelter in the cold January weather. Illness and desertion became a problem (Fonvielle 1999:32, 35). The Federal Navy began exploring upriver from Fort Fisher and Smithville in late January and early February 1865, occasionally firing on Fort Anderson in attempts to determine the strength of the armament and lure the soldiers into a fight.

While these small engagements occurred, Federal forces continued landing additional men near Fort Fisher. On the night of February 10, Lt. Cmdr. Cushing scouted around Fort Anderson, making detailed observations of the river defenses, and sneaking close to the earthworks of the fort after landing just upstream of the fort (Fonvielle 1999:42-52).

The first concerted attack on Fort Anderson after Fort Fisher fell began on February 11, 1865, when Federal forces attempted to break Hoke's line at Sugar Loaf. Though ultimately unsuccessful, it resulted in the establishment of a Federal line near Hoke's forces. He could not afford to dispatch troops across the river to help Fort Anderson while still holding his position (Fonvielle 1999:55-56). On February 17, 1865, Federal troops began marching up from Smithville towards Fort Anderson. The Federal Navy bombarded Fort Anderson in an attempt to hide the army's advance, though this was unsuccessful. February 18 brought more attempts to take Fort Anderson, with Federal and Confederate forces skirmishing along the road to Wilmington and shots being exchanged between vessels in the river and the fort. During the first day of bombardment, it was estimated that over 2,700 Federal shells fell on Fort Anderson, though less than 100 were returned from the fort. The main weakness of Fort Anderson was its open rear; if Federal forces could get around behind the works, around Orton Pond, the fort could be taken. Due to threats to the works from Federal forces on land and on the river, the decision was made to abandon Fort Anderson early on February 19, leaving behind artillery and ammunition. Federal forces on land took possession of the fort, though the navy briefly continued shelling the works. The Federal naval forces accepted surrender from the army, in an amusing twist of fate (Fonvielle 1999:58-84). With the fall of Fort Anderson, the end was near for Wilmington. The town was occupied on February 22, and the Civil War ended within a few months (Fonvielle 1999:90).

After the end of the war, Fort Anderson was used for a short time to house refugees. By April 1865, most of these refugees had been moved elsewhere, returning the area to its pre-war abandonment, aside from a few random visitors. In March 1866, two sailors from a Revenue Cutter went ashore, exploring. They entered a magazine, and lit a match so that they could see. They discarded it, which ignited gunpowder on the floor of the magazine, blowing it up. One of the two died of his injuries, but the other, amazingly, survived (Fonvielle 1999:91-92).

Brunswick's More Recent History

The land on which the colonial town of Brunswick (and eventually Fort Anderson) stood had been sold to Frederick J. Hill, who owned Orton Plantation, in 1842 (South 2007:107). Occasional visitors, including members of the Colonial Dames of America, visited the site into the early 20th century, but overwhelmingly, the area was reclaimed by the pine forests (Fonvielle 1999:93).

A 114.5-acre tract of Orton Plantation, containing Brunswick and Fort Anderson was sold by the Sprunt family to North Carolina in 1952. Later that year, St. Philip's Church and its five acres were transferred to the state by the Episcopal Diocese of East Carolina. The area was in danger of being permanently cut off from visitation by the construction of an ordinance depot nearby. At historian Lawrence Lee's urging, the State of North Carolina established Brunswick Town Historic Site in 1955, and reached an agreement with the US military in 1957 to allow for the creation of a buffer zone within the easements of Military Ocean Terminal, Sunny Point. This agreement allows the government to manage building, development, and visitation to the site, as well as allowing for the site's closure during a national military emergency. It was through the actions of Lawrence Lee, one of those who helped convince the owners of Orton to work with the state to allow the public to visit Brunswick, that archaeological study was undertaken on the site (South 2007:107; Fonvielle 1999:94-95).

Conclusion

Even though Brunswick, and later, Fort Anderson were only occupied for short periods of time, their history is intimately tied to the Cape Fear. The river and its ship traffic provided the major reason for the existence of the town. The bulky nature of naval stores, as well as the difficulty of transporting these goods overland, helped make the location of Brunswick important, despite vulnerability to storms. Its importance in trade led to an attack by the Spanish and British and significant resistance to the Stamp Act of 1765 by the town's citizens.

After the colonial town was abandoned, the port continued to be used into the beginning of the 19th century. This point along the Cape Fear continued to be of value for shipping traffic. With the construction of Fort Anderson and other forts along the Cape Fear River, the town of Wilmington and the blockade-runners were protected from Federal forces. When this protection was removed by concerted attack by Federal forces, Wilmington and the rest of the Confederacy fell quickly.

Because of the limited occupation of the site and its role in American history, it was important that Brunswick and Fort Anderson were preserved through the establishment of a historic site. Due to the site's preservation, there are numerous opportunities for archaeology to provide insight into the unwritten parts of the past.

Chapter 3: Archaeology at Brunswick

In his *Chronicles of the Cape Fear River,* James Sprunt expresses the view that excavation of the ruins of Russellborough would “doubtless reveal some interesting and possibly valuable relics of Governor Tryon’s household”. When he explored the ruins of the house, he uncovered fragments of Dutch tile and bottles (Sprunt 2005:106). It is possible that Stanley South encountered evidence of this early investigation when he later excavated Russellborough, as he found a number of holes dug into the ruins of the governor’s residence (Beaman et al. 1998:2). Even the soldiers stationed at Fort Anderson recount exploring the town ruins, collecting buttons, coins and other items (South 2007:162).

Indeed, Sprunt’s comments about the potential richness of the site have been borne out all over Brunswick. Because of the relatively short periods that the town and later fort were occupied and the preservation of the site, Brunswick continues to offer many opportunities for archaeological investigation. However, investigations have focused primarily on the terrestrial aspects of the site. The waterfront area of the town has been largely uninvestigated, despite its integral role in the life of Brunswick.

Early Archaeology at Brunswick: Lee, Tarlton, and South

The first major archaeological investigations at Brunswick were undertaken as part of a plan created by Superintendent of Historic Sites, William S. Tarlton, to develop Brunswick into a historic park. The goals of this plan were to first identify and map the extant ruins and link them to the structures depicted on the 1769 Sauthier map, and then develop the site for visitors by clearing ruins, creating interpretive signage, and restoring the streets in the town (Lee 1958:2-3; Beaman and Melomo 2011:26).

The first stage of this process was begun by E. Lawrence Lee, then a history professor at The Citadel in South Carolina. Lee's Master's thesis, outlining the history of Brunswick, had been completed in the History Department at the University of North Carolina at Chapel Hill in 1951 (Beaman and Melomo 2011:27). Deed information collected for the completion of his thesis provided the means to determine standard lot sizes and identify streets, which helped him to reconstruct the original lot plan for the town. Standard lot sizes were 82.5 feet wide, north to south, and 264 feet deep, east to west. This size was only altered in lots along the waterfront, where the riverbank determined lot depths (Lee 1958:Appendix B). This research helped to highlight the archaeological potential inherent in the ruins of the colonial town. Later occupancy hadn't altered the site's layout (much), and the architecture and artifacts uncovered during excavations would provide insight into the lives of the town's inhabitants (Lee 1952:245).

Lee began his archaeological investigations in June 1958. While clearing overgrowth, noting the location of ruins, and conducting some small excavations, Lee used the northeast corner of St. Philip's Church as the base point for mapping and identifying the ruins he uncovered (Lee 1958:4-7; Beaman and Melomo 2011:27). Continued survey and excavation located a north-south stone retaining wall with a semicircular inset. This unique feature allowed Lee to link the physical features he was encountering with his lot plan and Sauthier's 1769 map (Lee 1958; Beaman and Melomo 2011:27). The investigations were focused on the southern portion of the town because Lee assumed that the construction of the later Civil War-era Fort Anderson would have destroyed colonial aspects of the site, and there were no earthworks on this part of the site. The area of initial investigation was also between a deep gully running through the middle of the site and a swampy area that bounded the site on the south (Lee 1958:6-7; Beaman and Melomo 2011:27). Because of the number of ruins located between the gully in the middle of the site and the swampy area to the south, it was decided to develop the high area between these two features for visitation (Beaman et al. 1998:9).

Despite his interest in the project, Lee did not have the time to continue archaeological investigation and the development of a historic park at the site. In all, he recorded 34 ruins during his investigations (Beaman et al. 1998:5). In 1958, Stanley South visited Brunswick while Lee was investigating the site for the North Carolina Department of Archives and History. South had been working at Town Creek Indian Mound as site manager and archaeologist since 1956 (Beaman and Melomo 2011:27). Because of the skills required to complete his plan, Tarlton offered the position at Brunswick to South.

South arrived at Brunswick on August 1, 1958 to begin his work as site manager and archaeologist, a position he held for almost a decade (South 2010:xxi). His first task was a systematic survey of the site. This included the creation of a base map depicting on the structures that had been already located, including St. Philip's Church, as well as the 1769 Sauthier map, Lee's lot plan, and Fort Anderson's Batteries A and B (South 1960; Beaman and Melomo 2011:27). Units that corresponded to features that were investigated were indicated by numbers labeled with an N or an S, depending on whether they lay north or south of the grid zero established at the northeast corner of St. Philip's Church by South (South 2010:2). A discrepancy was noted between the base map and features that had been previously identified by Lee: the southern part of the town was shifted four degrees to the east of north (Beaman et al. 1998:9; Lee 1958:8). The source of this deviation was unclear, possibly stemming from the measurements taken by Sauthier, or the later measurements by Lee and South. But awareness of this discrepancy allowed the base map to be redrawn with greater accuracy (Lee 1958:9).

During his time at Brunswick, South and his crew of African-American fishermen from the local community excavated many structures within the town, including several homes, the public house, the governor's residence of Russellborough, and St. Philip's Church. Of the 60 colonial features were identified, 23 features were at least partially excavated while South was at Brunswick (Beaman et al. 1998:10). Most of this investigation was concentrated in the southern and central portions of the town. Investigation in the northern part of the town was more limited, as structural ruins were less visible because of Fort Anderson's earthworks (South 2010:191; Beaman and Melomo 2011:28).

South's investigation of Fort Anderson was almost as limited as his investigation of the site's waterfront. Despite his limited study, South did manage to clear the jungle-like growth from much of the area through a brush burning gone awry, providing a way for visitors to view the entirety of Fort Anderson's earthworks (South 2007:162). He excavated a Civil War barracks chimney base and its associated features in an area that was adjacent to the Visitor Center and parking lot. The structure was constructed of materials salvaged from the colonial structures and clay mortar dug from a pit in front of Battery B (South 2010:231; Beaman and Melomo 2011:28). South also dug through part of the earthworks of Battery B in order to investigate the colonial-era Newman-Taylor house foundation. This investigation helped South to determine that the earthwork was formed during a single construction episode (Beaman and Melomo 2011:28). It also allowed him to determine that the ruins concealed by the earthworks were in a remarkable state of preservation (South 2007:162). In addition to the excavation of these two features, South also documented brick and ballast stone chimney bases in an area of the site that had not been developed. About 50 chimney bases were located, standing in rows (South 2007:163-164; Beaman and Melomo 2011:31).

While South's investigation of Brunswick's terrestrial features was extensive, he undertook limited study of the waterfront portion of the site. South mapped the burned pilings of a wharf measuring 25 by 90 feet, which he believed to have been the wharf where the townspeople piled their spoils from the Spanish wreck. South also determined the location of some of the wharves along the waterfront by locating piles of ballast in the river (2010:53-54). His talks in the region interested a local diver, who took it upon himself to explore the shoreline. The diver found an 18th century anchor during his exploration. South attempted to locate it again at low tide, but was unsuccessful (South 2007:115). However, his attempts to locate the anchor led to the recovery of a 16-inch cannonball (South 2007:115, 164-165).

In addition to the ongoing archaeological work South was expected to carry out, he also had to develop the site for visitors. As he has pointed out, compromises had to be made between a pure representation of the past and the conveniences and educational needs of the modern public. These compromises included the use of concrete to reinforce foundation ruins, and the construction of a bridge across the pond in the middle of the site (South 2007:125-128). The need to educate the public about the site also led South to construct displays throughout the town (South 2010:xxiii).

During his time at Brunswick, South produced numerous technical reports during excavations, a manuscript outlining the history and excavation of Brunswick, as well as articles for the Brunswick County Historical Society Newsletter so that the public could learn about his work (Beaman et al. 1998:12). Additionally, South developed several important artifact studies and typologies based on his experiences at Brunswick. In addition to the Brunswick Pattern of

Refuse Disposal, the Carolina Artifact Pattern, and Mean Ceramic Dating, methods of understanding cultural behaviors, and finding the mean date of occupation for a particular feature, respectively, he also catalogued ceramic types, studied pipe stem dating, and developed button typologies (South 2007:111, 113-114, 126, South 2010:62; South n.d.:31; Beaman et al. 1998:13). Much of his work at Brunswick was integral to his explanations of how historical archaeology should be conducted, as published in *Method and Theory in Historical Archaeology*. This volume (South 1977) used examples from his career to explain how a scientific approach could be employed in the understanding of the past through archaeology.

Terrestrial Archaeology After South

The ruins of Brunswick and the earthworks of Fort Anderson were largely spared the attentions of the archaeologist's trowel for several decades after South's departure from North Carolina. Limited investigations were carried out when improvements were being made to the site. These studies occurred in conjunction with the creation of a nature trail through the site (now closed), erection of a picnic shelter, and the expansion of the site's visitor center. Archaeological investigations were also carried out during the construction of an Americans With Disabilities Act-compliant walkway around the site and the intended reconstruction of a gun emplacement on Battery B (Beaman and Melomo 2011:31).

In 2009, a ground penetrating radar investigation of one of the Battery B gun emplacements was conducted by Shawn Patch of New South Associates, Inc., which detected a buried surface. In April of that year, Assistant State Archaeologist John J. Mintz undertook an excavation of the gun emplacement with the assistance of the site staff and volunteers from the Friends of Brunswick Town and the local community. The excavation yielded the remains of the gun platform, including charred planks and support beams, bolts, nails, and brick. The study revealed details of its construction, necessary for the reconstruction of a gun emplacement to commemorate the Civil War sesquicentennial (Beaman and Melomo 2011:31).

The most recent concerted archaeological efforts at Brunswick began with the 2009 Peace College (now William Peace University) Archaeological Field School, lead by Thomas E. Beaman, Jr., RPA and Vincent H. Melomo, Ph.D. These excavations were focused on the Civil War-era Fort Anderson, though colonial features were also encountered. The goals of the initial investigation in 2009 included locating, mapping, and identifying chimney bases and barracks behind the earthworks of Fort Anderson's Battery A. It was hoped that the archaeological investigation of these chimney bases would provide insight into the types of barracks constructed by the soldiers. It was not clear from the documentary record whether these soldiers used Sibley tents, fully wooden structures with chimneys, or a combination of wooden and tent canvas structures. Furthermore, research was conducted into who may have occupied these structures (Federal or Confederate forces, or later African-American refugees) and what their lives were like. While the extent of the barracks area was more defined, investigations did not yield conclusive evidence for the construction of a specific barracks type or types. The artifacts recovered suggest that the barracks area was occupied by both Confederate and Federal forces before and after the fall of the Fort, though little evidence of their lifeways were evident in the artifacts recovered. And, because the occupation of the site by African-American refugees was so short, it was difficult to identify them within the archaeological record (Beaman and Melomo 2011). For the field school in May 2011, these Civil War-related research questions were retained, and the research design expanded to include a greater investigation of the prehistoric and colonial aspects of the site. This was to be accomplished by the placement of additional units in close proximity to the 2009 field school that corresponded with colonial features. Other units were placed to continue exploring the Civil War aspects of the site behind Battery A. A metal detector survey was also conducted to attempt to locate additional barracks that may have been located adjacent to the current Visitors Center (Melomo and Beaman 2012).

The study of two of the features in the barracks area behind Battery A, originally investigated by Stanley South in the late 1950s, became the focus of Jennifer Gabriel's MA thesis. Based on limited archaeological investigations, South had identified these features as dating to the colonial period. Evidence from excavations in 2009 and 2011 by William Peace University Archaeological Field schools led to Gabriel's conclusion that one feature represented a higher-status colonial dwelling. Based on analysis of the artifacts and research into the documentary record, the structure was named for George Moore, one of the owners of the property. The second feature, which function remains unclear, was identified as most likely of Civil War-era origin (Gabriel 2012a; Gabriel 2012b:89). In addition to the two features discussed at length in her thesis, Gabriel also used pattern analysis to interpret artifacts recovered in an area of the site that corresponded to Lot 344, the location of the Wooten-Marnen House. Though no *in situ* evidence of colonial architectural features were uncovered by the William Peace University Field Schools, artifact assemblages and documentary evidence suggest that a colonial dwelling and kitchen were located on this lot (Gabriel 2013).

Waterfront Archaeology After South

Limited archaeological investigations on the waterfront occurred after South left Brunswick. In 1983, Dennis K. Breese and the Fortuna Foundation, Inc. were granted an exploratory permit to explore the Cape Fear River off of Brunswick Town/Fort Anderson State

Historic Site. Their focus was the location of the wreck of the Spanish vessel *Fortuna*, sunk as local militia repulsed the Spanish in 1748. In 1985, the group, with help from the North Carolina Office of State Archaeology Underwater Archaeology Unit (UAU), recovered an 18th century cannon. Although no evidence of the wreck was recovered in association with this cannon, its age indicated that it might have come from the *Fortuna* (Hall 2007:22). This cannon has since been conserved and is now on display in the Visitor's Center at BT/FA.

The Cape Fear-Northwest Cape Fear Rivers Comprehensive Study by the UAU began in 1993. During this study, state archaeologists employed a proton precession marine magnetometer and side-scan sonar to attempt to locate artifacts and features of archaeological significance along the waterfront at the site. A total of 20 magnetometer and acoustic targets were located. Among these located features was target 4-O, also designated NC0086CFR, which was a wooden barge. Additional targets located included both modern and historic objects: pipe, wire rope, crab traps, wooden pilings, and scattered ballast stone (Hall 2007:23).

In 1997, Kenneth W. Robinson published an article in *North Carolina Archaeology* discussing Brunswick's waterfront from an archaeological and historical perspective. The discussion focused on the production of the naval stores that were the primary export for Brunswick, and then moved on to locating the facilities that would have been involved in the storage and transport of these items. He included two maps, the 1769 Sauthier map and South's 1960 base map, with possible wharf locations indicated with Roman numerals (Robinson 1997:53-54). One wharf labeled on both maps corresponds with the wharf since identified as Dry's Wharf. A second, upstream wharf was labeled, corresponding to Moore's Wharf (McKee 2013). The wharves downstream from Dry's Wharf, which Robinson said "do not correspond to any recorded archaeological remains", seem to be in the area that has been identified as the commercial district (1997:61-62). Robinson also suggested piling construction for the docks and wharves at Brunswick, but also reminds the reader that underwater archaeologists may be needed to find and record parts of the wharves and docks (1997:63). In addition to the waterfront structures that could be identified within the archaeological record, evidence of the naval stores industry within the town could include tar and pitch spillage, and pitch houses used to heat pitch for ship repairs (Robinson 1997:64).

Waterfront Archaeology Since 2000

In 2006, a survey to assess the potential post-dredging impacts on archaeological sites on the waterfront of the site was completed by Mid-Atlantic Technology and Environmental Research, Inc. for the United States Army Corps of Engineers (USACE). The survey encompassed a 3500-foot long, 1000-foot wide section of the western shore of the Cape Fear River (Hall 2007:4). This undertaking included remote sensing through magnetometer and side-scan sonar surveys, as well as diver investigation to ground-truth anomalies (Hall 2007:i). In the case of the magnetometer survey, data was collected along parallels that were spaced 50 feet apart, with ½ second sample intervals. This translates to measurements taken approximately every three feet while traveling at six knots (Hall 2007:23). Targets were identified and recorded as they were generated, along with notes about possible environmental influences on the data recorded. This data was then edited and analyzed in order to separate valuable data from background noise (Hall 2007:24-25). Due to the limited visibility in the river, investigation of magnetometer anomalies was difficult for divers, requiring them to rely on touch and probes to attempt to locate the anomalies. As a result, some sites were resurveyed with the side-scan sonar (Hall 2007:27).

A total of 15 anomalies were located by Mid-Atlantic, including anomalies that corresponded with a shipwreck and four locations with "historical debris" that had been located in 1993 during a survey of the Cape Fear River by the North Carolina Office of State Archaeology Underwater Archaeology Unit (now the Underwater Archaeology Branch) (Hall 2007:i). Three of the targets were identified as potentially significant. One, a 20th century shipwreck buried under a pile of brick, was associated with a large wharf constructed on vertical pilings. Nearby, there was a large piece of machinery, possibly a winch. This wreck had been previously identified during the 1993 survey by the UAU, but an additional barge was found nearby. The wreck was likely associated with a menhaden processing plant, and is indicated on a 1950 US Coast and Geodetic Chart of the area. The barge may reflect an angled feature on the chart, serving as a floating dock for the wharf (Hall 2007:32-34, 45). Two target clusters G and H were piles of round cobble ballast, "almost certainly associated with historic wharfs [sic] structures". These features included timber cribs or flats, and correspond to two irregular shapes on the 1769 Sauthier map (Hall 2007:45). Interestingly, a number of the potentially historically significant items located on side-scan sonar turned out to be portions of dead trees and snags underwater (Hall 2007: 41-44). Despite the location of these features, the firm did not recommend any additional archaeological investigations relative to the improvement of the navigational channel that had prompted the study. However, they did recommend additional study if there was to be any constructive or destructive activity within 500 feet of BT/FA's shoreline (Hall 2007:46).

Monitoring of the waterfront, at least from a terrestrial perspective, continued throughout the 2000s. Although some slight changes were noted in the shoreline, these changes did not warrant much concern. In the last few years of the decade, a cut began to form just downstream of a section of shoreline that jutted out directly in front of Battery B. No evidence of archaeological significance appeared at this point (Figure 3).

Figure 3. A 2013 Google Earth image of part of the BT/FA waterfront. The highlighted area indicates where the cut in the bank formed, and has expanded since the end of the 2000s.

In the fall of 2010, a regular check of the waterfront near the cut revealed a barrelhead emerging from the root mat of the marsh grass, along with the presence of a number of large timbers that appeared to be joined together. Because it was less than half uncovered and appeared to be held securely in place by the mud, the decision was made to leave it in place. Later that winter, the barrelhead disappeared. It was assumed that it had been washed out into the river by the tides and lost (McKee and Smith 2012). But this was not the case. In early February 2011, the barrelhead reappeared; it had been merely reburied in the mud. This time, it was determined that excavation was the preferred option, because it was not clear how long it would last *in situ*. As this barrelhead was excavated, additional wood fragments, bits of slate, and the leather heel of a shoe were also recovered. All artifacts were stored in tap water to keep them wet as well as begin desalinating them. If they were allowed to dry without desalination, salt crystals could form, damaging the wood. These artifacts were removed from the tap water at the end of April, in an attempt to slowly air-dry them. Fortunately, the leather heel dried fairly well, and there was only limited warping and twisting of the wood, due to cellular collapse within the wood. Ideally, these artifacts would have been treated in order to limit this collapse, preserving the wood more effectively (Cronyn 1990:254, 257-261).

Throughout the rest of the spring of 2011, additional wooden artifacts were recovered, including pieces of wooden barrel bands. A portion of rope was also recovered in April 2011. It was sent to the Office of State Archaeology, Underwater Branch at Kure Beach at the end of April for treatment, and returned to the site in the fall. After April, erosion on the waterfront was only producing glass and ceramic artifacts.

Conditions changed drastically in August 2011. Mid-month, a routine check of the waterfront revealed a small section of textile visible in the mud. As it was excavated and the surface mud removed, it became apparent that it was a knit cap, intact aside from a small hole. The cap, apparently knit from a single-ply yarn, when wet, measured approximately 9 inches long and 8 ½ inches in diameter. It initially appeared to have been knit in the round, and possesses a "button" like element on the top. Similar to, but not the same as, a Monmouth cap, a common type of headwear worn at the time, it could have been used by anyone from the common laborer to the wealthy merchant (McKee and Smith 2012). A further discussion of this artifact is found in the case studies outlined in later chapters of this thesis.

Soon after the knit cap was recovered, Hurricane Irene struck the Cape Fear. The storm caused significant damage, removing a large section of marsh grass from the area adjacent to the cut. The timbers that had become apparent in 2010 were further exposed, indicating that they were part of a structure, rather than isolated debris. Additionally, a section of textile was also recovered at the end of August, but its material and purpose are still unclear. The area also continued to produce ceramic and glass artifacts, as well as some brick and ballast stone.

Additional wooden artifacts, including another barrelhead, barrel bands and staves were recovered in November 2011. In addition, two more textiles were recovered. Along with continued changes in the marsh grass and mud concealing the timbers, these artifacts were suggesting that there was some significance to this area of the site.

The recovery of artifacts accelerated into the beginning of 2012. The timbers, now identified as a wharf, were being constantly uncovered by river action. Cycles of immersion and exposure due to tidal flow were causing damage to the timbers. The tidal flow was also removing significant amounts of mud and clay from the cut in the shoreline. It was in this cut that pieces of a shoe, along with a nearly complete straight last leather shoe were uncovered. It measures 10 ½ inches long by 4 ½ inches wide by 3 inches high, and was probably a man's shoe. The straps of the shoe lack holes, indicating that a buckle had not been used to fasten the shoe, if it had been worn at all (McKee and Smith 2012). This shoe is part of the case studies in conservation that are discussed in Chapter 6 of this thesis.

More textiles, rope, and wood fragments were recovered throughout January 2012. The recovery of these additional organic artifacts indicated that there were conservation concerns for this site.

Early in 2012, Paul Shivers, a project manager for Highfill Infrastructure Engineering, P. C. in Wilmington, North Carolina assisted the site by surveying one of the extant wharves and a portion of the waterfront. The wharf that was surveyed has since been identified as Dry's Wharf (McKee 2013). In addition to taking dimensional measurements of the wharf and the surrounding shoreline, Shivers generated GPS coordinates for major sections of the wharf. This will assist in future research about this wharf (Figure 4).

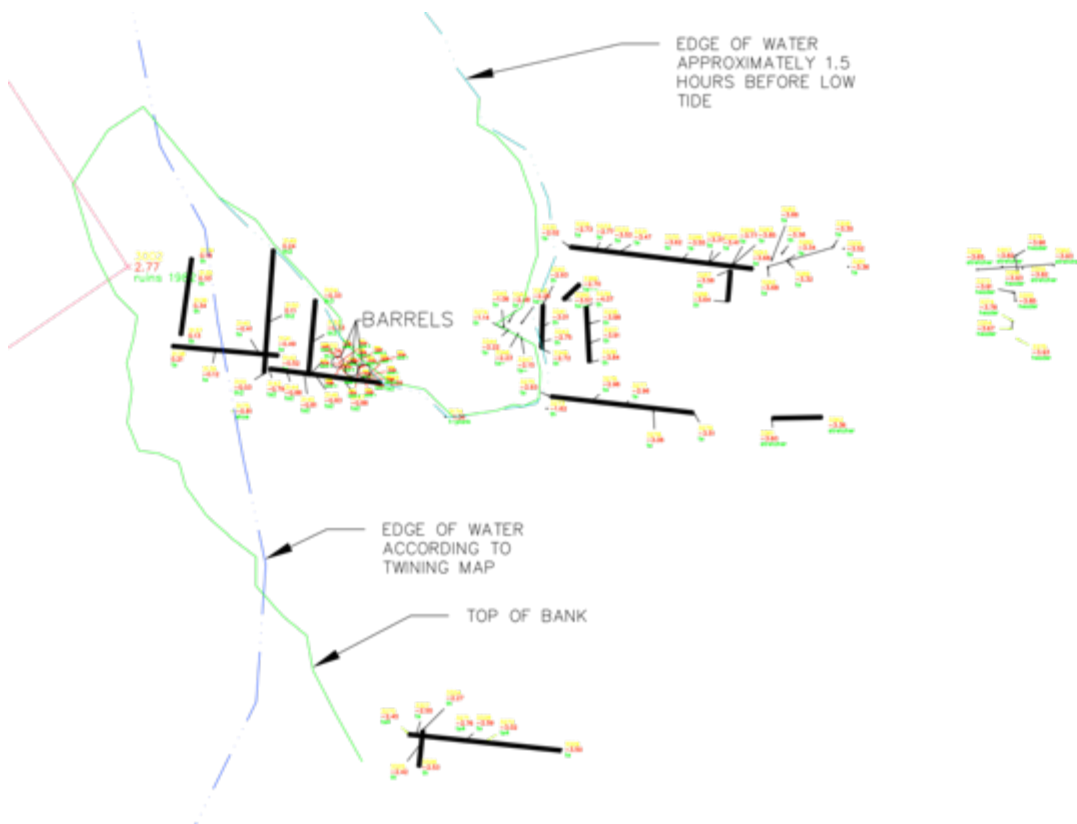

Figure 4. Map of Dry's Wharf based on survey data. Courtesy of Paul R. Shivers P.E. and David M. Edward P.L.S.

During the early part of Summer 2012, a metal detector survey was conducted in the area near the wharf. Though much of what was recovered was modern trash, such as machinery pieces, fishing gear, and food containers, a few interesting artifacts were uncovered, including a

1737 Spanish 2 real. The reverse depicts the coin's value, a Spanish shield with a pointed bottom, and "PHILLIPPUS VDG". The initials S and P flank the shield, with "P" representing the initial of the Mintmaster of Seville, Pedro Remigion Gordillo (Figure 5). The obverse of the coin includes the arms of Castile and Leon in an octolobe and the phrase "HISPANIARUM REX 1737" (Figure 6) (McKee and Smith 2012).

Figure 5. Spanish 2 real, reverse, before treatment

Figure 6. Spanish 2 real, obverse, before treatment

In July 2012, Triton Marine Mattresses were placed along 279 feet of the shoreline in an attempt to protect the waterfront of Brunswick. Held together by zip ties, the mattresses were filled with small stones. A stone revetment was also placed in front of Battery A in order to prevent the river from undercutting and eroding the works of Fort Anderson. While portions of the waterfront were protected with these marine mattresses, not all of the 2000 feet of shoreline at Brunswick Town/Fort Anderson State Historic Site is protected by their use (Cuevas et al 2013:1, 20, 23).

New South Associates performed a survey of the waterfront using ground-penetrating radar (GPR) and magnetometer technology on May 17th and 18th, 2012 (Figure 7). Using parallel

0.5 meter transects, the grid was run perpendicular to the wharf. A zigzag pattern was used to survey the wharf area in order to maximize the area covered and use of the time available (Patch and Lowry 2012:11).

Figure 7. Geophysical Grid Map showing GPR and Magnetometer survey areas (Patch and Lowry 2012).

Portions of the GPR grid were affected by the soil adjacent to the Cape Fear River, as their composition attenuated the signal. Patch and Lowry theorize this attenuation may have been due to soil salinity or the properties of water in the soil (2012:3). The GPR study found a number of possible features, including dock remains, structures, artifact scatters, debris, historic metal and burned areas (Patch and Lowry 2012:14). West of the wharf area, seven GPR and eight magnetometer anomalies were found at a depth of 20 to 80cm, and historic features were possibly located between 40 and 80cm. Several anomalies could be explained as tree roots or other natural features. Two parallel anomalies were found in the 40 to 80cm region, and may represent wall or foundation elements of a structure (Patch and Lowry 2012:14-18). Ground-truthing is necessary to confirm this identification. Magnetometer anomalies were also located near the wharf. Scattered point sources may represent features related to the wharf, and one roughly circular anomaly may be a structural element or a burned area (Patch and Lowry 2012:18).

Throughout the rest of the summer, fall, and winter, the wharf was archaeologically quiet, aside from the regular collection of ceramics and glass from the waterfront. The next major study undertaken on the waterfront was conducted by a group of midshipmen from the United States Naval Academy as a part of their senior capstone project. Though not directly involved in the archaeology conducted up to this point on the waterfront, their goal was to propose a means to build a "coastal structure as soon as possible in order to stop and prevent further damage to Fort Anderson, the colonial town of Brunswick, and the local ecosystem" (Cuevas et al 2013:1-2). Their goals were to prevent further erosion of the shoreline, protect the wharves, reclaim lost marshland, and promote sustainability including living organisms and plants (Cuevas et al 2013:27). Interestingly, they suggested that the marine mattresses already in place were "doing nothing to prevent waves and tides from affecting the shoreline" as wave action was overtopping them and impacting the waterfront (Cuevas et al 2013:16). The midshipmen studied a number of methods to protect the waterfront, including inaction, building sills, groins parallel to the shore, detached breakwaters, and placing revetment along the shoreline. Construction of a combination of breakwaters and sills were suggested as a way to provide the most effective protection, in terms of both preservation and cost. Constructed of stone, the breakwaters would disperse the force of the wave action due to shipping traffic and the sills would slow the water down so that it should lessen the damage to the shoreline (Cuevas et al 2013: 30-32, 35-38). Breakwaters would be placed around the wharves, giving them greater protection, and sills would be placed at the northern and southern extents of the waterfront (Cuevas et al 2013:50). This proposed design would also meet requirements to protect the coastal environment, including plants and local wildlife (Cuevas et al 2013: 51). Although well-researched and presented, this recommended design still does not come cheap: construction would require approximately 17 weeks for the construction of breakwaters and 18 weeks for the construction of the sills, and would ultimately cost over $2.7 million (Cuevas 2013:90-98).

In July 2013, a meeting was held at the site between the Office of State Archaeology, site staff, and representatives of other state agencies concerned with protecting the waterfront at Brunswick. A study conducted by the United States Corps of Engineers suggesting the construction of an offshore wavebreak was discussed, as well as discussing the ways that the wharves could be protected by strengthening the existing protection within the permits that have been granted to date. ‘Salvage archaeology’ was discussed, as the parties present agreed that as much information as possible should be salvaged. This work would require additional permitting to be acquired. To date, no further action has occurred as a result of this meeting.

July and August 2013 also included the recovery of additional organic artifacts, including another shoe, a large piece of a textile, rope, and a large piece of leather (Jim McKee, personal communication, July 30, August 15, and August 17, 2013). The shoe recovered on July 30 is the third artifact discussed in the conservation case studies in later chapters of this thesis. Only a small number of ceramic and glass artifacts were recovered during Fall 2013. This is not to say that there was less exposure occurring along the waterfront. The lack of finds more directly correlated to the time available to site staff to monitor the waterfront as fall included a number of educational events at the site.

These recent finds suggest that the erosion is accelerating, which increases the need for information regarding best methods of treatment of artifacts recovered. It also highlights the need for the time, space, and funds to deal with the ever-increasing conservation needs for the waterfront at BT/FA (McKee 2013; Smith 2013).

Conclusion

After such intense investigation of Brunswick under Lee and South in the 1950s and 1960s, Brunswick was somewhat forgotten in archaeology, aside from its contribution to the discipline's theoretical underpinnings. But even with so much study during the early years, the northern end of town and the waterfront were largely ignored. Even after limited archaeological investigations resumed at the site in the 1990s and 2000s, the focus remained on the terrestrial aspects of the site. It was not until the Cape Fear River itself began revealing structures along the waterfront of the site that the archaeological richness of this portion of the site became apparent. As this area is investigated, it is important to keep in mind that artifacts recovered from waterlogged environments require special consideration and treatment.

Chapter 4: Theoretical Considerations for Conservation

As long as people have been saving objects, be it a religious icon, a piece of pottery, or a child's art project, there have always been problems with keeping that object in its original state. A variety of methods have been employed over time to preserve objects. Archaeological conservation attempts to determine, through scientific means, the best way to limit changes to objects excavated from buried environments. Because each material has slightly different characteristics, the best treatment for each material type varies. Inorganic and organic materials require different methods of cleaning and stabilization, for example.

Why Conserve Artifacts?

Over time, all objects undergo a process of decay. While in some cases decay is accepted, or even preferred, in others it is to be stopped or at least slowed. This includes the preservation of objects for study, such as archaeological artifacts. But why should the past be preserved? As Caple (2000:12) says, "a past legitimizes the present", and provides a way to know things about society and culture. While most of our knowledge of the recent past comes from the written record, knowledge of the more distant past often comes from studying objects. Some of these objects are handed down from individual to individual, but others are recovered from the archaeological record.

Previously, attempts were made to remove any and all altered material from an artifact, in an attempt to make the artifact appear as it may have in the past. The processes used to achieve this were often harsh, causing considerable damage and sometimes altering the nature of the remaining original material (Cronyn 1990:8). Today, archaeological conservation has become a profession well integrated in the archaeological process. Conservators work with archaeologists, curators, researchers, and chemists to determine the best course of action (Cronyn 1990:10). Hand skills, along with an understanding of archaeological theory and chemistry, among other skills, are needed by the conservator (Cronyn 1990: 8). Training takes the form of undergraduate and graduate training programs, available in the United States and abroad. Internships and hands-on experience supplement this formal training (Watkins-Kenney 2010:11-12). In order to maintain standards, professional organizations such as the American Institute for Conservation (AIC) and the Institute for Conservation (ICON, formerly the United Kingdom Institute for Conservation, UKIC) in the United Kingdom have developed and revised ethical codes and practical guidelines for members (Caple 2000:60). ICON has also developed an accreditation program for conservators (Watkins-Kenney 2010:11). These ethical codes include: respect for the integrity and true nature of the object, reversibility and retreatability, minimal intervention, documentation of treatment, and the sharing of research with the profession and the general public (Watkins-Kenney 2010:11-12). Some would argue that these codes of ethics are necessary to provide a basis for decision making, by providing a framework from which practitioners can operate. However, it is debated how strictly these ethical codes should be followed (Caple 2000:59). In order to make as little an impact as possible on the artifact, the emphasis is placed on passive stabilization through environmental controls, rather than active conservation (Cronyn 1990:9).

This infers that the main goal of archaeological conservation is to preserve artifacts through environmental control and, preferably, limited treatment of the artifact. These actions are taken to minimize damage to an artifact and the loss of the information that an object contains. Examination, analysis, and cleaning provide the means for conservators to “reveal, retrieve, preserve, and record all archaeological evidence and information" contained within an artifact (Watkins-Kenney 2010:11). However, restoration of an artifact should only be taken to the point where it can be handled for study, exhibited and understood (Watkins-Kenney 2010:11). The conservation process should yield a product that is both physically and chemically stable. The artifact should be able to support its own weight and be able to be studied without fear of damage (Jensen 1987). This means that the artifact should not be in danger of breaking apart during storage, handling or display. Proper storage and mounting techniques help limit this type of damage, as fragile artifacts often require support. Unfortunately, good storage is not always seen as important (Sigurđardottir 2006:221). Artifacts can also undergo significant changes if the temperature and humidity fluctuate on a daily or seasonal basis, leading to continued damage while in storage (Singley 1995:35).

Additionally, these treatment methods should be as non-invasive, archival, and reversible as possible (Jensen 1987). This means that conservation should only be undertaken to the point needed by the artifact; the idea is not to return it to its 'original' state. Rather, it should be returned to a stable state, which may show evidence of the previous deterioration of the artifact. Any processes carried out on an artifact should be recorded so that if retreatment is required in the future, other conservators will know what was done to the artifact, and therefore how to reverse it if necessary (Caple 2000). Not all conservation techniques are reversible. Therefore, care must be taken to decide what processes are necessary to ensure the survival of the artifact.

Archaeology and Conservation

The very process of excavating an archaeological site is destructive. Therefore, the artifacts recovered and the information recorded about the site become the only information available after excavation concludes. Unfortunately, the recovery process often causes a sudden environmental change for an artifact. As a result, excavation can cause rapid destabilization and deterioration of an artifact (Watkins-Kenney 2010:11). This is where conservators can step in to help protect the information contained within artifacts.

Before any actual conservation of artifacts occurs, plans must be in place to ensure that conservation proceeds as intended and does not cause more damage to the artifact. First and foremost, there must be adequate facilities and funding available to complete the project (Cronyn 1990:4). Different types of artifacts require different storage conditions. Additionally, different materials call for different conservation techniques. Depending on the techniques employed, as well as the quantity of artifacts requiring conservation, the overall cost of conservation can vary considerably. As a result, the amount of conservation possible is often dictated by the resources available, rather than the condition of the artifact. Therefore, planning should emphasize "the best possible result within the time, expertise, funding, and facilities available" (Caple 2000:65). As Cronyn warns, "disaster can occur on site when unpredictable materials and conditions are found and there is no equipment or personnel available to deal with them" (1990:4).

When in the field, one's goal is not to clean the artifact. Rather, the goal is to stabilize the artifact enough that it can safely be transported to laboratory facilities. Care must be taken when lifting an object. If fragile, artifacts should be supported in a reversible way. Otherwise, archaeologists only need plan ahead and act carefully to safely excavate an artifact. After excavation, careful packing ensures that the artifact reaches the lab in one piece (Cronyn 1990:5).

Conservation continues while studying the artifact. If material is adhered to the artifact, it may require removal in order to understand the artifact. Various analytical tools and techniques are also available in the laboratory, enabling conservators and archaeologists to understand how, why, and of what an artifact was made. Documentation along the way helps provide additional information for future study. In some cases, this documentation may be the only record of aspects of an artifact. Some artifacts may not provide enough information about a site to warrant conservation. In other cases, artifacts will disintegrate, regardless of the amount of conservation undertaken (Cronyn 1990:11).

Therefore, the conservation of the entire site collection, not just choice artifacts, must be considered (Cronyn 1990:11). It is also at this point in treatment that stabilization of the artifact must be ensured. Stabilization allows the artifact to be brought into equilibrium with its environment, stopping, or at least slowing, decay. Supports may also be created at this point to allow for proper storage and display, or previous conservation techniques may be reversed (Cronyn 1990:5-7).

Conservation continues during exhibition of artifacts. This includes the maintenance of proper conditions for a given material type. Proper conditions include regulated humidity and light levels, and should be regularly monitored. Improper display conditions can cause damage to artifacts (Cronyn 1990:13). Any deterioration that becomes evident during display should cause the artifact to be taken back to the lab and reconserved (Cronyn 1990:7-8).

Conservation in North Carolina

Office of State Archaeology, Underwater Archaeology Branch at Kure Beach

Conservation in North Carolina began with a small lab located at what is now the Office of State Archaeology, Underwater Archaeology Branch in Kure Beach (Lawrence 2011:1). The first challenge for the state regarding archaeological conservation came with the salvage efforts associated with the blockade-runner *Modern Greece.* Between the spring of 1962 and the summer of 1963, over 10,000 artifacts had been recovered (Lawrence 2011:2). Many of these artifacts were in desperate need of conservation to ensure that they would survive for researchers to study, but there were few options already available for the care these artifacts would need.

Recognizing the need for a way to deal with the artifacts from the *Modern Greece* and other nearby wrecks, the North Carolina Department of Archives and History sought funding from several sources to allow for construction of an artifact preservation lab. These funds from the state legislature, the Confederate Centennial Commission, and local communities allowed for the construction of a lab at Fort Fisher State Historic Site (Townsend 1965:1-2). The lab allowed for storage and conservation of the recovered artifacts.

The earliest physical form of the lab was a prefabricated metal building. Over time, it was expanded and had siding installed. Today, it is the Underwater Archaeology Branch's (UAB) office building at Kure Beach. The second version was two singlewide trailers, which were used until the 1980s. These buildings were replaced by the current lab, which began life as the NCO officer club at the Fort Fisher Air Force Base. Originally a large L-shaped building, the structure was split into two buildings by the UAB staff (Nathan Henry 2013, personal communication).

Much of the early conservation in Kure Beach was experimental (Lawrence 2011:3; South 2007:176-178). With advice from Stanley South, manager of both Fort Fisher and Brunswick Town/Fort Anderson at the time, and a copy of *The Conservation of Antiquities and Works of Art* by H. J. Plenderleith, the lab staff set about trying to determine what methods would most help the *Modern Greece* artifacts (Lawrence 2011:3). These methods included electrolysis, heating in a blast furnace, and soaking to remove salts. Iron artifacts were sometimes coated with polyurethane to prevent rusting (South 2007:178). South himself even helped with the conservation of at least one artifact: a Confederate torpedo. Though his methods and the speedy nature of the process would make many of today's conservators cringe, it is important to note that he considered long-term stability to be important for the artifact (South 2007:176-177). Many of the earliest lab employees lacked formal training in conservation. Despite this, their ability to innovate made them successful at artifact stabilization (Nathan Henry 2013, personal communication). One of the earliest employees of the lab was Leslie Bright, who was hired in 1964. During his 34 years at the lab, Bright oversaw the conservation of artifacts from many sites, and also helped to develop the rest of the state's underwater archaeology program (Lawrence 2011:3-4).

Because of limited staff and funding, the Underwater Archaeology Branch (UAB) began working with several state universities to accomplish underwater archaeology projects, including some artifact conservation. Between 1974 and 1977, the UAB worked with the University of North Carolina at Wilmington. Their focus was on the southeastern part of the state, especially the Civil War wrecks. From 1979 to 1982, the UAB worked with East Carolina University to investigate colonial era ports in the state: Bath, Edenton, New Bern, and Beaufort (Lawrence 2011:8). Artifacts recovered from these sites required conservation.

In more recent years, the lab has undertaken conservation projects for other sites around the state. Working with local museums and historical societies allows these conserved artifacts to be displayed near their recovery site (Lawrence 2011:15).

Office of State Archaeology Research Center

The Office of State Archaeology (OSA), then known as the Archaeology Section, was established in 1973. The first state lab was located in the basement of Raleigh Engraving on

West Street, along with the OSA offices. Between OSA's establishment in 1973 and 1977, Jim Shive managed the lab. August Burke replaced him in late 1977, and held that position until 1982, when he became State Archaeologist. Billy Oliver held the position of lab manager from 1985 to 2011 (Dolores Hall 2013, personal communication).

In 1980, the OSA's offices and lab moved to the Heartt House on Blount Street. When the offices were moved, space was provided for analysis and a wet lab. Artifact curation was in the house's dirt floor basement (Dolores Hall 2013, personal communication).

The current state lab at Lane Street was a former book warehouse that had been converted to provide exhibits shop space for the Museum of History. Working with the North Carolina Department of Transportation (NCDOT), OSA established the Office of State Archaeology Research Center (OSARC) in 1995. NCDOT used funds from the Federal Highway Administration to renovate the warehouse to make it suitable for artifact curation and provide lab space. In exchange for this, OSA agreed to curate all NCDOT collections at no cost to NCDOT. Construction was completed in 1998. At that point, the state's collections were moved from the Heartt House to OSARC. OSA offices were moved to the Archives and History Building in 2007 (Dolores Hall 2013, personal communication).

The main objective of OSARC is "to properly conserve, identify, catalog, photograph, package, and archive the state's irreplaceable archaeological artifacts and records for future generations of North Carolinians" (Oliver n.d.:2). Unfortunately, much of the state's collections were collected before state and federal standards were established. Professional archival standards were not being met, so a process of comprehensive inventory and re-packaging according to archival standards has been underway since 2001 (Oliver n.d.:2).

While the permanent staff of OSARC was let go due to budget cuts on June 30, 2011, the space continues to be used. A temporary staff member is in the lab weekday mornings, and most of the OSA staff is there on Wednesdays. They maintain the facility, process old collections, accept new collections, make loans for exhibits throughout the state, and allow researchers to used the space (Dolores Hall 2013, personal communication).

Queen Anne's Revenge Conservation Laboratory

The decision by the North Carolina Department of Cultural Resources to undertake the complete excavation and recovery of a shipwreck in Beaufort Inlet identified as the Queen Anne's Revenge, the flagship of the pirate Blackbeard, required considerable conservation space. Existing facilities at the UAB Lab at Fort Fisher were not large enough to accommodate both ongoing projects and the *Queen Anne's Revenge* project (*QAR*). Between 1997 and 2003, the conservation lab used by the *QAR* project was shuffled between Fort Fisher, Beaufort, and Morehead City. At that point, a Memorandum of Agreement between East Carolina University (ECU) and the North Carolina Department of Cultural Resources (NCDCR) established the Queen Anne's Revenge Conservation Laboratory on the grounds of ECU's West Research Campus. In addition to the physical space, ECU provides facilities maintenance, student graduate assistants, and faculty consultation opportunities, while NCDCR was responsible for the development of the space, management of the wreck site, and direction of the *QAR* Lab. As of 2009, the lab possessed approximately 8,000 square feet, including office, library, and wet and dry lab spaces, along with x-ray facilities and a 4,000 square foot warehouse for wet storage and treatment of large artifacts (Watkins-Kenney 2010:4-5).

Responsibility for the artifacts first fell to Leslie Bright at the Fort Fisher Lab. Between 1997 and present, three individuals (Nathan Henry, Wayne Lusardi, and Sarah Watkins-Kenney) have held the position of Chief Conservator. This position became a permanent State position in 2001, and was supplemented by two permanent Assistant Conservator positions in 2006. In addition to this permanent staff, numerous volunteers, interns, graduate students, and temporary state employees have worked in the lab (Watkins-Kenney 2010:5).

The conservation process at the *QAR* Lab follows a 12-step process, which includes both active and passive conservation. These steps include recovery, post-recovery processing, wet storage, several analysis and cleaning steps, desalination, bulking or consolidation, drying, protective coating application, repair and reconstruction and final documentation before being placed on display. Active steps include examination and cleaning, while passive steps include desalination and bulking. Depending on material type, condition, and size of the artifact, treatment times can range from a few days to several years. Throughout the conservation process, artifacts are documented through photographs and the results of their examination and analysis. In addition to this information, each action taken on an artifact is documented. After treatment is complete, the artifacts are moved to the North Carolina Maritime Museum for curation and storage (Watkins-Kenney 2010:6-10).

Brunswick's Conservation Needs

Because the waterfront area of Brunswick Town/Fort Anderson State Historic Site includes areas that are on land and in the river, the concerns for both terrestrial and underwater conservation need to be considered. In the case of artifacts that have been underwater, there are concerns that an artifact may contain soluble salts. When an artifact contains soluble salts, especially chlorides, corrosion of metals can be a result. Additionally, as the artifact dries, these salts crystallize, causing damage to the artifact due to expansion. Wet artifacts also require controlled drying. At times, the water content of an artifact can be deceptive. In the case of wood and other organics, the cellular structure may be compromised by decay. When wet, it appears stable, but may collapse when it dries, as the water is supporting the cells. Therefore, the space occupied by water needs to be replaced by another material in order to avoid causing damage through collapse and shrinking while drying (Watkins-Kenney 2010:11).

Ceramics

Nature

Ceramics are made of fired clay, with their final characteristics determined by the clay's composition and the conditions and duration of firing (Cronyn 1990:140-141). The raw clay can be shaped by coiling, joining flat pieces together, pouring more liquid clay into a mold, or shaping through the use of a potter's wheel. Before firing, the clay is allowed to dry slowly. This lessens the chance that the clay will crack during firing (Römich 2006:174-175). Kaolinite is often the base clay used, and additional materials, such as sand, can be added to help with shaping, coloring, and firing. The process of firing causes structural changes in the clay that increases the strength and decreases the material's porosity (Cronyn 1990:141-143). This change occurs because particles within the clay are connected via partial fusion or sintering, which causes powders to fuse when heated (Römich 2006:176). Generally, differences in strength and porosity, caused by the firing temperature, lead to categorization of ceramics as underfired earthenwares, earthenwares, stonewares, or porcelain (Römich 2006:177; Cronyn 1990:144).

Mechanical burnishing, coloring with powders, or the application of slip, composed of diluted fluid clay, or a glaze, created from a glass that can bond to fired clay, can be used to alter the surface appearance of a ceramic vessel. Glazes are classified as alkaline or lead glazes, based on the main modifier in the glass. In addition to the compositional differences, alkaline glazes tend to mature at higher temperatures than lead glazes. This higher firing temperature causes alkaline glazes to be used more commonly on stonewares, rather than earthenwares. Lead glazes are often used on earthenwares (Cronyn 1990:144). The application of a glaze requires a second round of firing. In some cases, this glaze is weakly joined to the body, but in others it is firmly attached, adding strength to the ceramic body. If the body and glaze are not compatible, cracking and crazing can occur (Römich 2006:177-178).

After firing, alterations and repairs can be made to ceramics. Historically, resins, fats, or oils have been applied to more porous wares to reduce porosity. Depending on the time period, source, and material, ceramics were repaired with plaster, bitumen, resins, and metal clamps (Cronyn 1990:145).

Damage

The most obvious source of damage to ceramics is caused by accidental breakage during handling (Römich 2006:181). When exposed to damp environments, underfired eathenwares will rehydrate, causing the material to revert to clay. This clay is soft and may crumble under pressure. Softened ceramic sherds and vessels may be distorted by heavy overburden, even if the ceramic does not revert to clay. If a slip, glaze, or paint is present on a ceramic, exposure to temperature changes can cause cracking. These surface coatings and portions of the vessel body can then spall off.

In addition to these forms of damage, ceramics, especially more porous varieties, may become stained by environmental contaminants. These materials may include iron, sulfides, or organic materials (Römich 2006:180-182; Cronyn 1990:145-147). Water and the crystallization of soluble salts can also cause the surface treatments of ceramics to spall off. Glazes can also deteriorate through leeching or dissolution, depending on the pH of the artifacts surroundings (Römich 2006:181).

Conservation

Examination allows the conservator to determine the body type, presence of surface treatments, strength of the ceramic, and whether or not associated materials are present. Chemical analyses of the ceramic and deposits on the surface also help determine the conservation procedures to be carried out (Cronyn 1990:147-148). Careful handling is necessary at each stage of conservation for ceramics; there is a risk for breakage if the ceramic is roughly handled (Cronyn 1990:150).

Cleaning of ceramics should be done carefully. If surface debris is allowed to dry, it can damage paints or glazes. Gentle brushing is usually best, as it removes surface debris, while lessening the likelihood of surface abrasion. Surface cleaning with swabs, using water or alcohol, can also be used. Soaking in water can help remove soluble salts, since there is the risk of damage from salt crystallization during the drying process if these salts penetrate the ceramic. Chemical cleaning can weaken the ceramic or remove traces of food or other substances that may have been absorbed by the ceramic (Cronyn 1990:148-150). While soluble salts can be removed by soaking, insoluble salts must be removed in other ways. They can be scraped from the surface, or, if the sherd has been wet, removed with acids. It is possible to dissolve iron oxides in ceramics or their glazes when treated with acids, so care should be used when employing this method of cleaning (Hamilton 2000b).

Both passive and active stabilization can be used with ceramics. In most cases, passive stabilization is sufficient. Generally, damp ceramics can be allowed to dry after cleaning, unless there are concerns that the ceramic has been contaminated by soluble salts. In those cases, the salts must be rinsed out before drying.

Active stabilization includes the application of consolidants to prevent ceramics from crumbling. In some cases, reconstruction of ceramic vessels is desired. This process can allow for greater understanding of the artifact, but packing and storage becomes more complicated because of the vessel's bulk and fragile nature. Adhesives can also cause damage if used incorrectly. Adhesives that are stronger than the ceramic can cause damage to the surface, because the ceramic breaks in a new location. Adhesive tapes should only be used as a temporary joining method, as the adhesives on tape can stain ceramics or damage surface treatments. If gaps are to be filled, the filling material should not place pressure on the surrounding ceramic (Cronyn 1990:150-155). When stored, ceramics should be kept in an environment with a RH of less than 65% (Cronyn 1990:159). Light levels are less of a concern for ceramics; only certain types of low-fired ceramics and previously conserved ceramics are likely to be affected by light (Römich 2006:182).

Glass

Nature

Glass is considered a siliceous material, meaning that it contains silica, which is arranged randomly within a three-dimensional network (Cronyn 1990:102, 128). Because of the random network found in glass, it has some fluid-like properties. The melting point of the glass varies based on other materials, called fluxes and stabilizers, that are included with the silica. The relationship between the silica, fluxes, and stabilizers determines the nature of the glass produced, as it changes the glass's characteristics (Cronyn 1990:128). Generally, glass is 70-74% silica, 16-22% alkali, soda ash, or potash, and 5-10% flux (Hamilton 2000c). Glass may contain up to 30 different components, though the majority of these are only found in very small quantities (Römich 2006:163). Glass can be produced, cooled, and later shaped. It is important to note that each manipulation changes the glass by altering its physical shape, chemical composition, and leaving marks from bubbles and tools (Cronyn 1990:129).

Glass can be combined with other materials. One such method is enameling, where glass is heated and applied to a metal surface. Because the glass melts below the melting point of the metal, it adheres to the metal. It can also be used as an inlay for plaster, or have decorations applied via gilding or paint (Cronyn 1990:129).

Damage

While glass may exist in the archaeological record in good condition, it usually has been damaged by burial (Cronyn 1990:130). Because glass is so brittle, it breaks easily. Other damage to glass is caused by water, though the rate at which it degrades is influenced by the glass's composition (Römich 2006:164-165). In the case of some glasses, soluble salts can penetrate if it is buried in a wet environment. When these wet artifacts dry, the salts crystallize and expand, exerting pressure on the material. Further pressure can be created if the salts hydrate, which causes the crystalline structure to absorb water without dissolving. Additionally, hydration can be caused by a rise in the environment's relative humidity (RH); fluctuations in RH can cause cycles of pressure within the glass that cause further damage (Cronyn 1990:103). However, Hamilton says that at least in the case of glass produced after the 18th century, salt contamination is not an issue (2000c). In addition to possible penetration by soluble salts, glass can become coated in insoluble salts, including calcium carbonate, calcium sulphate, or calcium silicate (Cronyn 1990:104).

In acidic environments, water and hydronium (H_30^+) ions replace alkaline or alkaline earth elements within the glass. This shift causes the formation of a hydrated, or depleted, layer in the glass. The composition of this layer is different than the bulk of the glass core (Römich 2006:164). As a result, the surface of the glass appears dull or iridescent. This layering, and subsequent flaking, can allow further damage to lower layers of the glass. In some cases, this water holds the glass together, so that when it dries, it falls apart. Alkaline environments, especially damp ones, and seawater, cause extensive damage to glasses (Cronyn 1990:131). These conditions cause the glass to dissolve over time, as the bonds within the silicon and oxygen network in the glass are broken down (Römich 2006:164). Color changes can also occur in the glass. This may be caused by fluxes or coloring metal ions leeching from the glass, ions leeching into the glass from the environment, or from oxidation during burial (Cronyn 1990:133). Even well crafted glass will not survive burial in an environment with a pH over 9 (Cronyn 1990:134).

Conservation

The first step in glass conservation is careful examination. Note if there is any paint or gilding, as these surface treatments can adhere more to soil and concretions than to the glass itself. Observation of thickness, tool marks, and any bubbles in the glass can provide information on how the artifact was made and what its purpose was (Cronyn 1990:135). It should also be noted if the glass appears to be delaminating. If this is the case, the glass should be laid as flat as possible and no pressure should be placed on it, in order to prevent damage to the weathering crust (Cronyn 1990:139).

Any cleaning methods should take into account both the effectiveness of the technique and the risk of damage to the artifact (Römich 2006:171). Cleaning should be undertaken to remove only surface encrustations or soil, but not any flaking bits of glass. Removal of the weathering crust of the glass damages the original surface and thickness of the glass, leaving a roughened surface and altering the nature of the artifact (Conyers 1990:13-136). Removal of this layer also removes the protective coating for the remaining stable glass (Römich 2006:171). Any color changes that have occurred cannot be reversed. If the glass came from a very dry environment, alkaline fluxes can leech out of the glass if the RH rises above 40%, creating a condition referred to as “weeping” glass (Conyers 1990:135-136).

Both passive and active stabilization can be employed with glass. If glass was damp when recovered, it should be kept damp, at least in the short term. Long-term wet storage for damp glass is not sustainable - over time the glass will dissolve. Experts do not agree on the RH at which glass should be stored. “Weeping” glass can be stabilized by keeping the RH around 40% (Conyers 1990:137). Some say the RH should be 20-30%, or at least under 40% (Hamilton 2000c), and others say 40 to 55% (Singley 1995:40). Regardless of the RH at which the glass is stored, rapid fluctuations in humidity should be avoided (Römich 2006:173).

Active stabilization of glass requires water to be removed from the glass without destroying the weathering crust, followed by consolidation of this crust and the surviving core. In some cases, the consolidation of the weathering crust reintroduces at least some of the transparency to the glass.

Reconstruction of glass artifacts can be challenging. The smooth faces of breaks make it difficult to rejoin pieces, resulting in imprecise joins. Thermosetting resins, when possessing the same refractive index as the glass being joined, can provide a strong, nearly invisible join between pieces. If glass is weathered, it cannot be joined until it is consolidated. The adhesive chosen needs to work with both the consolidant and the weathering crust to ensure that the join holds. Gaps can also be filled, but the availability of non-yellowing translucent materials and the ability of the glass to support the fill materials may make this task difficult (Römich 2006:170-171; Cronyn 1990:137-139).

Wood

Nature

The cellular structure of wood is composed of bundles of cellulose fibrils, reinforced by lignin, which forms the skeleton of some plants. Living cells contain sap made of sugars, salts, and other substances. They are elongated along the vertical axis of the tree, creating the wood's "grain". Resins and tannins may be present, acting as a preservative. The living sapwood of a tree is found on the outside, while the inner heartwood is dead. Although all are composed of wood, trees are mainly divided into two groups, hardwoods and softwoods, based on the types of cells present. Hardwoods, which are mostly deciduous, possess vessels that carry substances throughout the living tree. Softwoods, which are mostly coniferous, lack these vessels. Different types of woods are used for different objects, based on the wood species' characteristics (Hamilton 2000a; Cronyn 1990:246-247). When wood dries, it shrinks at different rates along radial, tangential, and longitudinal lines, due to the cellular structure of the wood. Knowledge of the wood species, and therefore cellular structure, is important, especially in the case of waterlogged wood (Hamilton 2000a).

Wooden artifacts may be found with pigments, metal fasteners, or as part of a composite artifact. It may have also been treated with substances to protect it during its use life or undergone treatments to harden it. The bark may or may not still be attached, depending on how the wood was used (Cronyn 1990:248).

Damage

Damage to wood can be caused by several factors: physical action (such as changes in humidity), insect attack, and fungal decay (Hamilton 2000a). Loss of water from the cells causes shrinkage, warping, and cracking of the wood. When wood is rehydrated, it may swell. The movement involved in these processes can damage surface treatments, joins, or the wood itself. In other cases, insects and fungus may damage wood. They may use wood as food, boring into the surface and weakening it. Discoloration of wood can also be caused by the oxidation or removal by water of lignin. Decay or association with metals also causes wood to discolor (Cronyn 1990:248-249).

Generally, wood found in aerated soils is subject to decay, though the speed at which they undergo this process varies based on wood type and local conditions. Wood from anaerobic soils or marine deposits may appear to be in good shape. However, damp conditions cause the wood to weaken by hydrolyzing cellulose and allowing for attack by anaerobic bacteria. The degree of weakening is determined by wood and tissue type, as well as local conditions (Cronyn 1990:249-250). Water leeches sugars and starches out of the wood first, then minerals, colorants, and tannins. Hydrolysis of cellulose leaves only lignin to support the wood, though lignin too will collapse in time. This leaves only water to support the wood, the loss of which will cause cellular collapse when it dries (Hamilton 2000a).

Conservation

Visual examination can tell the conservator a lot about a wooden artifact. In addition to the type of wood used, it can reveal construction techniques such as the tools used to make the object. Examination can help determine the type and extent of decay present; this is important for the determination of the proper conservation procedures (Cronyn 1990:251-253).

Dry wood should be lightly brushed to remove surface particulate matter. Wet wood can be cleaned by spraying with water and careful use of soft brushes. Staining can be difficult to remove, as original preservatives may be removed, and the wood may break down (Cronyn 1990:253).

Wet wood can undergo significant damage if allowed to dry out in an uncontrolled manner. The wood shrinks and cracks, and the cells bond with themselves. Therefore, water must be replaced with a substance to strengthen and consolidate the wood before drying (Hamilton 2000a). Once wood is damaged during drying, it is impossible to reverse. When stored wet, there is the risk for secondary decay due to bacterial and fungal attack (Cronyn 1990:254).

Passive stabilization of wood focuses on maintaining equilibrium with the relative humidity (RH) of the surrounding environment. Dimensional stabilization of dry wood is best maintained through environmental controls. Wet wood should be kept wet, and kept in conditions to limit the possibility of bacterial growth. Slow drying is only possible if the wood is in very good condition; otherwise results will not be ideal. If the wood is damp, it is possible to slowly dry the wood until its water content is the same as the surrounding environment. If the wood is not totally dry, rewetting can also be done slowly. Though there is the danger of over-drying wood, the larger concern is fluctuating RH. Repeated expansion and contraction of the wood can cause considerable damage. Biocides can be used to address insects and fungi issues in both wet and dry wood. Keeping the storage area clean also reduces the possibility of insect attack (Cronyn 1990:255-261).

Active stabilization is necessary for many wooden artifacts. Consolidants can be challenging to use on decayed wood, as it may cause surface darkening and cracking after treatment. If glues are used to rejoin parts of wooden artifacts, they must allow for movement with the timber as RH changes. (Cronyn 1990:255-261). Stabilization of wet wood can be achieved by replacing water with bulking agents, followed by drying through solvents (with or without the addition of bulking agents), controlled air drying, and/or freeze drying. It is important to note that treatment with polyethylene glycol, one substance used as a bulking agent, is not completely reversible (Hamilton 2000a). All of these treatment options can cause the loss of fine details, so careful documentation should be done before the drying process is begun. Reshaping of wet or dry wood is only partially successful, and not guaranteed (Cronyn 1990:255-261).

Leather

Nature

Leather is a product created from the skin of animals, processed in order to make it "non-putrescible even under warm moist conditions" (Thomson 2006:3). In other words, the leather will not rot, even when exposed to moisture during its use life. Made from the corium, the thickest layer of the skin, leather derives its strength from the collagen fibers that compose it. When viewing leather that is in good condition, the smooth “grain” side shows a pattern of hair follicles, while the rough “flesh” side shows the ends of collagen fibers. Water makes the skin pliable during an animal’s life. This flexibility is maintained in leather by replacing the water with another substance, such as oil, during the tanning process (Cronyn 1990:263). This process also helps prevent leather from rotting, even if it becomes wet (Thomson 2006:3). Some leather products only undergo a partial tanning process, resulting in semi-tanned leather. Other products, like rawhide, and parchment, are processed without tanning (Cronyn 1990:264). During production, the treatment of skin products, including leather, is determined by cultural traditions, available materials, and the local economy (Cameron et al. 2006:244).

Damage

Even in the best of situations, leather does not survive burial well. If the RH is below 50%, leather will become brittle, and may shrink and crack. Fats and oils present in the leather may cause it to stiffen or darken, and pests may cause further damage (Cronyn 1990:266). Leather will not survive burial in land deposits where the pH exceeds 6.4, as the high pH removes tannins and allows for faster hydrolysis of the collagen (Cronyn 1990:267).

Waterlogged leather is even less likely to survive a long burial. Waterlogged environments create a unique set of issues for leather, and its condition when excavated is influenced by both pre- and post-depositional factors. The tannins used to tan some types of leather can react with iron in the environment, darkening the leather as iron tannates are formed (Cameron et al 2006:245). As the pH rises, the color of the leather will darken (Cronyn 1990:266). Leather can also darken due to saturation by other components of the burial environment (Cameron et al 2006:245). As a result, the original color of the leather can be obscured, especially if it was light colored. In spite of these color changes, leather may appear to be in good shape, even after a long period of burial. This being said, the oils and tannins used to tan the leather may be leached out, making it less flexible as it dries. Penetration by water can also cause hydrolysis of collagen fibers. This process makes the leather weaker, increasing the likelihood that it will crumble if mishandled. Splitting is another type of damage often encountered with waterlogged leather. The leather splits into layers due to discontinuity between the collagen fibers of the grain and flesh layers of leather. When tanning agents fail to penetrate the leather completely, splitting is more likely to occur. As a result, many waterlogged leather artifacts are found in many pieces, if they are found at all (Cronyn 1990:266-267).

Some types of leather products, such as rawhide or semi-tanned leather, rarely survive damp conditions. This is due to the hydrolysis and breakdown of collagen fibers in the leather. However, there are some conditions that will help preserve leather. In wet environments, the presence of copper and heart oak slows decay. This is due to the toxic nature of copper; where copper is present, bacteria cannot survive, preventing them from breaking down the leather. Certain woods, such as heart oak, contain tannins, so the penetration of these tannins from the environment can help maintain the leather. In marine environments, the lack of bacteria may help preserve leather (Cronyn 1990:267). Generally, only vegetable-tanned leathers survive wet anaerobic deposits, though the reason for this preservation is not completely understood (Cameron et al 2006:244).

Conservation

Before undertaking conservation, visual examination of the leather should occur. Good lighting and some magnification will assist in an accurate condition assessment; without magnification, the leather may appear in good shape, but be revealed as compromised when magnified. Additionally, visual inspection will allow the conservator to determine if there are any associated materials, including paints and dyes. Skin thickness and follicle patterns can also help identify what animal from which the skin came (Haines 2006:12; Cronyn 1990:267-269).

If the leather is dry, it can be cleaned with damp swabs, though care should be taken to avoid over-wetting the surface, which can cause damage. Wet leather can be cleaned using soft brushes and ultrasonic cleaners (Cameron et al 2006:246; Cronyn 1990:269-270). Cleaning should be done carefully, as waterlogged leather can behave like wet paper, delaminating and tearing easily (Grieve 2007:723). This means that sharp objects, such as scalpels, should be used carefully as to avoid cutting the leather. Blunt objects and those that apply concentrated force, such as an ultrasonic dental scaler, should be employed in ways that do not risk damaging the leather. If stains are present and stable, they should be left in place, as removal may destabilize the leather. As a chemical cleaning method, chelation agents, such as ammonium citrate, can be used to remove iron from the leather. There is a risk of removing some of the tanning agents, as well as iron staining, if the leather is tanned with vegetable tanning agents (Grieve 2007; Mardikian et al 2004).

Passive stabilization of dry leather focuses on controlling the artifact's storage environment. Support of leather artifacts is recommended, regardless of the stability of the leather (Canadian Conservation Institute 1992:2). Light levels in the display area should be kept low enough that they do not cause heating of the leather. RH should be kept around 50 to 60%, which will prevent the leather from drying out and cracking (Cronyn 1990:272). This is especially important if there is a surface treatment that could be damaged if the leather swells or shrinks. Wet leather should be kept damp in a sealed container. Too much water can cause the tannins to leach out of the leather.

If active stabilization is required, care should be used. One should attempt to limit the shrinkage and other appearance changes that can occur (Jensen 1987). Shrinkage not only alters the appearance of the artifact following conservation, it can also prevent the artifact from being reassembled. Gaps can form which require bridging, or pieces will not fit together. It must be noted that reconstruction of leather objects is time consuming and has a high risk of damage to the artifact (Cameron et al 2006:249). Certain conservation techniques can also cause color changes, rendering a dark leather artifact light and vice versa. Biocides can alter the pH of wet or dry skin products, causing damage (Cronyn 1990:272). Reshaping must be done carefully, as the risk of damage to the artifact is high, due to the amount of handling required (Cameron et al. 2006:249). Careful application of humectants could be used to reintroduce moisture into some dry leathers. Other leather artifacts may be rewet and treated as if they were originally wet. Drying should be done slowly after bulking agents have been introduced to prevent collagen from cross-linking, which causes the leather to shrink and become stiff and hard (Cameron et al 2006:247-251; Cronyn 1990:272-274). PEG has often been used to add bulk and flexibility to leather before drying (Hamilton 2000e). Drying with solvents or freeze-drying are also options to limit cross-linkage (Cameron et al 2006:247-251; Cronyn 1990:272-274).

Textiles

Nature

Textiles are used to create clothing, shelter, or as tools to accomplish a task, and are made of fibers that are joined in some way. A fiber can be defined as a "long, narrow, and flexible material that may be of animal, plant, synthetic, or mineral origin" or zoologically as an "external, multicellular structure made up primarily of protein" (Robson and Ekarius 2011:1). Cellulosic fibers come from plants and proteinaceous fibers from animals. Cellulosic fibers are composed of cellulose, and include hair cells, like cotton, and bast fibers, like linen. Proteinaceous fibers are composed of keratin, including wool, hair, and kemp fibers. Wool tends to be the finest fiber in a fleece, and is characterized by crimp and elasticity. Hair fibers are straight, smooth, and inelastic, and are stronger than wool fibers. Kemp is the heaviest and coarsest of the fibers, found in certain types of fleece (Robson and Ekarius 2011:8-9). Silk, another protein fiber, is composed of fibroin, and is made from the unwound cocoons of silk worms (Cronyn 1990:285). Synthetic and mineral fibers, such as rayon or fiberglass, have only entered the archaeological record in the last century, and possess their own issues in waterlogged environments (Cronyn 1990:285-286).

In order to produce textiles, individual fibers are spun together, adding length and strength. These linked fibers are then woven, looped, or matted together to create fabric. Common methods of joining fibers include weaving, knitting, basketry, rope making, and felting. These fabrics and spun fibers can be altered through dyes or the addition of metallic threads or gold leaf (Cronyn 1990:285-286).

Damage

Damage in textiles can be caused before or after deposition into the archaeological record. Deterioration within a textile may not be uniform, with sections that were more exposed during the objects use-life or burial period exhibiting more damage than other areas (Peacock 2005:498). This damage falls into three categories: organic (insects, mold and bacteria), physical (wear and tear), and chemical (exposure to gases) (Hamilton 2000d). Insects, such as moths, may also attack fibers. General wear and tear on the fibers, as well as staining, soiling, or bleaching may occur while the textile is in use (Cronyn 1990:286).

After deposition, damage may continue. Pressure from the deposits above the textile may deform the fibers, and the action of microorganisms and plants may damage or totally destroy the artifact (Peacock 2005). Abrasive substances, such as silt or sand, may be carried into a textile during burial. As the textile is moved or cleaned, these internal abrasives can cause damage to the fiber (Cronyn 1990:288). Fibers within the textile may be affected by hydrolysis, which causes the breakdown of the proteins that compose the fiber. As a result, individual fibers may be broken, weakening the entire textile (Cronyn 1990:286). This weakening and fragmentation of fibers through hydrolysis may make one material look like another; longer animal fibers may appear to be a shorter plant-based fiber. Furthermore, this weakened fabric may be fragmented within the archaeological deposit, making identification of the original artifact more difficult. It is also possible that this weakness may not be apparent until the artifact is taken back to the lab and cleaned. In that case, the textile may require some form of support to prevent fragmentation during and after treatment. Because the condition of textiles can be hard to determine without additional tools, block lifts are recommended to limit damage to the textile (Singley 1995:42).

In addition to alterations in the characteristics of the fibers, substances previously added to the fibers may change during burial. In the case of dyed fabrics, the dyes may leach out into the surrounding environment. Certain dyes are more likely to leach than others, based on the components of the dye. Dyes can also act as biocides, preventing decay, or can speed deterioration, depending on its composition. Color changes due to environmental contaminants are also possible. Tannins in the soil can darken light fabrics, and metal corrosion products can also discolor textiles. Copper corrosion products may add greenish colors to a textile, and iron will cause a range of orange to rust brown staining (Cronyn 1990:286).

Conservation

Visual examination is needed to determine the fibers found in a textile, as well as its construction techniques and whether or not other non-fiber materials are present. Construction methods may be visible without magnification, but fiber identification requires light- or scanning-electron microscopy. If dyes are present, extraction and analysis though spectrophotometry is necessary for identification (Cronyn 1990:287). Care should be taken to protect all textiles from ultraviolet light, as this can cause damage by oxidizing stains in the material (Cronyn 1990:288). A strong, stable textile can undergo potentially harsher cleaning methods than those that possess fibers that are degraded and prone to breakage. Textile fibers can be heavily degraded by overburden during burial, chemical hydrolysis, and bio-deterioration (Peacock 2005:498).

Cleaning dry textiles works best with water, because it cleans and plumps up fibers. If folded, the textile should be dampened or submerged and unfolded underwater. This lessens the stress on the fibers. If the textile is very fragile, loose dirt can also be removed using puffer brushes. Their use prevents abrasion. Wet textiles should be cleaned before being allowed to dry. The textile should be supported during cleaning, and if folded, submerged and unfolded under water. Surface dirt is removed with soft brushes, sponges, and in some cases, ultrasonics (Cronyn 1990:287-288).

Passive stabilization of textiles includes keeping uncleaned fabrics damp and refrigerated or frozen until conserved. After cleaning, controlled drying stabilizes most textiles. If the textile is incredibly fragile, it may be affixed to a backing material with a multitude of small stitches (Cronyn 1990:289-292). Careful packaging and handling protect these dry artifacts. Low to no light is preferred, and textiles should be protected from dirt and dust. A RH of 65% will help prevent bacterial or fungal issues, while keeping spaces clean will help reduce insect problems. A stable RH of 50 to 65% helps maintain the dimensional stability of textiles (Cronyn 1990:289-292). Storage under 70% RH is important, as higher RH encourages mold growth. Ideally, textiles should be stored in a dark environment with low temperatures and humidity (Hamilton 2000d).

When considering the appropriate active conservation methods for a given textile, a number of factors should be considered. The first is that one should attempt to preserve the wet dimensions of the textile after drying. Some shrinkage will occur, but techniques employed should attempt to limit this dimensional change. The artifact should also be conserved in such a way as to preserve its original appearance as much as possible (Jensen 1987). Another method of active stabilization includes treatments to increase the flexibility of the textile. There have been some debates over whether or not lubricants and consolidants should be used to treat textiles before drying, as they can cause discoloration and stiffness in the textiles (Jakes and Mitchell

1992:343). Drying options include air-drying, solvent drying, critical-point drying, vacuum freeze-drying, and slow drying while frozen (Peacock 2005; Jakes and Mitchell 1992).

Conclusion

While the history of conservation in North Carolina is relatively short, there are plenty of opportunities to let it grow. With the facilities that exist, there is space available to conserve artifacts from around the state. Funding is an issue, but interested individuals can be found to provide support for these projects. It also provides an opportunity for students to receive hands on training in conservation, along with archaeological field techniques.

Organic and inorganic artifacts require different treatments in order to stabilize them. An understanding of the difficulties with, and the needs of, different material types helps the conservator determine how best to treat a given artifact. This understanding can also guide the conservator to determining in what order artifacts should be treated, if the collection is a mix of materials.

Chapter 5: A Conservation Plan for Brunswick

As previously discussed, conservation should be included from the very beginning and throughout all archaeological projects. Conservation needs should be considered during site survey, development of research questions and excavation methodology, excavation, and post-field processing of artifacts. Unfortunately, it is sometimes overlooked until excavations have already begun and fragile artifacts are being recovered.

The waterfront at Brunswick Town/Fort Anderson State Historic Site (BT/FA) can be considered a microcosm of this issue. In the case of both Dry's Wharf and Moore's Wharf, artifacts were recovered before adequate conservation plans could be put in place. This has been more of an issue for Dry's Wharf, as organic artifacts requiring extensive conservation have been recovered here. Moore's Wharf has yet to produce artifacts that require extensive conservation. These two wharves represent the course of action that needs to be followed if conservation is not accounted for until the excavation phase of an archaeological investigation.

The wharves in the Commercial District of Brunswick provide an opportunity to consider the conservation needs of an archaeological investigation from the beginning. While these wharves have been located, they have yet to produce many artifacts. However, due to the productivity of Dry's Wharf, it is safe to assume that organic artifacts requiring conservation will be recovered, should excavations be undertaken in this part of the waterfront.

It is important to note that even the best preparations are not foolproof. No two features along this waterfront will be exactly the same. Based on experience with Dry's and Moore's Wharves, one should always expect the unexpected. Additionally, no two artifacts will behave exactly the same during conservation due to differential burial conditions, so a given procedure may not produce the same results on two artifacts of the same material.

Assessing the Site

Locating Features

The best method for the location of additional wharves and wharf-related features along the waterfront at BT/FA would be a walkover survey. In addition to locating features, a survey allows for an assessment of their condition. This assessment can determine if an excavation should be planned for the near future, or if the site can be monitored and left unexcavated. It also provides a means to assess what types of artifacts may be recovered during excavation, if any surface finds are exposed. Knowing what may be recovered, even in a very general sense, can help determine how much space for conservation will be needed. As BT/FA's waterfront is a wet archaeological site with tidal flow from the Atlantic Ocean, some desalination and controlled drying will need to be included as a part of any conservation efforts undertaken. As such, space must be allocated for these procedures.

A similar survey to locate features on the foreshore and in the coastal zone was carried out along the North Kent Coast of England by Dietlind Paddenberg and Brian Hession. The survey was undertaken in order to provide additional information to allow for "informed decisions and influence the shoreline planning process" (Paddenberg and Hession 2008:142) along a portion of the English coast. The survey was guided by studying existing information, including maps, aerial photographs, and museum collections, among other sources. Time in the field confirmed data initially noted during the previous research and also located previously unrecorded sites (Paddenberg and Hession 2008:142). Similar research has provided the means to identify Moore's and Dry's Wharves, and could guide investigators to other potential wharves.

Similar to the conditions encountered by Paddenberg and Hession, surveys at BT/FA would be impacted by tidal flow – the Cape Fear River rises and falls with the tide, which limits surveys to one to two hour periods close to low tide, during daylight hours (2008:143-144). While marshy areas above the shoreline can be walked over for several hours before and after low tide, the marsh grass growing here obscures any features that may be found in the mud. Additionally, the mud can be very sticky, creating a hazard for those walking over the area. Areas directly along the shoreline are best surveyed within thirty minutes or one hour of low tide, depending on seasonal tidal fluctuations. At times, the incoming or outgoing tide can trap a surveyor on a portion of the shoreline, requiring careful navigation of the marshy area below the bluff to get back to dry land.

One major difference between surveying the BT/FA waterfront and the Paddenberg and Hession survey is the utility of boats for increasing site accessibility (2008:144). For Paddenberg and Hession, boats allowed for greater access to sites. In the case of BT/FA, boats do not add to the accessibility of sites, and could actually cause damage to the features being located. The area to be surveyed is no more than a few miles long, and the wharf features that have been located to date are not much more than a foot above the water's surface, even at low tide. Therefore, it would not save time when surveying to use a boat, and there would be a risk of running into some features when trying to land a survey boat.

A smaller, but still instructive, survey was undertaken in Bath, North Carolina to determine if any features would be impacted by the construction of a bulkhead and backfilling to prevent erosion around Town Point (aka Bonner Point) (Broadwater et al. 1979:1). The walkover survey began on land and continued with extensive offshore surveying. Land features were noted because they could continue into the water or be affected during the construction process. Probes were used in the offshore survey, due to poor underwater visibility (Broadwater et al. 1979:10-13). A similar terrestrial and underwater survey was carried out at Red Banks Landing in 2000. Students from East Carolina University's Department of Anthropology conducted the terrestrial survey, and students from the Maritime Studies department conducted the underwater survey. The survey's goals included determining what archaeological deposits existed on site, examining the extent of the landing structure still extant, and assessing the Tar River's characteristics in order to determine why the landing was constructed at that particular site (Hicks 2012:38). While the features located in the river are the ones most visible along BT/FA's waterfront, these features most likely continue at least partially onto land. Additional features may also be associated with the land end of the wharves. Limited offshore surveying has been carried out at BT/FA, as many of the features are accessible at low tide. Probing has been used to locate the remains of timbers on the ballast stone jetties that form the base for both Dry's and Moore's Wharves, as oyster shells significantly obscure the remaining timbers.

Assessing Site Stability

A secondary purpose for the walkover survey is to assess site stability. An ongoing issue along BT/FA's waterfront is shoreline erosion, caused by tidal currents, wind and wave action, hurricanes, and ship traffic in the adjacent shipping lane (Cuevas et al 2013:1). As a result, additional portions of wharf timbers, especially on Dry's and Moore's Wharves have been exposed. In the case of Dry's Wharf, this water action has also caused timbers to be dislodged (McKee and Smith 2012). Because of this ongoing damage, it is important to assess any sites along the waterfront to determine the best course of action. In some cases this is likely to be ongoing documentation and monitoring. In others, full-scale excavations may be necessary to preserve as much information as possible.

Background on the Wharves

In the case of Dry's and Moore's Wharves, the locations chosen for construction were based on the location of the Cape Fear River Channel. The channel originally came in close to shore where these wharves were built. The initial source of the ballast stone that forms the base of both Moore's and Dry's Wharves likely came from the shipping traffic that plied the Cape Fear. Because the goods that were brought into the port were often smaller and lighter than the naval stores shipped out, incoming vessels carried ballast to help them be more stable. Due to the depth of the river both at its mouth and at The Flats south of Wilmington, vessels traveling upriver would have needed to offload ballast to continue upstream. They also would have had to offload ballast in order to have space in their hold for the goods being shipped out of Brunswick. This ballast could have then been used as filler (Heintzelman 1986:15). Therefore, it is likely that the ballast used on the wharves came from the same vessels trading in the port. And, with the large volume of ship traffic that Brunswick saw, it would not take long to accumulate enough ballast to build these wharves.

Dry's Wharf

Dry's Wharf was the first to begin seriously eroding from the banks of the Cape Fear River, and has provided the most information about the waterfront to date, relative to the other features along the shoreline. It is from this wharf that the bulk of the artifacts from the waterfront have been recovered, including a large quantity of ceramics and the knit cap and two shoes that have been conserved (Smith 2013).

Dry’s Wharf is associated with Lot 36 on the town lot plan, which ran from the courthouse to the river. This lot was owned by William Dry II (Brunswick County Deeds). He is also the most likely candidate for the builder of the wharf. Both he and his son, William Dry III were merchants, and likely used the wharf to conduct trade. Based upon the Drys' time of residence in Brunswick, the wharf was probably in use from 1740 to 1765. Pipe stem and mean ceramic dates based on artifacts recovered from the wharf confirm this date range (McKee and Smith 2012). Based on the depiction of the waterfront on the 1769 Sauthier map, the wharf was probably silted over and no longer in use by that point (Figure 8) (Sauthier 1769).

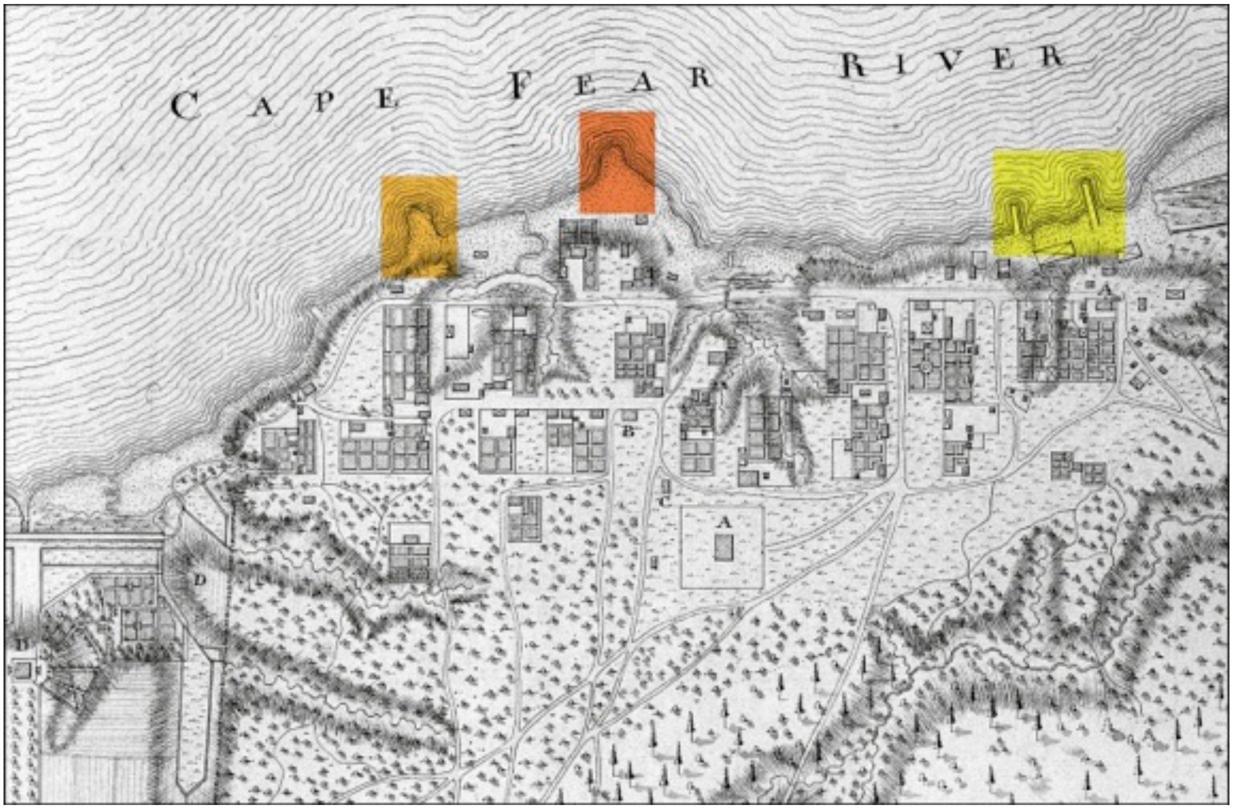

Figure 8. Excerpt from *Plan of the Town and Port of Brunswick* by Claude J. Sauthier (1769) illustrating Brunswick and commissioned by Governor Tryon. Highlighted areas indicate the wharf features presently exposed. The orange point (left) identifies Roger Moore's Wharf, the reddish-orange point (center) identifies William Dry's Wharf, and the yellow paired rectangles (right) identify the commercial district. Original on file, King's Map Collection, Reference Number CXXII 55, King George III's Topographic Collection, British Library. Copy on file, North Carolina Historic Sites Section, Archaeology Branch.

Dry's Wharf is oriented east to west and extends 110 feet into the Cape Fear River, with 50 feet of timbers on dry land. The wharf is of crib, or crib-cobb, construction. A crib wharf usually has stretchers, timbers that run from the shoreline out into the river, with other timbers, called headers, laid across the ends. Each layer was usually floored and filled with sand, silt, ballast, tree debris and refuse. Cobb type wharves were constructed in a similar fashion, though the timbers of each course were laid next to each other without flooring between them (Hicks 2012:113-114). Similar construction techniques were used on plantation wharves studied by Theresa R. Hicks in Virginia, South Carolina, and elsewhere in North Carolina (2012). Dry's

Wharf is formed from cribs 24 feet long and 20 feet wide, separated by 6-foot breaks. These cribs were then backfilled with ballast, with Crib 2 containing barrels that were filled with ballast to act as revetment. These cribs were constructed with saddle notches and trunnels used to join the timbers, a construction method referred to as Roman construction. At present, it is believed that there are 4 courses extant, though it is unclear how many courses comprised the original wharf. The cribs were constructed on a ballast stone jetty, which reduced the number of courses necessary for the decking to be above water at high tide. Crib 2 also includes a saddle notch cut at a 45-degree angle (Figure 9). This angled timber, along with the stone jetty that forms the wharf's base, may have been methods employed to address the fast current of the Cape Fear River just off Brunswick (McKee 2013; McKee and Smith 2012).

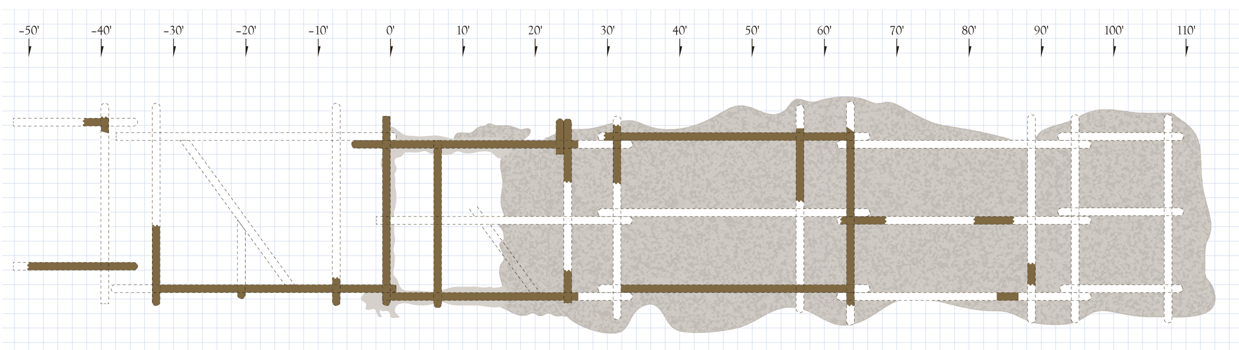

Figure 9. Conjecture of William Dry's Wharf, based on data and an initial conjecture by Jim McKee. Image courtesy of Bryan Wiggins. The 0 point on the conjecture indicates the shoreline. Negative distances are on land, while positive distances are in the river.

Moore's Wharf

All that seems to remain of Roger Moore's Wharf is the end quarter. There is significant river scouring action along this section of the waterfront, as the current is very swift. This scouring action is causing damage to the timbers, and may also be washing lighter artifacts downstream. If any additional woodwork existed, it has likely been swept away by the Cape Fear (Jim McKee 2014, personal communication).

Originally, the river channel would have dipped into the cove immediately upstream of Moore’s Wharf. However, in the 1930s, the United States Corps of Engineers straightened the channel, pulling it out of the cove. Today, the river is attempting to return to its original course and is cutting a new channel closer to shore (Jim McKee 2014, personal communication).

Based on deed records, the lot this wharf would have been on was owned by Roger Moore (Brunswick County Deeds). In addition to the property in Brunswick, Moore also owned Orton Plantation, just upriver from the town. The wharf was likely built using crib or crib-cobb construction in much the same fashion as Dry’s Wharf. What timbers exist rest on a ballast stone shelf or jetty that drops off very sharply at the end. However, this wharf was likely in use a few years early than Dry’s, based upon when Roger Moore came to Brunswick. Therefore, it probably dates to 1730 to 1755. In the 1769 Sauthier map of Brunswick, the area where Moore’s Wharf was is depicted as a small point of land (See Figure 8) (Sauthier 1769). From this depiction, one could conjecture that the wharf had been abandoned for sufficient time to allow it to silt over.

Commercial District

There are two additional wharves depicted on the Sauthier map, downstream of Moore’s and Dry’s wharves, in the commercial district of the town (See Figure 8). Two additional concentrations of timbers have been observed on the waterfront at BT/FA. As a result, it seems that these two features may correspond to the other wharves on the Sauthier map. Further investigation of this area of the waterfront will be required to confirm the identification of these features as more wharves. The owners of these wharves are not currently known.

Artifact Discovery and Recovery

Currently, most artifact discovery and recovery has occurred as a result of regular checks of the waterfront. In the case of ceramics and glass, this recovery does not require anything more involved than bending down and picking up the artifact. With organic artifacts, discovery either immediately preceded the recovery, or occurred a day or two before recovery. Almost all of the organic artifacts considered in this thesis originate from Dry's Wharf. Recovery of organic artifacts has been undertaken only when there is a concern that the artifact may be washed away. Removal of anything from the area around Dry's Wharf causes further destabilization of the soil and erosion. Therefore, recovery has been a last resort while monitoring the waterfront.

There has been only the most basic planning for conservation needs during artifact recovery thus far. This planning included locating a container for the artifact and determining if there was a safe place for storage. It was only after recovery had occurred that the discussion of how, when and where to conserve the artifact took place. As a result, only a few artifacts have been successfully conserved, including those that form case studies for this thesis, though the other organic artifacts have been kept stable by keeping them wet and refrigerated, if possible.

Other archaeological projects can provide insight into comparative methods and concerns surrounding excavations on a riverfront site. Two examples come from Charleston, South Carolina. The first Charleston example is the Vendue/Prioleau Project, conducted by New South Associates, Inc. The investigation was associated with development along the waterfront in Charleston. The area being investigated was reclaimed land that had previously been wharves extending into the Cooper River (Joseph et al. 2000:1). This area had been the primary wharf area on the Cooper River. The wharves were crib (or cobb) construction, likely built on land, floated into the river, and then sunk to form the wharf. Some of these wharves had a stone curtain around them as protection (Joseph et al. 2000:4). Trenches were used to investigate these wharves, which were buried in the reclaimed land, though trenches were not entered below five feet for safety reasons. Backhoes and water hoses were used during the excavation process, due to issues encountered with other excavation techniques (Joseph et al. 2000:27-29). Artifacts recovered from these investigations were primarily glass and ceramics, along with timbers, which were documented and left in place (Joseph et al. 2000:Appendix B). The second Charleston example reflects the type of excavations that may be necessary for the location of buildings associated with wharves, slightly further from the shoreline. They are equally as important, as the land and water portions of shoreline sites should not be separated during investigation and interpretation (Hicks 2012:22). Excluding one area limits the interpretation of the other. Excavations at the Exchange Building during 1979 and 1980 occurred as a result of renovation plans for the building associated with bicentennial activities in the city (Herold 1981:6). Excavations took place within the footing trenches for an elevator shaft, as well as within other trenches placed around the construction site. The water table was established as a vertical datum, with depths taken from it (Herold 1981:15-16). Within the trenches, wood, grass, seeds, cloth, leather, barrel fragments, and pitch were recovered (Herold 1981:19).

Along Brunswick's waterfront, excavations utilizing trenches would allow a larger cross section of the area to be investigated without having to strip all of the soil off the area being investigated. Any trenches crossing a wharf should be oriented perpendicular to the wharf itself in order to locate associated structures to the sides of the wharf. Trenches parallel to the wharf could help determine the wharf's extent on land, and locate structures associated with the end of the wharf. As long as the trenches are above the high tide line, tidal flow would not heavily impact investigations. If below the high tide line, trenches would need to be able to be excavated and filled in within a 5 to 6 hour window before, during, and after low tide. Trenches extending into the river would require the involvement of divers or the construction of coffer dams or similar to investigate the area. This could help prevent additional shoreline erosion. This technique would also provide a means to study the stratigraphy of the waterfront, which would help to explain how deposition patterns had changed through time. The organic finds from the excavations at the Exchange Building, along with the previous finds from Brunswick's waterfront, suggest that it is not unreasonable to expect to find more organic artifacts elsewhere along the waterfront at BT/FA.

Another example of excavation concerns on the waterfront comes from the construction of the Millennium Footbridge in London, England. Investigations centered around the pile caps for the abutment structures that support the bridge (Hughes and Seaman 2004:106). They faced safety issues including excavating near the bottom of temporary retaining walls built during the construction process, below the basement level of the nearby Swiss Bank building, soft and loose soils, and excavating below water table level. Depth of excavations was determined by the soil conditions and overall safety (Hughes and Seaman 2004:108). The walls of the areas investigated were shored up with walling planks, which made working closer to the water table safer. The planks were removed as work progressed to allow documentation of the trench faces. Closer to the water table, this technique can allow water into the excavation area, which can negatively affect data gathering (Hughes and Seaman 2004:109).

While there are no large buildings or construction projects along the waterfront at Brunswick, there is concern about the soil stability and the level of the water table. Some of the sediment along the waterfront is very sandy, while other sections are a thick mud or clay. This would require some sort of support to avoid collapse of trenches or test units placed close to the shoreline. Parts of wharf areas are at or below water level at high tide. This would lead to inundation of excavations during some parts of the day, ruining excavation progress and possibly impacting the length of the work day. As a result, a coffer dam or similar structure would have to be constructed to hold back the waters of the Cape Fear during excavations. This could have a negative impact on the site; however, as it would allow timbers and other artifacts that have been wet time to dry out.

Unfortunately, the reports from these projects do not discuss whether or not there was a conservation plan in place during excavations, or if any conservation work was carried out as part of the project. This makes it difficult to analyze how other projects in similar sites accounted for the possible recovery of fragile artifacts. It also highlights the need for conservation plans to be discussed in project reports, so that others can see the value of planning ahead for conservation during excavations.

Artifact Triage

Ideally, any treatment, including consolidation, that needs to be carried out should be "long lasting, give dimensional stability, not alter appearance, not cause swelling or shrinking, be compatible with preservatives, allow post-treatment repairs, penetrate the structure, be non-toxic, be non-flammable, resist insects and fungi, and be reversible" (Watkins-Kenney 2013:5). The methods employed for each artifact will vary based on material type and the condition of the artifact. Therefore, following recovery, the condition of artifacts must be assessed. Generally, the glass and ceramics have been in very good shape. Some of the glass has exhibited iridescence, caused by hydration of the glass (Römich 2006:164), but most glass is the original dark olive green color. Hydration damage seems to be more of an issue for thinner bottles, such as case bottles, than the thicker wine bottles.

For the organic artifacts, some surface cleaning has been necessary to assess the condition of the artifact recovered. Most of the organics are heavily coated in sediment following recovery. This surface coating makes it difficult to determine the size of the artifact or its current condition (Figure 10).

Figure 10. Shoe #2 before treatment. The toe and a section of upper (diagonal across center of shoe) and a bit of the heel area are the only leather sections visible.

Based on the artifacts that have been used for this study, most of the organics from the waterfront should be stable enough to allow some extended wet storage before treatment. The knit cap, one of the case studies for this thesis, was stored for over two years before conservation occurred. Damage due to storage appears minimal. This said, the storage period should be as short as possible to prevent further damage to the artifacts due to deterioration caused by environmental changes or biological growth. Unless closely monitored, it is very easy for artifacts stored wet in a refrigerator to dry out, or if too close to the freezer portion of the refrigerator, to freeze. Outside of a refrigerator, it is possible for an artifact to dry out or grow mold, depending on conditions.

Despite the stability of most of the artifacts recovered thus far, some artifacts recovered in the future will, undoubtedly, be in poor condition. In this case, the artifact should be thoroughly documented through measurements and photography in order to preserve as much information as possible. After documentation, conservation may be undertaken, though some artifacts may not be able to be stabilized by conservation.

Treatment Order and Likely Outcomes

There is no hard and fast rule for the order in which a collection of artifacts should be treated. Rather, treatment order should be based upon the overall time available to treat the collection, the estimated time each type of artifact will require for treatment, and the tools and experience available to the conservator. If one is unsure as to how to treat an artifact, individuals with more experience should be consulted. In some cases, this will require conservation by an outside consultant. Based on current observations of the artifacts from BT/FA's waterfront, a general order of treatment should be: glass and ceramics, wood, leather, and finally, textiles. This order is based on the relative ease and cost of conservation. The artifacts listed first can be treated relatively easily, while artifacts listed later will require additional materials and space to be secured. In some cases, additional research or training may be necessary, requiring more time before treatment can occur.

Glass and Ceramics

Treatment

The glass and ceramics will primarily need surface cleaning with a soft brush and water. This can be carried out at BT/FA, if time and space allow. In the case of some of the coarse earthenware, such as brick or olive jar fragments, soaking may be required to remove any soluble salts that have penetrated the ceramic. Glass can also be carefully cleaned with water and a soft brush. If iridescence is present, care should be taken to avoid dislodging these delaminated layers. They form a protective coating for the underlying glass core; their removal can cause further delamination of the glass (Römich 2006:171; Cronyn 1990:131).

Both glass and ceramics should be slowly air-dried. Care must be taken to ensure that these materials are completely dry before being bagged and catalogued. Otherwise, mold and other substances may grow on the surface of the ceramic or destroy the tag that is included with the artifact (Figure 11). Unless excavated from a waterfront feature, and closely associated with each other, it is not likely that any cross-mending will be possible, as it would be difficult to identify which artifacts fit together.

Figure 11: Ceramic with tag damaged by moisture.

Outcome

After surface cleaning, desalination and proper drying, both glass and ceramics are stable. They should be stored in 40 to 55% relative humidity (RH) for glass and below 65% for ceramics (Cronyn 1990:159; Singley 1995:40). Rapid fluctuations in humidity should be avoided. Glass and ceramics should be protected from breakage during storage and handling, as they can be fragile (Römich 2006:173, 181). Light levels are not a primary concern for most ceramics (Römich 2006:182). These artifacts can be displayed without risk of damage, as long as they are properly supported to avoid possible breakage.

If ceramics are not properly desalinated or dried, soluble salts may crystalize on the surface or mold may grow (Römich 2006:181). Soluble salt recrystallization may or may not be a problem for glass, depending on the reference cited (Hamilton 2000c; Cronyn 1990:103). If salt crystallization or mold growth occurs, rewashing and another period of drying will be required. If there is a surface treatment, such as a glaze, the salts or continued exposure to moisture may cause it to spall off (Römich 2006:181). Delft is especially prone to losing its glaze.

Wood

Treatment

The wooden artifacts recovered along the waterfront fall into two categories. One includes large finds, such as the wharf timbers, and the other includes small finds, such as barrel parts. Treatment of all waterlogged wooden artifacts is likely to include bulking and consolidation to provide support for the wood during and after drying. The earliest wood treatment, from 1859, was boiling in alum (Watkins-Kenney 2013:2). Other treatment options have become available primarily during the mid-20th century. Treatment with polyethylene glycol (PEG) was developed in the early 1950s in Sweden, and has become widely used. Other treatment options, such as treatment with sugars, glycerol, resins, or silicone oils, along with their application and the drying methods employed, are generally compared to PEG when assessing the efficacy of the method (Watkins-Kenney 2013:3). More recent studies have focused on materials that leave room for retreatment, such as foaming polymers, especially those with biomimetic properties (Christensen et al 2012). Due to the differences in the size and condition of these two categories of artifacts, two different treatment streams must be considered.

The wharf timbers, due to their size, provide considerable conservation challenges. These challenges fall into two categories: the cost of initial storage and conservation, and the availability of resources (Gregory 1998:343). Many of the timbers on Dry's Wharf alone are ten to twelve inches in diameter and up to 24 feet long. This presents issues for storage and treatment; very large tanks would be needed. Space for such large tanks would need to be located, as would ways to store and dispose of the large volume of solutions in which the wood would be stored. The timbers are waterlogged, and extremely heavy, which makes moving them difficult. The wood is also badly damaged from biological activity and environmental fluctuations. Longer timbers would require support at multiple locations along their length to avoid breakage during transport. The supplies needed to address these issues would include tank materials, substances such as PEG for bulking and impregnation, and biocides to prevent bacterial growth, and lifting equipment. When combined with the time needed for monitoring, this process can become expensive very quickly (Caple 1994:62-63). As a result, excavation and conservation of these timbers is not recommended. A more pragmatic approach would be to thoroughly document and rebury the timbers. This method allows finds to be kept in an environment that is the same, or similar to, the environment from which they were recovered. Even if the timbers are reburied *in situ*, they should be labeled so that data recovered can be correlated with a specific timber if they are later uncovered (Watkins-Kenney 2013:5).

Reburial will involve the placement of soil, and possibly geotextiles, to provide protection for the timbers. This cover, in conjunction with environmental conditions, would theoretically help preserve the timbers. The goal is to make the burial environment as anaerobic as possible, as this limits the degradation that occurs in the wood. Burial below 50 cm (about 20 inches) in submerged sites has resulted in good preservation in experimental conditions, due to limited oxygen levels and presence of microorganisms (Gregory 1998:343, 353). Several other studies of *in situ* preservation indicate that there are additional factors, besides the amount of time spent underwater, that influence the stability of archaeological remains (Amendas et al. 2013; Lillie et al. 2008). Reburial *in situ* may not be possible for all parts of the BT/FA waterfront, as the Cape Fear River is tidal and the current is swift. In those cases, timbers should be reburied somewhere else, where conditions are less problematic (Gregory et al 2012:S146). However, the process of deterioration is only slowed; it cannot be stopped entirely (Manders 2008:32).

As part of the reburial process, *in situ* monitoring of the timbers should take place. This should be done in order to assess preservation of timbers, even though the monitoring process may be invasive, altering the environment (Van de Noort et al. 2001:96). Samples for monitoring should be taken from several places around the site, as conditions may vary throughout (Jordan 2001:51). Monitoring may include visual and microscopic analysis (if uncovered again or cored), measuring oxygen levels, pH or the redox potential of the environment. Redox potential affects the conditions that cause the gaining of electrons (reduction) or the loss of electrons (oxidation) alters the chemical environment, which can affect preservation (Jordan 2001; Smit 2004; Gregory 1998:344-346). Oxygen levels and pH determine which microorganisms may be present in the environment, and also affect the rate of hydrolysis within wood (Jordan 2001:50). Not only would this provide information about conditions affecting the timbers along the waterfront, it would provide comparative data for others studying the long term effects of reburial on wooden artifacts, such as the Reburial and Analyses of Archaeological Remains (RAAR) project (Watkins-Kenney 2013:5; Van de Noort et al 2001:96).

Barrel parts, such as barrel staves, heads, and barrel bands, are the majority of small wood finds for the waterfront at Brunswick. Their small size will allow for bulk treatments with polyethylene glycol (PEG) or similar bulking agents/consolidants. It must be noted however, that if future retreatment is carried out, it may not be possible to completely remove PEG from within the wood. There are also concerns about the depth to which the PEG can penetrate and its breakdown over time (Christensen et al 2012:S184). While these limitations should be taken into account, PEG may be the most cost effective and accessible treatment option for these artifacts. While treatment of wood with sucrose is cheaper, results are not always ideal (Caple 1994:62). There is a risk of microbial or insect attack during and after conservation. These organisms can also cause the sucrose to break down into glucose and fructose, which leaves a sticky residue on the artifact (Gregory 2012:S142).

After bulking and consolidation, these wooden artifacts must be dried slowly and carefully. Failure to do so can lead to collapse, shrinkage, and distortion of the wood's shape, breakage, and salt precipitation on the surface. Drying options include controlled air-drying, vacuum and non-vacuum freeze drying, and solvent drying (Gregory et al 2012:S140-141). In the case of the waterfront artifacts, controlled air-drying is the most feasible, due to the availability and cost of freeze drying and solvent drying. Unfortunately, if drying occurs too quickly, cracking and shrinking of the wood can occur (Gregory 2012:S142).

Outcome

Wooden artifacts treated with PEG should be fairly stable. RH should be kept stable somewhere between 30% and 60%. Fluctuations in RH will cause damage to the wood, as high humidity can lead to fungal attacks and low humidity to cracking (Gregory et al 2012:S145). It is important to note that PEG is hygroscopic, meaning that it attracts and holds water; therefore, treated objects will be sensitive to high humidity in storage and display environments. It may also settle towards the bottom of an artifact, so surfaces should be checked regularly for any residue (Gregory et al 2012:S141). When closely monitored, there should be few issues with dimensional changes in the wood. Following treatment, some wooden artifacts may be suitable for display.

Leather

Treatment

The treatment of leather should begin with surface cleaning. Not only does this cleaning remove contaminants from the artifact, it also allows you to assess the condition of the leather. A thorough understanding of the leather's condition helps to guide the later conservation procedures. This may be done with soft brushes, water, and ultrasonic cleaners (Cameron et al 2006:246). Because of the fragile nature of wet leather, cleaning should be done carefully (Grieve 2007:723). Blunt objects, objects that apply concentrated force in one area, and sharp objects, such as scalpels, should be used with the utmost care to prevent damage to the leather. Chelation agents, such as ammonium citrate, can be used to remove stains from leather, though there is a risk of removing some of the tanning agents, if the leather is tanned with vegetable tanning agents (Grieve 2007; Mardikian et al 2004).

PEG has often been used to add bulk and flexibility to leather before drying (Hamilton 2000e). Any reshaping must be done carefully, as the risk of damage to the artifact is high, due to handling (Cameron et al. 2006:249). The bulk of the reshaping process should be undertaken while the artifact is wet, as flexibility is greater when the leather is wet than dry. Drying should be done slowly after bulking agents have been introduced to prevent collagen from cross-linking, which causes the leather to shrink and become stiff and hard (Cameron et al 2006:247-251; Cronyn 1990:272-274). Of the drying options available, controlled air-drying is again the most cost effective and accessible method. Freeze-drying produces better results, but requires access to special equipment. Good results can be achieved by slowly drying the leather artifact in a closed container. Weight should be applied to the object if there are concerns about changes in shape during drying.

Outcome

Depending on the level of soiling, it may not be possible to completely clean a leather artifact. Use of bulking agents during the conservation of leather artifacts will produce a product that is still fairly supple after drying. Support of leather artifacts during storage and display is recommended, regardless the artifact's stability (Canadian Conservation Institute 1992:2). Low light levels are preferred so that heating of the leather does not occur. RH should be kept stable around 50 to 60%, which will prevent the leather from drying out and cracking in low humidity or swelling in high humidity (Cronyn 1990:272). Fluctuations in RH should be avoided, as this will cause damage to the leather.

Textiles

Treatment

Wet textiles should be cleaned with soft brushes, sponges, and ultrasonic cleaners, if available. If, during cleaning, the textile is folded, it should be unfolded underwater. This lessens the stress on the fibers (Cronyn 1990:287-288). Gentle detergents, such as Triton-X non-ionic detergent, can be used to loosen stubborn dirt within a textile. If cleaning a woolen textile, care should be taken when using an ultrasonic cleaner or detergent. These two cleaning methods encourage felting of wool fibers, which causes irreversible changes; the textile is likely to shrink, and any surface detail will be obscured. Cleaning should not be done with abrasive or sharp materials, as this could damage fibers within the textile, which could cause it to fall apart. If metal staining is present, a low concentration bath in ammonium citrate or oxalic acid may help to remove the stain (Focht 2008:20). Care should be taken to avoid a long soak time, as these cleaning agents may damage or bleach a textile (Focht 2008:21).

Following cleaning, some textiles will require bulking and consolidation and reintroduction of flexibility. Low concentrations of PEG may be useful for this purpose (Focht 2008; Morris and Seifert 1978:38). There are several drying options available for the treatment of textiles. If available, freeze-drying would produce good results in terms of flexibility and fiber condition. However, due to availability and cost of materials and equipment, the two best options for drying waterfront textiles would be controlled air-drying or slow freeze drying in a freezer (Peacock 2005; Jakes and Mitchell 1992).

Outcome

Stability of textiles recovered from the waterfront depends on burial conditions and the outcome of conservation treatments. Support may be necessary to prevent damage to a textile from its own weight. Treatment with PEG or other lubricants or consolidants may cause discoloration and stiffness in the textiles, which may be undesirable (Jakes and Mitchell 1992:343). Careful packaging and handling help protect these artifacts during storage, by keeping out dirt, dust, and other agents of decay. Textiles on display should be kept out of direct sunlight and bright, direct artificial light, both of which can degrade the material. A stable RH of 50 to 65% helps maintain the dimensional stability of textiles and prevents fungal issues (Cronyn 1990:289-292).

Conclusions

Conservation should be accounted for at all stages of an archaeological investigation, especially when investigating additional features in an area now known to produce artifacts requiring conservation. Surveying the waterfront will provide a means to assess what features are present along Brunswick's waterfront, which inform estimates of the number of artifacts requiring conservation that will be recovered. Excavation provides confirmation for these ideas, as well as information about the preservation environment and the site itself. Conservation at this point involves careful packaging of artifacts for transportation to laboratory facilities.

After recovery, the condition of artifacts must be assessed. This allows the conservator to determine what artifacts can be conserved, and in what order this conservation should occur. In the case of artifacts from Brunswick's waterfront, glass and ceramics should be addressed first, then wood, leather, and textile artifacts.

A variety of treatments are available for the materials that have been encountered along the waterfront. Glass and ceramics will generally only require surface cleaning and slow drying to ensure preservation. Large wooden artifacts, such as the wharf timbers, should be documented and left *in situ*, while smaller wooden artifacts may be cleaned, impregnated with PEG and dried. Similarly, leather and textile artifacts can be carefully cleaned, impregnated with PEG, and dried. Some of the artifacts recovered will be able to be reassembled into a more complete whole. Many of these treatments do require some specialized training. The major obstacles to treatment are personnel, time, availability of some supplies, and work space.

Chapter 6: Conservation Case Studies

The treatment of a knit cap and two leather shoes provides a means to understand how conservation can be applied to archaeological projects (see Appendices A-C). While conservation concerns should be applied from the start of a project, this is not always the case. Therefore, the case studies start from the point where conservators are often consulted in an archaeological investigation: after an artifact that requires conservation is recovered. All artifact images in this chapter are courtesy of the North Carolina Department of Cultural Resources.

Artifact Selection

The case study artifacts were chosen based on several criteria: time since recovery, potential significance and completeness of the artifact, and the ability to complete treatment within a relatively short window of time (one semester, or about 15 weeks). The cap was assumed to be intact aside from holes, and had been in storage for the longest period of time, almost two years. Shoe #1 was mostly intact, but was missing the heel and had a hole in the toe. It had been in storage for approximately 18 months. Shoe #2 was of unknown completeness at the beginning of treatment, and had been in storage about 3 months. Other artifacts had been in storage longer than Shoe #2, but it was determined that this shoe could provide more information than many of the unidentified textile fragments. Complete accessories, such as hats and shoes, have been found elsewhere, but their presence in the archaeological record is rare relative to other artifacts (Babits and Brenckle 2008; Herold 1981; Henshall and Maxwell 1951). Therefore, all of these artifacts provided an opportunity to learn more about the everyday objects used by the residents of and visitors to Brunswick. Active treatment was not expected to take a long time, as the artifacts did not come from a marine environment, which would have required extensive desalination. Soaking in bulking agents and the drying process were assumed to be the steps that would take the longest.

Artifact Background

Brunswick Cap

Archaeological Background

The cap was recovered from Dry’s Wharf, on August 13, 2011. A small section of knit fabric was observed on the surface near the timbers of Dry’s Wharf during a check of the waterfront (Figure 12).

Figure 12. Brunswick Cap before recovery. The cap is just barely visible across the middle third of the photograph. The edge of the fold is just above the rocks in the bottom right corner.

McKee carefully excavated underneath the artifact, and determined that more than a small section of knit fabric was present. He then carefully washed the surface sediment off the cap at the edge of the Cape Fear River. It was at this point that it was determined to be a knit cap, and not another type of textile. The cap had been found folded in half, with the top of the cap almost touching the bottom edge of the cap.

The cap was taken back to the Visitor Center, where it was photographed and measured. It was then stored in tap water and placed in a refrigerator to prevent conditions that could cause further damage. In the fall of 2011, the cap was taken to the Underwater Archaeology Branch Laboratory, Kure Beach, NC. There, it was assessed by Nathan Henry, Conservator, and transported to the Queen Anne's Revenge (QAR) Conservation Laboratory in Greenville, NC. At the QAR Lab, it was stored damp in a refrigerator. In October 2011, Runying Chen of East Carolina University took fiber samples to assist in identifying the material of which the cap was made. She determined that the cap is made of wool (Runying Chen, personal communication, January 13, 2012). The cap was stored at the QAR Lab until September 2013, when it was loaned to East Carolina University for conservation as part of this thesis.

Historical Background

The cap is knit from a single-ply, 'Z'-twist yarn, with a gauge of approximately five stitches and 9 rows to the inch. Spinning fibers in a clockwise direction produces a 'Z'-twist yarn. There is considerable bunching at the top of the cap, with a button-like lump at the crown. It also appears to be seamed up the back, indicating that it was knit flat or cut from another garment and then joined, which is supported by the bunching at the top (Kirstie Buckland, Lawrence Babits 2013, personal communication). This seam appears to be crossed by a row of purl stitches. There is no evidence of a cast-on edge at the bottom of the cap, further confusing the matter.

At present, it is easier to say what the Brunswick Cap is not, rather than what it is. In some respects, it resembles the Monmouth Cap. Generally, these caps were described as "round, brown, and topped with a button", when described by anything more than a name (Buckland 1979:28). A surviving example of a Monmouth Cap was knitted in the round in stockinette stitch (knit stitches only) with a thick two-ply yarn. It has a doubled brim, and the cap's diameter was decreased above the brim by knitting stitches together. After the top of the cap had been drawn together, a button was fashioned on top. A loop was also added to the brim, and the whole cap was felted and shorn to increase its waterproof nature (Rutt 1987:58-59). By the mid 17th century, Monmouth caps had become part of sailor's slops, and had followed individuals to the American Colonies (Buckland 1979:28, 33). Two hats of this type have been found in recent years. The Kravic cap, recovered from New York Harbor, was originally tarred. This would have increased the waterproof nature of the cap. Another, untarred example of the Monmouth cap was recovered from the *H.M.S. Debraak*, which sunk in 1798 (Brenckle 2004:74).

Another type of cap worn in the 18th century was the thrum cap. These were knit with thrums, unspun bits of wool or loose woolen strands, secured in the stitches. This shaggy surface added warmth and water-repellent qualities to the cap (Brenckle 2004:74). A similar cap existed that was known as a Welsh wig, though this was likely a 19th century cap type. These hats, based on an example from St. Fagan's Folk Museum, had loops of wool down the nape of the neck for added warmth (Rutt 1987:59).

The Brunswick Cap is also not quite like the brimless Gunnister Cap. Though that cap lacks a brim, the cast on edge was turned under and sewn down. It also has a small loop on the top, formed by knitting a tube with the remaining crown stitches, and then tacked down on the top of the cap. This cap also has bits of unspun fiber knit into the fabric, which hides the stitches (Henshall and Maxwell 1951:37).

Shoes

Shoe #1: Archaeological Background

Initially observed on January 4, 2012, this shoe was found within a few feet of the extant cribs of Dry's Wharf. Only the very top edge of the leather upper was visible above the sediment immediately downstream of the wharf. At low tide on January 5, 2012, the shoe was recovered by Jim McKee (BT/FA Interpreter), Hannah P. Smith (BT/FA volunteer), and John Moseley (Fort Fisher State Historic Site) (Figure 13).

Figure 13. Shoe #1 immediately after recovery. The interior of the shoe is full of the same sediment that is supporting it in Jim McKee's hand. One strap of the shoe is tucked inside, and the other (not visible) is folded back along the heel quarter.

Initial excavation around the shoe revealed most of the leather upper, including the vamp and both quarters with straps, were intact. The heel of the shoe pointed towards the river, and the toe towards the hillside adjacent to the waterfront. The entire interior was full of sediment.

Once sufficient sediment had been removed around the shoe, McKee began excavating under the shoe. This was done because the condition of the sole, if present, was unknown. It was determined that retaining as much sediment as possible was best, as it was providing support for the shoe in situ. Photographs were taken as the shoe was being excavated (Figures 14-16).

Figure 14. Shoe #1 *in situ.*
Only the top edges of the shoe are visible.

Figure 15. Shoe #1 being uncovered.
Most of the heel is now visible, but the toe is not.

Figure 16. Shoe #1 with sediment after excavation. The hole in the toe area is visible, as is the strap that is folded back along the side of the heel quarter.

After excavation was completed, the shoe was taken up to the BT/FA Visitor Center, where initial cleaning occurred in order to fully document the shoe. A dental syringe and tap water were used to remove the surface sediment so that the full dimensions could be determined. It was at this point that it became apparent that the shoe was structurally stable. Once measurements were taken, the shoe was stored in a plastic box with tap water in the refrigerator in the BT/FA Maintenance Shop. This water was changed semi-regularly to help remove any sediment that was coming off the shoe as well as attempting to desalinate the leather. It was not until June 2013 that plans were made to actively conserve the shoe, as part of this thesis.

Shoe #2: Archaeological Background

This shoe was recovered from Dry's Wharf on the waterfront at BT/FA on July 30, 2013. It was approximately a foot from the timbers of the wharf's cribs in a layer of sediment full of pine tar and organic matter. Because of the density of the sediment surrounding the shoe, Jim

McKee excavated using a block lift technique. This ensured that as much of the shoe as possible was recovered with limited damage (Figure 17). After photographing, the shoe and its associated sediment were stored in a plastic box filled with water. This shoe was not refrigerated, as there was not enough room available in the refrigerator being used to store artifacts. An agreement was made with the North Carolina Office of State Archaeology to conserve this shoe at East Carolina University as part of this thesis.

Figure 17. Shoe #2 following recovery. Note that only the tip of the toe (left) and part of the upper (diagonal across center) is visible within the sediment.

Historical Background

Early in the 18th century, shoes were often made of leather with blocked (squared off) toes and square heels. The uppers covered the foot, and the tongue of the upper rose high in front of the ankle. The sides of the shoes were closed, and they were secured by straps that extended from the heel quarters, buckling in front of the tongue (Figure 18). The buckles were small, square or oblong, and made of a variety of metals such as silver, steel, and pinchbeck, which is a copper/zinc alloy resembling gold. Around the mid-1720s, buckles began increasing in size, becoming more statement pieces than before (Ribeiro 2002:30).

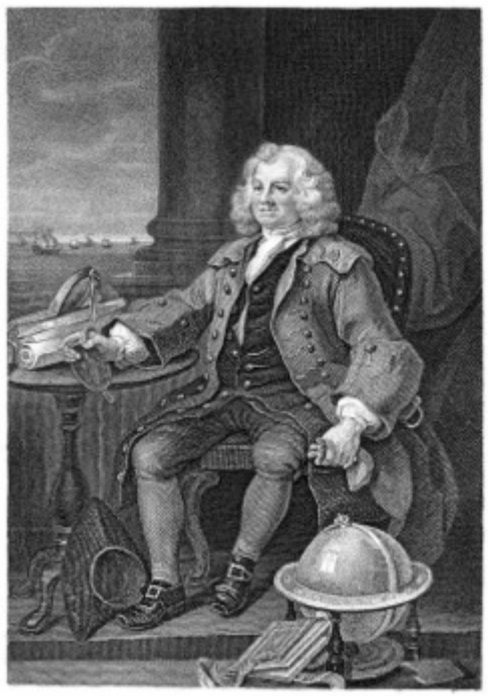

Figure 18: Hogarth's "Captain Thomas Coram." 1740. Note the appearance of the shoes. (Trusler 2013)

By the end of the 1720s, the blocked toes (See Figure 18) were being replaced by more rounded ones. This rounded shape was nearly universal by 1740 (Ribeiro 2002:30). Additionally, the wide squared toe began being replaced by a more pointed toe by the 1720s. At the same time, the height of the heel dropped to approximately one inch. Previously, even men's shoes had heels of several inches (Swann 1982:25). Pointed toes became common by 1780. At this same time, the straps for buckles became narrower (Brenckle 2004:105).

In addition to the style, the construction of a shoe is important. During the 18th century, shoemakers, called cordwainers, used vegetable tanned leather for shoes. The shoes were sewn with linen thread, and were constructed on a straight last. This straight last resulted in shoes that did not specify wear on the left or right foot (Brenckle 2004:104). As a result, shoes had to be broken in, and the left or right shoe would be specified through wear, rather than construction. Shoes could be made by turning or welting. Turned shoes were made of thin leather that was sewn together while inside out. After the shoe was completed, the last was removed, and the shoe turned right side out. Welted shoes were assembled right side out, with a thick rim of leather stitched to the bottom edge of the upper to increase flexibility and make the seam between upper and sole watertight (Brenckle 2004:105).

Comparative Treatments

Cap

Cleaning methods employed on the cap were based on recommendations in Cronyn's *Elements of Archaeological Conservation* (1990:287-288). The bulking and consolidation techniques employed on the cap were based on several previously treated textiles. The cap was treated with PEG in order to prevent structural collapse of the fiber during drying and provide lubrication of fibers (Jakes and Mitchell 1992:348). PEG concentrations were based on solutions used to treat a shot bag from the *Defence* (5% PEG and 1% Ethulose) and sailcloth from the *Queen Anne's Revenge* (5% PEG) (Focht 2008; Morris and Seifert 1978). Although both of these examples involved treatment of linen, a plant-based fiber, low concentrations are appropriate to use on the wool cap. Wool and other protein-based fibers are less susceptible to wear and abrasion than plant-based fiber (Robson and Ekarius 2011:8). As a result, the wool is less likely to need heavy consolidation. Additionally, wool is quite porous (Robson and Ekarius 2011:9). Therefore, it is likely that a reasonable amount of PEG was absorbed during immersion, and high concentrations of PEG would not be necessary to ensure absorption.

Drying procedures were based on experiments carried out by Jakes and Mitchell and Peacock (1992; 2005). Jakes and Mitchell determined that, at least in the case of plant-based fibers, air-drying causes some surface fiber tangling. Critical point drying and slow drying in a freezer produced good results, but vacuum-freeze drying caused changes in the appearance of the textile (Jakes and Mitchell 1992). Peacock notes that in the case of heavily degraded wool that was not treated with a lubricant or plasticizer, air drying produces a stiffer fabric than solvent or vacuum freeze drying, but that there was "no significant difference in the flexibility of the new or moderately degraded wool fabrics between the drying methods" (2005:504). Because access to critical point and freeze-drying equipment was not feasible, controlled air-drying was employed.

Shoes

Previous treatment methodologies also informed the treatment of these two shoes. Treatment of shoes from the *U.S.S. Monitor* employed an ultrasonic dental scaler to remove concretion from the leather (Grieve 2007). Because this tool could safely remove dense debris from leather, it could be assumed that it would effectively remove sediment without causing damage.

Ammonium citrate was used to remove iron staining from shoes from the *Monitor* and leather artifacts from the *H. L. Hunley*. These treatments were low concentration, 3% and 5%, respectively, but for a longer time period than employed on the shoes from Brunswick (Grieve

2007; Mardikian et al. 2004). Ammonium citrate will remove tanning agents from vegetable-tanned leather (Grieve 2007:726). Therefore, the soaking period was shortened to 24 hours for the Brunswick shoes because it was unlikely that there was much iron staining, and there was a desire to limit removal of tanning agents.

When leather is allowed to dry naturally without any added substances to preserve flexibility, the leather will shrink and become stiff and hard. PEG acts as a lubricant and humectant once the drying process has been completed (Cameron et al 2006:248). One early PEG treatment involved soaking shoe fragments from the *Defence* in a 10% PEG 1500 solution for six weeks at room temperature (Morris and Seifert 1978:34). More recently, a 30% PEG 400 solution was used on leather from the *U.S.S. Monitor* and the *H. L. Hunley* prior to freeze-drying. The *Monitor* shoes were immersed for 22 days; long periods of immersion are not required for adequate penetration. In other experiments, it was determined that solutions of less than 15% did not provide enough support for leather, but should not exceed 30% (Grieve 2007:736; Mardikian 2004:517). Because of the apparent good condition of the leather in the Brunswick Town shoes, as well as concerns about PEG migrating out of the leather due to humidity fluctuations, the decision was made to use the lowest concentration of PEG likely to produce good results. There were also concerns about making the leather dark and shiny if too high a concentration of PEG was employed.

In the case of many leather artifacts, freeze-drying is the preferred method. This drying technique was used on the shoe from the *Defence*, as well as artifacts from the *U.S.S. Monitor,* and *H. L. Hunley* (Grieve 2007; Mardikian 2004; Morris and Seifert 1978). However, due to time, travel, and financial constraints, the decision was made to air dry the two Brunswick Town shoes, despite potential risks, including loss of flexibility.

Because of the relatively intact condition of Shoe #1, reassembly options had to be considered. A shoe from the *Defence* was reassembled by bridging sections with tissue adhered with a 20% solution of Acryloid B-72, as well as restitching where possible (Morris and Seifert 1978). Reconstruction of a shoe from the *U.S.S. Monitor* employed a 15% AYAT solution to reattach the heel lifts to the shoe (Grieve 2007:737). AYAT is a polyvinyl acetate thermoplastic resin used as an adhesive for organics (Hamilton 2000f). But because each artifact is different, experiments were carried out to test adhesives and bridging materials for reconstruction of the Brunswick Town shoes, based on what was currently available in the conservation lab at East Carolina University. Decisions on the adhesive and bridging material were also based on the flexibility of the resulting joins, as portions of the joins needed to be able to flex for accurate reconstruction to occur.

Methodology and Outcomes

Cap

The cap first had to be partially rehydrated, as it had dried out considerably during its two years of storage at the *Queen Anne's Revenge* Conservation Lab (Figure 19 and 20).

Figure 19. Brunswick Cap before cleaning, side 1

Figure 20. Brunswick Cap before cleaning, side 2

Following rehydration, the cap was first cleaned using a Parkell TurboSensor ultrasonic dental scaler. This removed most of the surface sediment. Cleaning with the dental scaler was suspended when it became apparent that the technique was causing some felting of the wool. This tool was unable to remove an unknown substance that was caked onto part of the cap. Further cleaning was undertaken using alternating baths of Triton-X non-ionic detergent and rinse water. This cleaning was also suspended due to further felting of the fibers. Cleaning was stopped before felting obscured the stitches. The cleaning process reintroduced flexibility into the cap, but also revealed that there were more holes in the fabric than previously believed. Despite the presence of these holes, the cap is very structurally sound. It was then placed in a dilute ammonium citrate bath in order to remove possible iron staining, although this treatment seems to have had little effect. After rinsing, the cap went into a PEG solution to help bulk and support the fibers.

The cap was air dried in a closed container while stuffed with tissue paper as internal support. The bulk of the drying occurred within a week. Further cleaning was carried out using a vacuum to remove dried sediment and some roots. Other larger roots were carefully removed with tweezers. Not all of the roots or caked on substances were removed due to concerns about causing further damage. The decision was made to not patch the holes in the cap.

Following treatment, the cap had shrunk slightly, indicating that some felting had been unavoidable during cleaning. The knit fabric remains fairly flexible (Figures 21 and 22). Loss of flexibility was probably due to a combination of remaining sediment and the wool felting. This slight felting has added some stability to the fabric. In a revision of previous plans, the decision was made to not patch the holes in the cap. These repairs would change the overall character of the cap, and the cap is stable enough without them. Additionally, if the cap is displayed on a head form, the additional material may place strain on the rest of the cap.

Figure 21. Brunswick Cap, after treatment, seam visible

Figure 22. Brunswick Cap, after treatment, holes visible

Microscopic analysis provided insight into this artifact before and after treatment. Before cleaning, considerable grime was visible using both a Quanta 200 scanning electron microscope (SEM) and a Leica light microscope. The SEM images showed that there was some fiber collapse. This could be due to a cycle of wetting and drying, or slow hydrolysis of the fibers while the cap was buried (Cronyn 1990:286) (Figures 23 and 24).

Figure 23. Fiber at 35x magnification, before treatment.

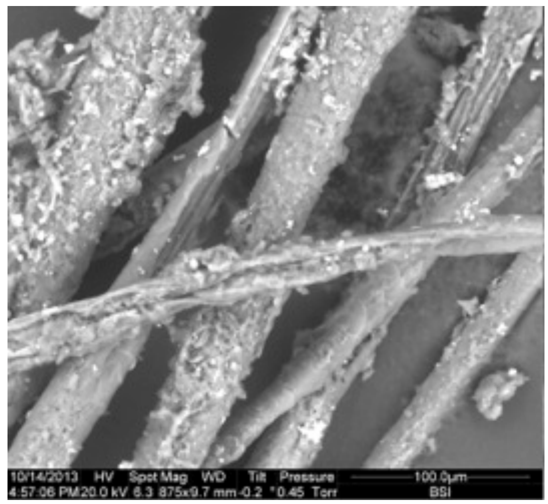

Figure 24. SEM fiber image at 875x magnification, before treatment.

After cleaning, it was possible to see that most of the surface grime had been removed (Figure 25). The fibers also had a slightly iridescent appearance, likely caused by the presence of PEG. Unfortunately, the SEM was not available to analyze these cleaned fibers to see if fiber collapse was present elsewhere in the cap.

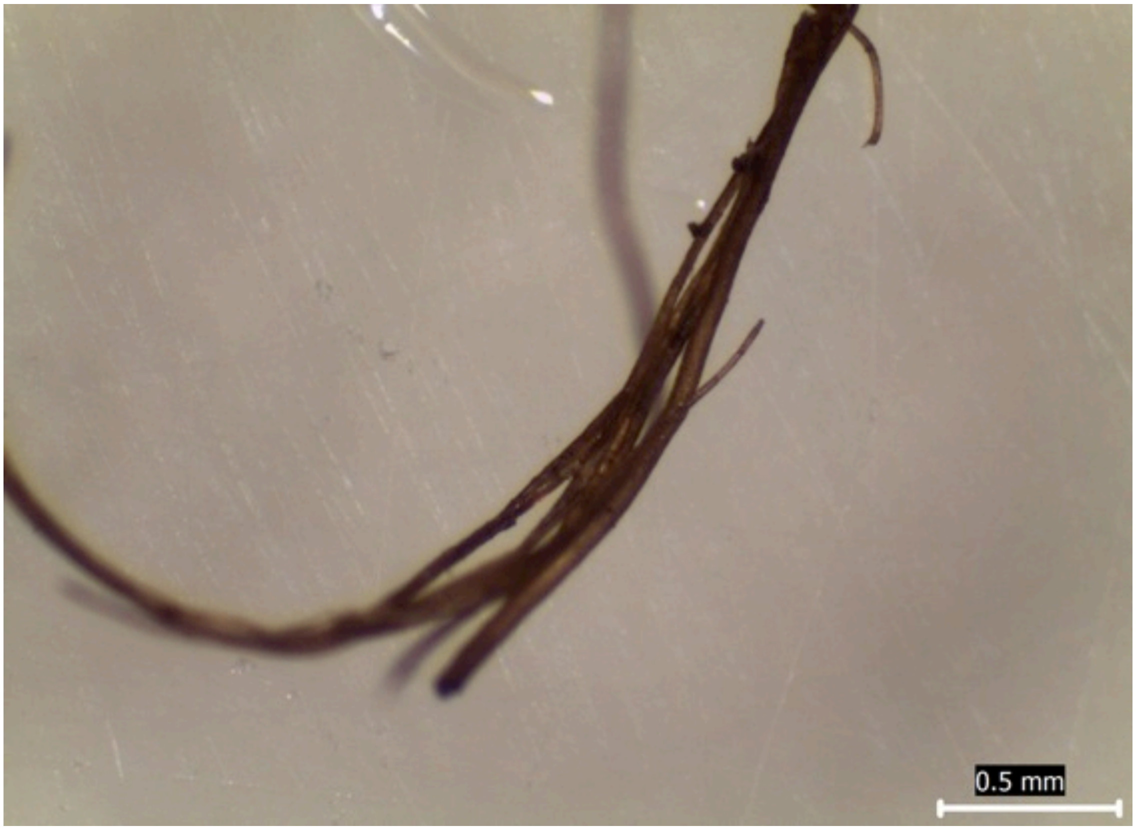

Figure 25. Fiber at 35x magnification, after cleaning.

When on display, it is recommended that the cap should be kept out of direct sunlight. It should also be kept out of bright, direct artificial light, which can also degrade the material. The cap should be kept at about 50 to 65% RH, though humidity fluctuations should be limited (Cronyn 1990:289-290).

Shoes

The two shoes were in considerably different shape before treatment began, although they underwent similar cleaning procedures (Figures 26-29).

Figure 26. View of Shoe #1 (top) before treatment. Note sediment inside.

Figure 27. View of Shoe #1 (sole) before treatment

Figure 28. Shoe #2 (top) before treatment. Only the toe (left) and some of the upper (diagonally across center) are visible.

Figure 29. Shoe #2 (side) before treatment. The toe is visible (left) as is the heel (right).

Both shoes were initially cleaned using an underwater vacuum to remove loose surface sediment. Thicker sediment and clay were removed using a variety of clay shaping tools. Thick tar-like material was removed from Shoe #2 using a scalpel, as other tools would not remove it. After the bulk of the sediment was removed, cleaning was continued with a Parkell TurboSonic ultrasonic dental scaler. This removed the dirt that was firmly attached to the leather, as well as some of the staining. Shoe #2 underwent a short bath in acetone in order to remove tar products. Possible iron and sulfur staining was removed by soaking the shoes in ammonium citrate. Shoe #1 reacted more with the ammonium citrate, with some of the tanning agents leaching out of the leather, turning the solution a dark brown color. Subsequent rinses also darkened. Shoe #2 did not react as much, as evidenced by the light color of the solution and rinse water. Both shoes were then soaked in PEG to bulk the leather before drying. Shoe #2 had to be re-cleaned after treatment with PEG after the outsole detached, revealing sediment that had been trapped between the insole and outsole. After re-cleaning, Shoe #2 was placed back in PEG.

Shoe #1 was placed inside an enclosed plastic container with Ethafoam and Volara supports inside the vamp to dry. After the bulk of drying had occurred, the supports were removed and the shoe was allowed to continue air-drying. After drying was complete, the heel quarters were reattached to the vamp and sole using goldbeater's skin, a product made from intestine, and Jade 403, an adhesive (Talas 2013). The goldbeater's skin was then inpainted to make the repairs blend in with the shoe leather. An Ethafoam support was fashioned to support the vamp during storage.

Shoe #2 was dried under weight in an enclosed container. After drying was complete, the remains of the upper were attached to the underside of the insole using Jade 403 adhesive. The insole, outsole, and heel were left detached from each other.

Attempts were made to assess part of Shoe #1 before treatment using a light microscope. Unfortunately, the wet condition of the leather made it difficult to make detailed observations of the leather (Figure 30). Samples from both shoes were observed using a light microscope in order to assess the condition of the leather after treatment.

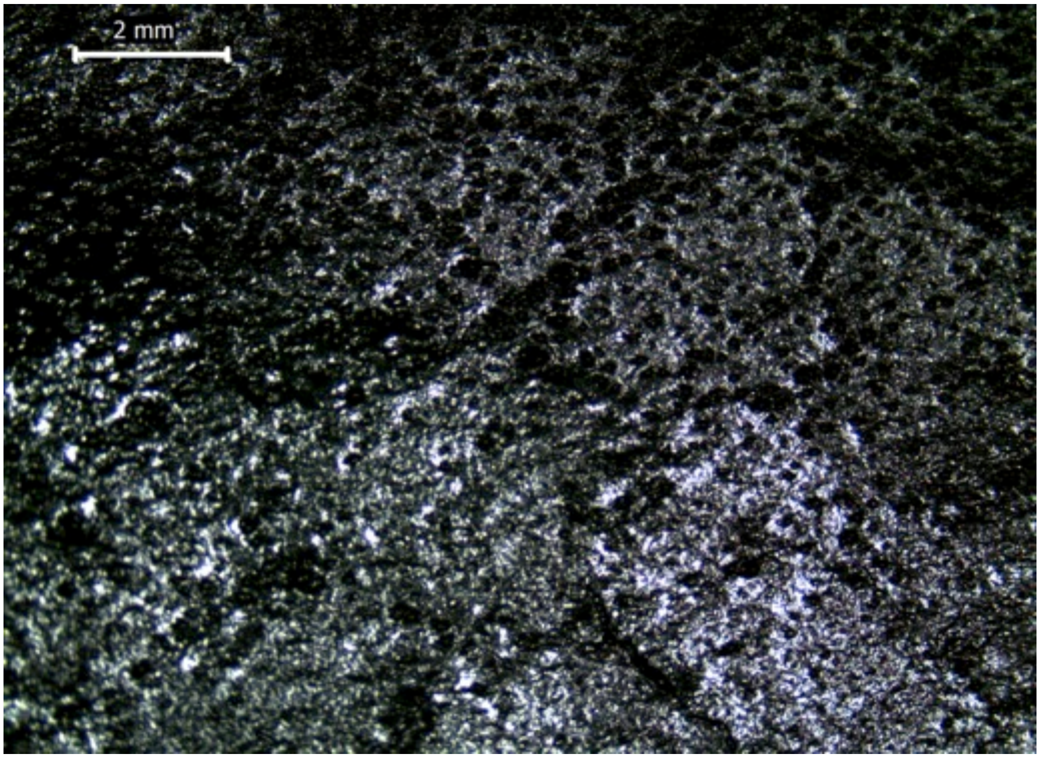

Figure 30. Shoe #1 during treatment, 8x magnification. The wet leather was too reflective for much detail to be visible under magnification.

Both shoes are stable. The leather in Shoe #1 is more flexible and in better shape than the leather of Shoe #2. Shoe #1 again resembles functional footwear (Figures 31 and 32). Reattachment of the heel quarters to the vamp using Jade 403 adhesive and goldbeater's skin resulted in a strong, flexible join. Inpainting with watercolor gouache does not detract from the overall appearance of the shoe. However, some twisting of the leather occurred during drying, causing the toe to curl upward slightly. This was partially corrected when the sole was reattached to the insole in the toe area. Careful weighting of the toe also helped bring this curve downward.

Figure 31. Shoe #1 (top) after drying. One join visible at top middle of photograph (inside shoe)

Figure 32. Shoe #1 (sole) after drying. Some staining remained.

Shoe #2 remains in a separated state (Figures 33 and 34). There were several fragments of leather found while cleaning the shoe that could not be identified and reattached. The insole, outsole, and heel were left separate. This will allow the shoe to be displayed in such a way as to generally show how these shoes were constructed.

Figure 33. Shoe #2 (top) during drying. Note the heel pegs.

Figure 34. Shoe #2 (sole) during drying. Note the heel pegs.

After drying, the leather appeared to be in fairly good shape when viewed with a light microscope. The edges of a tear in Shoe #1 had a fibrous appearance, but appeared stable (Figure 35). No additional cracks were apparent, following a visual inspection.

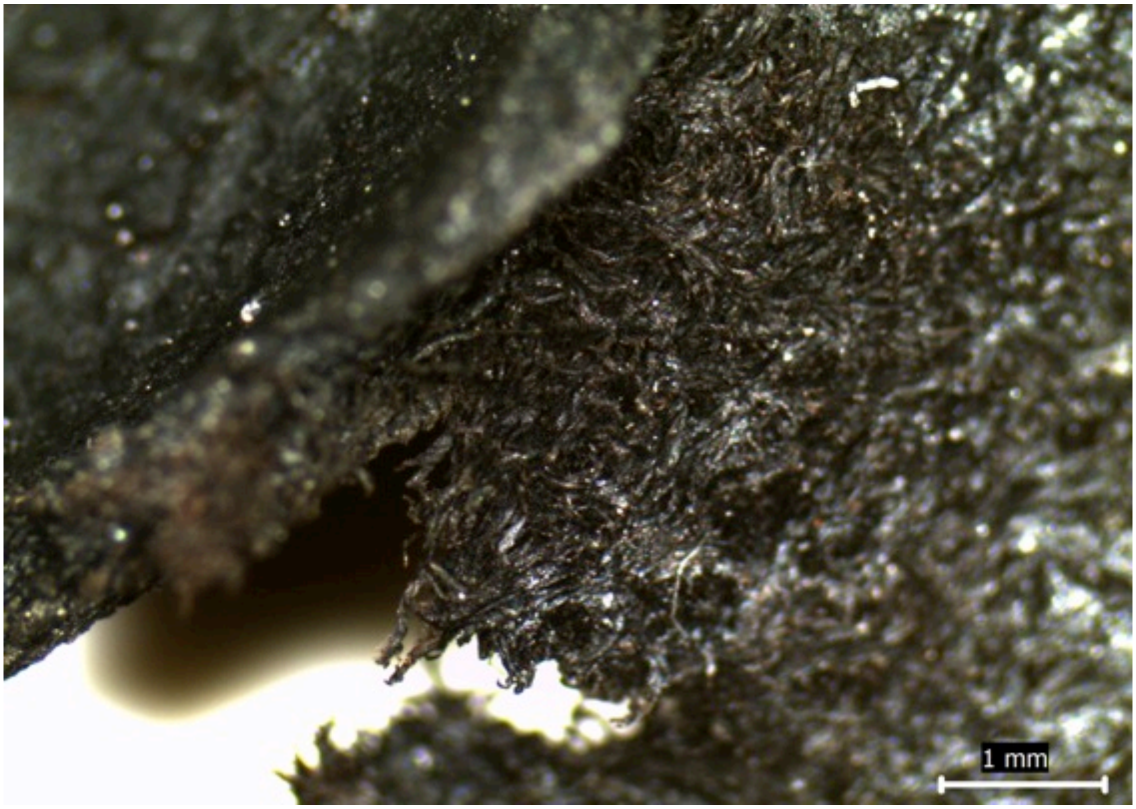

Figure 35. Shoe #1 torn area after drying. 16x magnification

Shoe #2 appeared less stable, as cracks were visible in the leather. These may have been caused by the tar (Figure 36). Microscopic analysis also revealed that the wooden pegs in the heel of Shoe #2 underwent minimal twisting and shrinking during the drying process (Figure 37). It was not possible to identify the animal source for the leather for either shoe.

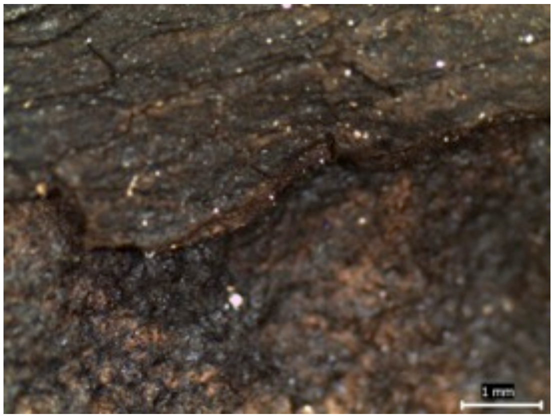

Figure 36. Grain side of Shoe #2
Note the cracking and delamination.

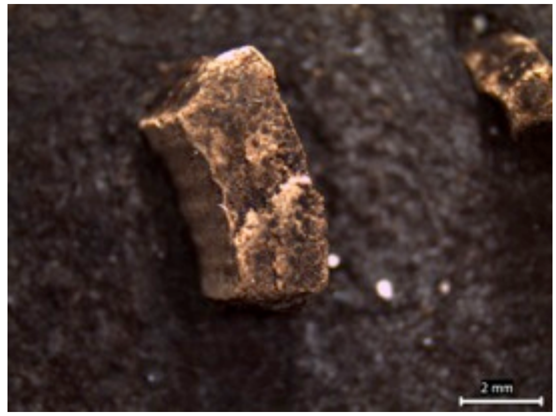

Figure 37. Wooden peg in Shoe #2
heel. Note that the wood has not twisted
much.

When on display, the shoes should be kept out of direct sunlight. Light levels in the display area should be kept low enough that they do not cause heating of the leather. RH should be kept around 50 to 60%, which will prevent the shoes from drying out and cracking (Cronyn 1990:272). Humidity fluctuations should be avoided to prevent the leather from swelling and drying, as well as to prevent the PEG from rising to the surface of the leather.

Conclusions

The conservation of the cap and shoes provided a means to test conservation techniques discussed in the conservation plan for the waterfront of Brunswick Town/Fort Anderson State Historic Site. After conservation, the cap and shoes were clean, stable, and ready to be prepared for display. These case studies also revealed that some conservation projects could be carried out in a relatively short period of time. About six to eight hours a week for approximately eight weeks was all that was required for active conservation for all three artifacts. Employing a 40-hour work week, each of these artifacts could have been completed more quickly. Impregnation with PEG and drying required an additional four to eight weeks, but did not involve considerable time commitments for the conservator. Most of the techniques employed were quickly learned, limiting the need for additional training. The largest obstacle to conservation of similar artifacts will be the availability of supplies and work space. However, the conservation of similar artifacts should be left to those with conservation training. This training is necessary to help one determine which treatments are best for the artifact and apply them in a way that will not cause further damage.

Chapter 7: Conclusions

Plans should be made for the conservation of artifacts as soon as the decision to undertake excavation is made. By planning for conservation from the start of the project, the time and cost involved in the conservation process are taken into account, allowing investigators to decide what should be conserved and how the process should be handled. Planning also allows investigators to be able to more efficiently handle any surprises that may arise during the course of an excavation. Even after the first wharf timber was exposed, it was a surprise to see just how much organic matter was preserved on Dry's Wharf.

Conservation Plan

Assessment and Possible Excavation

Both archaeology and conservation are constantly changing. As a result, the archaeological concerns discussed and methods proposed in this thesis represent some of the current options available in both fields. Detailed survey of the waterfront at BT/FA will help identify features that require study and possible excavation and conservation of artifacts recovered, just as it helped Paddenberg and Hession (2008) locate sites along the North Kent coast of England. Tidal flow will impact the ability of investigators to survey the waterfront, as some features are inundated during high tide. The marshy areas of the waterfront may pose some hazards to surveyors, as the mud is quite thick and sticky, and the tall marsh grass may hide features and hazards alike. Additionally, survey of the waterfront should include both the terrestrial and river portions of the site, like at Bath, NC, as some features extend from land into the river (Broadwater et al. 1979).

The continuing erosion of the marsh grass indicates that much of the waterfront at BT/FA is unstable. While the placement of marine mattresses and revetment along Battery A have helped to slow erosion along parts of the waterfront, it has sped up the process elsewhere. While a discussion of the best methods to preserve the waterfront's sediments and marsh grass is beyond the scope of this thesis, these rapid changes underscore the need for plans to address stabilizing this area and recovering as much data as possible before it disappears. It also underscores the value of having a conservation plan in place so that artifacts exposed by erosion can be properly treated and analyzed.

Excavations in Charleston, as part of the Vendue/Prioleau Project (Joseph et al. 2000) and at the Exchange Building (Herold 1981), provide insight into the methods that may be the most useful for the investigation of the waterfront. Along with the artifacts recovered to date from Dry's and Moore's Wharves, these studies also provide insight into the artifacts likely to be found along the waterfront at BT/FA. Construction and shipping materials are likely to be found in high quantities along the waterfront, but large quantities of glass, ceramics, and other organic artifacts are also likely to be present in Brunswick's Commercial District. Trench excavations may allow erosion to be limited because all the surface sediment is not removed, and also allows the stratigraphy of the waterfront to be studied. If the trenches were placed above the high water mark, associated buildings would be the feature most likely to be encountered. There would be fewer issues with flooding above the high water mark as well. Any trenches below the high water mark would require placement of a dam or other water diverting structure. Otherwise, the trenches would fill with water, creating a working hazard and damaging the archaeological evidence on the site.

The excavation methods employed while investigating the area around the Millennium Footbridge in London (Hughes and Seaman 2004) had to account for conditions likely to be encountered while working along BT/FA's waterfront. Loose sediment and working at or below the water table makes excavations difficult and sometimes dangerous, as there is a risk of trench and unit walls collapsing. The tidal flow of the river would need to be held back so that excavations could use most of the workday, and be protected from the river.

Background on the Wharves

The first wharf to begin eroding from the banks of the Cape Fear is believed to have belonged to William Dry II, one of the leading merchants in Brunswick. Based on when Dry lived in Brunswick, along with pipe stem and mean ceramic dates, the wharf was likely in use sometime around 1740 to 1765 (McKee and Smith 2012). Because of the amount of erosion that has occurred, this is also the wharf that we know the most about. Constructed using a crib or crib-cobb technique, the wharf was built of timbers approximately one foot in diameter.

Another wharf on the waterfront is believed to have belonged to Roger Moore, owner of Orton Plantation (Brunswick County Deeds). Based on Moore's arrival in Brunswick, this wharf is believed to date to 1730 to 1755. The number of artifacts recovered from this wharf has not yet reached sufficient numbers to generate a reliable mean ceramic date.

The wharves we know the least about appear to be located in Brunswick's Commercial District. These wharves are not yet well documented. More information will become available as the shoreline erodes, or the area is excavated.

Artifact Triage and Treatment

A careful assessment of the condition of artifacts recovered will be required to decide what treatments would be best for a given artifact. In some cases, this would only require careful visual analysis, but other artifacts would require some surface cleaning before assessment. Each artifact must be assessed individually. Shared characteristics will provide the basic course of action to be taken on a group of artifacts, though no two artifacts will behave in exactly the same way.

Based on the condition of artifacts that have been recovered from Dry's Wharf, the treatment order should be glass and ceramics, wood, leather, and textiles, if all materials are recovered at the same time during an excavation. This treatment order is based on the time involved, as well as the supplies and training required to carry out the treatment. Glass and ceramics need some cleaning and careful drying, which does not require a lot of time from the conservator. Coarse ceramics may require some soaking to remove salts before drying. This portion of the Cape Fear is slightly brackish, due to its proximity to the Atlantic Ocean. Wooden wharf timbers should be carefully documented and preserved *in situ* or reburied with monitoring to ensure that the timbers are preserved as well as possible. Excavation and conservation in a laboratory setting will not provide any additional information that documentation cannot already provide. Smaller wooden artifacts can be cleaned, bulked with PEG, and slow dried. The bulking and drying processes require considerable time to allow sufficient penetration by PEG and to prevent the wood from warping and twisting. Leather should be treated the same way as wooden artifacts, though cleaning methods, PEG concentrations, and drying time will be different. Drying should occur with support or weights to maintain the proper shape of the leather artifact. This process takes less time than the same process with most wooden artifacts, which allows leather to be treated more quickly. Textiles should follow the same procedure as wood and leather, though care must be taken during cleaning to avoid felting or further damage to the textile fibers. In some cases, PEG may not be necessary for textile treatment, although the additional flexibility it imparts is probably preferred for the long-term stability of the artifact. Drying is likely to be very quick with textiles, though wool textiles may undergo dimensional changes.

The treatment options suggested are based on the availability of the supplies needed, the cost of treatment, and the time and hazards involved for the conservator. Much of the cleaning can be carried out with water, brushes of various kinds, and dental tools that can be easily acquired. Other aspects of the treatment, including specialized equipment such as ultrasonic dental scalers or ultrasonic baths, as well as the chemicals needed to clean and stabilize the artifacts can quickly become expensive. Treatment with PEG is considered reliable and low cost, though even this is relative. A one-liter bottle of PEG 400 alone costs $158.50 (Fisher Scientific 2014). Treatment of the cap used 216 mL, or about $34 of PEG 400. Compared to treatments such as acetone-rosin, alcohol-ether, and camphor-alcohol for wood, for example, PEG is relatively safe. PEG does not have the flammability issues that these other methods have (Hamilton 2000a). An emphasis is placed on air-drying for artifacts recovered from BT/FA due to the cost and availability of freeze-drying and other drying methods.

Over time, the ‘best’ option for artifacts recovered from the waterfront at Brunswick and similar sites is likely to change. New treatment options are being developed on a regular basis, and others are falling out of favor. For example, silicone oil is a new treatment that has be developed for the treatment of leather, textiles, and wood (Hamilton 2000a, 2000d, 2000e). Treatment of wood with alum, first used in 1859, has fallen out of favor and has been replaced by PEG as the standard treatment (Watkins-Kenney 2013:2; Christensen et al. 2012:S184). As the cost and availability of supplies for treatment rise and fall, the techniques embraced by conservators will change.

Treatment Order and Likely Outcomes

Based on the artifacts recovered along the waterfront to date, a general treatment order can be recommended. This order is based on the time and resources required for proper treatment. Glass and ceramics can be treated first, as most of these artifacts only require careful cleaning and drying to be stable in most environments (Cronyn 1990:159). Wood treatment can occur next. The large wooden artifacts, including wharf timbers, may be best preserved if left *in situ* and monitored to determine what, if any, deterioration is occurring (Gregory 1998). Smaller wooden artifacts may be excavated, cleaned, and bulked with PEG. Freeze-drying would be best, though good results can be achieved through controlled air-drying. Following drying, these wooden artifacts will be most stable if kept in an environment with a RH of 30% to 60%. Higher humidity may cause mold growth, and fluctuations in temperature and humidity can cause the wood to crack and warp (Gregory et al 2012:S145). Treatment of textiles may occur next. A gentle cleaning with soft brushes, ultrasonic cleaners, and some detergents can remove sediment. Following stain removal and bulking, textiles are stable, if somewhat fragile (Peacock 2005; Jakes and Mitchell 1992). Air-drying may be the most cost effective option, as damage is possible with any drying method. Storage conditions are best between 50% and 65% RH. As with wood, fluctuations should be avoided (Cronyn 1990:289-292). The treatment of leather artifacts may be done last. It is not that they are the least important. Rather, their treatment may be the longest, as cleaning must be done with care, and bulking is necessary to prevent the leather from drying and cracking. As with wood and textiles, PEG can be used as a bulking agent (Cameron et al. 2006). Freeze drying is good for leather, but again, air-drying is a cost-effective alternative, if done under controlled conditions (Cameron et al 2006:247-251; Cronyn 1990:272-274).

Case Studies

Brunswick Cap

Treatment of the cap has resulted in a stable artifact ready for display and study. Cleaning with an ultrasonic dental scaler and Triton-X non-ionic detergent removed a majority of the sediment that had soiled the cap during burial. However, not all of the substances on the cap could be removed, as this process could have caused additional damage to the cap. Surface fibers were already showing evidence of felting during the cleaning process. Proper cleaning helps prevent sediments from abrading the fibers (Cronyn 1990:288). Treatment with ammonium citrate does not seem to have removed many contaminants from the cap, based on the color of the solution and rinse water. This cleaning process was kept to a minimum to avoid causing additional damage to the cap.

Some flexibility was reintroduced to the fibers of the cap by immersing the artifact in PEG. This treatment was based on treatments of linen with PEG (Focht 2008; Morris and Seifert 1978). While the cap is a wool textile, not linen, this treatment has produced satisfactory results. Solvent drying without the addition of humectants or consolidants was considered for the cap, but it was decided that this drying method could have rendered the cap stiff and inflexible, and therefore more fragile. Based on previous experiments, no difference was found between drying methods when humectants are used on textiles (Peacock 2005:504). Because of the need for no specialized equipment, air-drying was chosen to dry the cap.

Although the holes in the cap were not patched, the material seems stable. Low light and humidity levels will help preserve this cap for future study. It is safe to handle this artifact during study, though care should be taken to not place excessive stress on the fabric. Rolling and unrolling the brim of the cap should be kept to a minimum. It should be possible to display the cap either flat or on a head form. Excluding the cost of tools such the ultrasonic dental scaler, solution testing equipment, electricity, and water, conserving the cap cost almost $100 in chemicals. Total active conservation time was about 12 hours, spread out over a 12 week period. An entire month of that time was dedicated to soaking the cap in PEG to provide support for the fibers, and the subsequent drying of the cap.

Shoes

The treatment of the two shoes illustrates how two artifacts from the same environment can be quite different. Found within a few feet of each other, one shoe was nearly complete, while the other lacked most of the upper but had a complete sole. The leather of Shoe #2 was cracked, while the leather of Shoe #1 was surprisingly supple and undamaged. Their treatment also reflects how variations in response to a given treatment can vary between artifacts. Mechanical and chemical cleaning was more effective on Shoe #1 than Shoe #2, as substances were trapped in the cracks of Shoe #2's leather. It is likely that the tar that coated Shoe #2 also affected the ability of the ammonium citrate solution to penetrate the leather and remove contaminants.

Bulking and drying of the two shoes had different results. While it is difficult to assess how much PEG was absorbed by the two shoes, the flexibility of the leather provides an indicator. Shoe #1 was much more flexible than Shoe #2 after immersion in PEG. Though dried in the same way, Shoe #2 is stiffer than Shoe #1. This may be due to the amount of PEG that was able to penetrate the leather, as well as its overall condition prior to treatment.

Because of the different condition of the two shoes, different plans were developed for reconstruction. Shoe #1 was in much better shape, so it was decided to make it resemble the original as closely as possible without adding to the existing shoe. The heel quarters and parts of the sole were reattached with goldbeater's skin and Jade 403 adhesive, resulting in joins that are not very obvious to an observer. A form was made for the interior of the shoe to keep the upper from collapsing over time. Shoe #2 was partially reconstructed. While the upper was reattached to the insole, the outsole and heel were left detached so that the shoe could be used to show some aspects of the construction employed for this type of footwear.

Both shoes are stable following conservation. Limiting temperature and humidity fluctuations will help keep the shoes stable for display and study. Both shoes can be handled with care. The straps on Shoe #1 are flexible enough to be moved, but should not be moved too often, in order to prevent the leather from cracking. When handling Shoe #2, one must remember that the large components of the shoe are not attached. Therefore, the entire shoe should be supported from below when lifting. If individual components are being lifted, they should be lifted with both hands to avoid stress on one part of the leather.

Final Conclusions and Future Research

The Likelihood of Finding Similar Sites

It is highly likely that similar sites will be found, both at other sites along coastlines around the United States and at BT/FA. The plantation wharves in Virginia, North Carolina, and South Carolina studied by Hicks (2012) indicates that the remains of waterfront structures is likely to be found associated with farms that were established before road travel became the fastest means of transport. The fact that these wharves existed in a form that could be studied also shows that these wharf timbers can survive the conditions present in rivers in the Southeastern United States. Further surveys of the Cape Fear River would likely relocate wharves and other waterfront sites that have been previously located, as well as locating additional sites that had not been previously detected. In other cases, wharves will be found buried in fill where land was reclaimed, as in Charleston (Joseph et al. 2000).

It is also likely that artifacts will be found in association with wharf structures, either as part of their fill or as objects that were lost or discarded near the river. Based on artifacts and features from excavations in Charleston (Joseph et al. 2000; Herold 1981), surveys along the North Kent Coast (Paddenberg and Hession 2008), and artifacts recovered from BT/FA, it is also likely that organic artifacts will survive in some form in these waterlogged coastal environments. These artifacts will need conservation in order to be able to be studied.

Future Research Along the Waterfront

Part of the research that remains ongoing at BT/FA is the location and documentation of additional wharves. Additional features will probably be exposed as erosion along the Cape Fear River continues. Between Moore’s and Dry’s Wharves, pilings are visible at low tide. Though these are believed to be of a later date than the colonial wharves on the site, what time period they correspond to is as yet unknown. Along the waterfront between Moore's Wharf and Russellborough to the north, and south of Dry's Wharf, timbers have been found. Whether they are waterfront features or simply debris deposited by the river is unclear. Further survey is necessary to determine what these collections of timbers are, as well as what other features exist. Careful documentation of these waterfront features is necessary so that their place in the history of Brunswick and the rest of the Cape Fear can be determined. Documentation will also preserve data about these structures, even if the decision to not excavate them is made. Artifacts recovered from the waterfront should also undergo further study. This would help provide possible dates for the construction and use of the wharves and other waterfront features.

The second part of ongoing research regarding the waterfront includes further testing and modification of the conservation plan proposed in this thesis. However, before any additional treatment can be carried out, space for the process, as well as conservators willing to take on the treatment of these artifacts must be located. Funding to pay for the supplies would also have to be secured. As the example of the cap shows, the material costs alone add up quickly. Only a few of the over two-dozen organic artifacts recovered from Dry's Wharf have been conserved to date. While the treatments carried out on the Brunswick Cap and shoes resulted in stable artifacts, there are other treatment options available for all the materials recovered. Testing other methods would help determine if a given treatment produces results that are more or less desirable than the treatments already used. Additional testing would also help determine how quickly artifacts can be treated and what the overall cost of the process would be, in terms of both time and money. Further research into the history of the cap and shoes will also assist with dating Dry's Wharf. As additional artifacts are recovered and treated on a limited basis, more information will be available to archaeologists and conservators should excavations be undertaken along the waterfront.

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Appendix A: Conservation Report for the Brunswick Cap

East Carolina Conservation Laboratory
Treatment Report

Internal Number: ECCL.2013.020.0001	**External Number:** CFR0053.005
Object Title: Brunswick Cap	
Object Dimensions: 8 7/8in L x 8 1/2in D (before treatment); 8 ¼ in L x 8 in D (after treatment)	
Date Received: 09/10/13	**Date Completed: 02/04/14**
Requestor: NC Department of Cultural Resources	**Conservator: Hannah P. Smith**

Object BT Description (attach sketches and photographs separately):
The Brunswick Cap is knit from a single ply yarn. The cap is knit with a gauge of approximately 5 stitches to the inch. The number of rows per inch could not be determined before cleaning. There are several holes on one side of the cap, approximately halfway between the "button" on the top and the bottom edge. There is a fold mark where the cap has been folded top to brim during burial.

Object BT Condition (note corrosion, deterioration, stability, wear):
While the majority of the loose surface sediment has been removed from the cap, there is considerable sediment stuck in the fibers, obscuring construction details. There are sections of the cap that are very stiff due to the sediment that is stuck in the fibers. Some sections appear fuzzy, due to damage caused by burial or weathering. The holes in the fabric appear stable and unlikely to continue unraveling. There is a considerable amount of root penetration of the fabric, but no evidence of iron staining.

Test/Analysis (i.e.: pH, material type):
Runying Chen identified the cap as wool when she analyzed the cap in November 2012. This identification was confirmed in October 2013 through the use of a scanning electron microscope. Light microscopy indicated significant deposits of sediment on the fibers before cleaning. Further observations after cleaning revealed that the majority of the sediment had been removed. Before and during cleaning, the Cap was monitored with a Hanna Instruments pH/EC/TDS meter. This allowed the pH of the storage solution (tap or distilled water) to be monitored, as well as track the presence of contaminants in the storage solution, and therefore the cap.

Treatment (note date and details):
After transport to ECCL from the QAR Lab, the Cap was assessed and placed in a container to rehydrate. The Cap had partially dried out during the two years of storage at the QAR Lab.
On 09/17/13, 10/16/13, and 10/27/13, the cap was cleaned with an ultrasonic dental scaler. Each surface was cleaned, the cap flipped over, and the cleaning process repeated. The inside of the cap had to be cleaned by touch, rather than sight. Therefore, the cleaning of the interior was less successful than the outside surfaces. This process was suspended when the surface began felting.

The cap was then cleaned with alternating baths of Triton-X non-ionic detergent and rinse water. The process was repeated 4 times. Again, cleaning was suspended when the surface began felting. The cap was placed in a 3% ammonium citrate solution on 10/29/13 and removed on 10/30/13. This treatment was used to remove possible metal contaminants from the burial environment. The cap was then rinsed in distilled and tap water to neutralize the ammonium citrate. The cap was placed into a 6% (v/v) aq PEG 400 solution on 11/05/13. It was removed from PEG on 11/20/13, stuffed with tissue, and placed in a covered container to air dry. It was moved to a covered fish tank in order to allow the cap to be placed upright and dry evenly. By 11/24/13, the cap was dry enough to allow for surface vacuuming and the removal of some roots with tweezers. Not all of the roots or surface sediment could be removed during conservation. The decision to leave some stubborn sediment (possibly tar?) and roots in place resulted from concerns about causing further damage to the cap. A final vacuuming and documentation was carried out on 01/21/14. The cap was stuffed and wrapped with tissue and placed in a cardboard box for storage until transportation to either Brunswick Town/Fort Anderson State Historic Site or the Office of State Archaeology in Raleigh occurs.
Exhibition/Storage Suggestions (i.e.: light levels, humidity): The cap is stable enough to be displayed stuffed or on a small head form. Long-term storage should keep the cap partially stuffed and adequately supported to avoid putting too much stress on the knitted fabric. When on display, the cap should be kept out of direct sunlight. It should also be kept out of bright, direct artificial light, which can also degrade the material. The cap should be kept at about 50 to 65% RH, though humidity fluctuations should be limited.

Appendix B: Conservation Report for Shoe #1

East Carolina Conservation Laboratory
Treatment Report

Internal Number: ECCL.2013.020.0002	**External Number:** BTWF catalogue number 234
Object Title: Shoe #1	
Object Dimensions: 10 ½ in L x 4 ½ in W x 3 ¼ in T (before treatment); 10 5/16 in L x 4 in W x 3 ¾ in H	
Date Received: 08/22/13	**Date Completed: 02/04/14**
Requestor: Office of State Archaeology **NC Department of Cultural Resources**	**Conservator: Hannah P. Smith**
Object BT Description (attach sketches and photographs separately): Leather shoe with hole alongside one side of the toe. Both heel quarters with straps are intact. Considerable sediment within the shoe and some sediment stuck to the bottom of the shoe, but most sediment had already been removed from the top of the shoe. It was unclear whether or not there was a heel originally associated with the shoe.	
Object BT Condition (note corrosion, deterioration, stability, wear): The leather at the top of the heel quarters was beginning to delaminate. At least one of the heel quarters had detached from the sole prior to cleaning. There may be further damage to the shoe due to pressure from the sediment. The leather is a very dark color, and there is no evidence of metal staining. The leather is somewhat flexible, but also stiff.	
Test/Analysis (i.e.: pH, material type): Solution testing with a Hanna Instruments pH/EC/TDS meter was carried out to asses the presence of salts and other contaminants in the leather throughout the cleaning process. Experiments with modern leather were carried out to determine which adhesive and bridging material were the most appropriate for repairing the shoe. Tested Jade 403, Lascaux 498, and AYAF (Bakelite series) adhesives, and Reemay, Japanese tissue, and goldbeater's skin as bridging materials. A portion of a heel quarter was viewed with a light microscope during treatment, but too much detail was obscured to allow an assessment of the material. After treatment and drying, the leather was again assessed with a light microscope to determine the leather's condition.	
Treatment (note date and details): Beginning on 08/27/13, the sediment within the shoe was removed with an underwater vacuum, as well as clay shaping tools, a dental mirror (to see into the toe box), and a dental syringe. On 09/13/13, after the majority of sediment was removed, further surface cleaning was carried out using an ultrasonic dental scaler. This removed sediment that had become ground into the surface of the leather. On 09/19/13, the shoe was placed in a 5% (w/v) solution of ammonium	

citrate in tap water to removed possible metal contaminants present in the leather. It was kept in this solution for 24 hours, and then rinsed in distilled water until 09/25/13, when it was placed in a 15% (v/v) solution of PEG 400 in distilled water. The shoe was kept in PEG for 3 weeks, with a weight taken on 10/10/13 to determine how much PEG had been absorbed. The shoe was removed from PEG on 10/15/13, and blotted dry with Kimwipes, before being supported from inside with Ethafoam and Volara. Additionally, the shoe was bound with plumber's tape to keep the leather from deforming during the drying process. The shoe was dried in a plastic box with the lid on. The lid was propped open to allow more airflow on 10/22/13, and the supports were removed on 10/27/13. Weights were taken throughout drying to monitor the process. Due to seasonal changed, moisture had to be reintroduced into the leather by placing the shoe in a closed box with water to ensure flexibility for repair. All repairs were made with Jade 403 and goldbeater's skin. The heel seam for the heel quarters was bridged on 11/19/13, and the separated sole partially reattached with Jade 403. Area being reattached was weighted with sandbags to ensure surface contact. The heel quarters were reattached by first attaching them to the edge of the vamp, and then to the insoles. Support was provided with sandbags during the drying process. On 01/16/14, loose edges of the goldbeater's skin at the vamp-heel quarter bridge were tacked down, and the sole reattached at the tip of the toe using Jade 403 and clothespins separated from the leather with Mylar. The goldbeater's skin was inpainted with Reeves gouache on 01/23/14 to make the repair less obvious. On 02/04/14, a support was fashioned for the vamp using Ethafoam. The finished support was covered with brown muslin to help make it less noticeable when the shoe is viewed.
Exhibition/Storage Suggestions (i.e.: light levels, humidity): When on display, the shoe should be kept out of direct sunlight. Light levels in the display area should be kept low enough that they do not cause heating of the leather. Relative humidity should be kept around 50 to 60%, which will prevent the shoe from drying out and cracking. Humidity fluctuations should be avoided to prevent the leather from swelling and drying, as well as to prevent the PEG from rising to the surface of the leather.

Appendix C: Conservation Report for Shoe #2

East Carolina Conservation Laboratory
Treatment Report

Internal Number: ECCL.2013.020.0003	**External Number:** BTWF catalogue number 1259
Object Title: Shoe #2	
Object Dimensions: 9 5/8 in L x 4 5/8 in W x 2 5/8 in H (before treatment); 9 ¾ in L x 3 7/8 in W x 1 7/8 in H (after treatment)	
Date Received: 09/10/13	**Date Completed: 01/21/14**
Requestor: Office of State Archaeology NC Department of Cultural Resources	**Conservator: Hannah P. Smith**
Object BT Description (attach sketches and photographs separately): The majority of the shoe is obscured by sediment. Heel lifts are present, but detached. It is not possible to determine how much of the upper is intact. Both the toe and heel ends of the shoe curve up slightly.	
Object BT Condition (note corrosion, deterioration, stability, wear): Most of the shoe is obscured by sediment. As a result, it is difficult to determine what condition the shoe is in. The leather, where visible, is severely delaminated. There is a considerable amount of tar and petrochemicals that have penetrated the leather – the shoe stinks.	
Test/Analysis (i.e.: pH, material type): Solution testing with a Hanna Instruments pH/EC/TDS meter was carried out to asses the presence of salts and other contaminants in the leather throughout the cleaning process. In order to remove the tar on the leather, acetone, white spirits, and denatured alcohol were tested as solvents. Experiments with modern leather were carried out to determine which adhesive was most appropriate for repairing the shoe. Tested Jade 403, Lascaux 498, and AYAF (Bakelite series) adhesives. After treatment and drying, fragments of the shoe were assessed with a light microscope to determine the leather's condition.	
Treatment (note date and details): Beginning on 09/24/13, the sediment within the shoe was removed with an underwater vacuum, as well as clay shaping tools. Because the sediment was so thick, the vacuum repeatedly clogged, and was abandoned as a cleaning tool. The clay tools removed some of the sediment, but a scalpel was required to remove the bulk of it. The tar in the sediment made it difficult to remove any other way. On 10/02/13, after the majority of sediment was removed, further surface	

cleaning was carried out using an ultrasonic dental scaler. This removed the remaining sediment and revealed that the leather was badly cracked and soaked with tar. The shoe was placed in a 17.6% (v/v) solution of acetone in tap water for approximately 3 hours, in order to remove more of the tar. This treatment was followed by further cleaning with a dental scaler on 10/22/13, and then placed into a 5% (w/v) solution of ammonium citrate in tap water to remove possible metal contaminants present in the leather. It was kept in this solution for 24 hours, and then rinsed in distilled water until 10/27/13, when it was placed in a 15% (v/v) solution of PEG 400 in distilled water. The shoe was kept in PEG for 3 weeks, with a weight taken on 10/30/13 and 11/05/13 to determine how much PEG had been absorbed. The shoe was removed from PEG on 11/14/13, when the sole detached and additional sediment found on these interior surfaces. It was cleaned again on 11/15/13 with the dental scaler and placed back in PEG. It was finally removed from PEG on 11/20/13 to dry. The surface was blotted dry with Kimwipes, and it was dried in a closed container. During drying, the shoe was weighted with sandbags to prevent the leather from curling. After several days of drying separately, the heel was put back in place to ensure that the soles and heel fit together correctly after drying. The lid was propped open on 11/24/13 to allow more airflow for drying. Weights were taken throughout drying to monitor the process. Due to seasonal changed, moisture had to be reintroduced into the leather by placing the shoe in a closed box with water to ensure flexibility for repair. On 1/16/14, final repairs were made to the shoe. Because of the separation of the components of the shoe during conservation, the decision was made to keep these parts separate so that the "inner workings" of the shoe could be seen and understood by visitors to the site. The remaining sections of the upper and the spacer were attached to the underside of the insole using Jade 403. After separating the insole and outsole with plastic wrap, the sections were stacked and weighted with sandbags to ensure proper drying. A small flap of leather that had separated at the toe was readhered on 01/21/14 using Jade 403. The repair was held in place with a clothespin and Mylar until the adhesive had dried.
Exhibition/Storage Suggestions (i.e.: light levels, humidity): When on display, the shoe should be kept out of direct sunlight. Light levels in the display area should be kept low enough that they do not cause heating of the leather. Relative humidity should be kept around 50 to 60%, which will prevent the shoe from drying out and cracking. Humidity fluctuations should be avoided to prevent the leather from swelling and drying, as well as to prevent the PEG from rising to the surface of the leather.

Appendix D: Loan Agreement

Note: Originals with signatures on file at OSARC

Outgoing Loan Number _______**64**___________
Termination Date _December 31, 2014_________

Outgoing Loan Folder Cover Sheet

Instructions: This Outgoing Loan Folder Cover Sheet may be used whenever the OSARC lends museum federal or state agencies, repositories, or non-government institutions. Insert this in the outgoing loan folder.

A. **Type of Loan** __ DCR __X_ non-DCR _X_ Temporary __ Permanent ___ Indefinite B. **Borrower** C. **Purpose** __ Exhibit __ Collections Management __ Study __ Storage X_ Conservation __ Other (describe): __ Exhibit Preparation Initiation Date June 18, 2013 _________ Termination Date December 31, 2014_____ Extension Date ____________________	C. **Outgoing Loan Agreement Documentation in this Folder** __ Outgoing Loan Agreement and List of Objects __ Correspondence relating to outgoing loan __ Insurance documents __ Shipping documents __ Packing documents __ Conservation records __ Restriction records relating to outgoing loan __ Photographs __ Facility Report __ Other (specify): __ Loan extension request and documents

D. **Return of Outgoing Loan** __ Loan Returned Partial (date):

Complete (date):

__ Comments

NC Division of Archives and History
Office of State Archaeology Research Center

List of Objects

Loan Number 64

Site Name	Accession Number	Item Count or Quantity	Object Name	Description and Condition	Value	Comment
Brunswick Town		1	Leather Shoe	Waterlogged		Retrieved from the eroded bank of the waterfront
Brunswick Town		1	Wool Cap	Waterlogged		Retrieved from the eroded bank of the waterfront

NC Division of Archives and History
Office of State Archaeology Research Center

Object Condition Report

Documentation:

Accession Number: Accession Number:

Object Name: Leather Shoe & Wool Cap Item Count: 2 (1 each)

Component Parts (List): Outgoing Loan Number: 64

Photograph Numbers:

Condition:
Describe structural and surface condition (e.g., tears, cracks, chips, holes, losses, abrasion, scratches, residues, mold, buckling, discoloration, stains, patina), and any other conditions, and note location:

The leather shoe and the wool cap are waterlogged. Both objects were recovered from the bank of the Brunswick Town waterfront. Both are in need of conservation.

Condition Described By:

Name (Please Print) Title (Please Print)

Signature Date

Condition on Return of Object: ___Same as above ___Other (Describe):

Condition Described By:

Name (Please Print) Title (Please Print)

Signature Date

NC Division of Archives and History
Office of State Archaeology Research Center

Outgoing Loan Agreement

Outgoing Loan No.

OSARC (Lender): Office of State Archaeology
(Street/Box) 4619 Mail Service Center
Telephone: 919-807-6553
(City, State, Zip) Raleigh, NC 27699-4619
Fax Number: 919-715-2671
Contact (please print): Dolores A. Hall Email: dolores.hall@ncdcr.gov
Shipping Address (if different):

Borrowing Institution (Borrower): East Carolina University
(Department) Department of Anthropology
(Street/Box) East Carolina University
(City, State, Zip, Country) Greenville, NC 27858
Telephone: 252-328-9454
Responsible Official (Borrower): Charles R. Ewen, Ph.D.
Fax Number:
Email: ewenc@ecu.edu
Title: Professor
Shipping Address (if different):

Check one: __ DCR _X_ non-DCR Check one: __ Federal __ State __ Local _X_ Research or Educational Institution

Purpose of Loan:
__ Exhibit __ Study _X_ Conservation __ Exhibit Preparation __ Storage
__ Collections Management (including cataloging and storage __ Other (describe):

Credit Line:

Objects in Loan: _X_ List Attached

Initiation Date: June 18, 2013 **Termination Date: December 31, 2014**

Insurance and Shipping/Packing:
X_ Insurance to be waived __ To be carried by Borrower
Insurance company: Policy No:

Outgoing packing by:__ Lender _X_ Other: Borrower
Return packing by: _X_ Borrower ___ Other:
Method of shipping: Outgoing: Hand Delivery Return: Hand Delivery
Charges to Borrower: __ yes X_ no Describe:

Loan Conditions:

Outgoing loans are subject to the terms and conditions noted on the attached Conditions for Outgoing Loans.

Facilities form required: __ yes X_ no

Additional Loan Conditions:

Artifacts to be conserved by borrower.

Signatures:

On initiation of this agreement: The undersigned borrower is an authorized agent of the borrowing institution. Signature indicates agreement to terms specified in this loan agreement and attached conditions.

Please sign both copies and return the original to the OSARC.

Name of Authorized Official (Lending Institution), Title (Please print)

Signature Date

Name of Responsible Official (Borrowing Institution), Title (Please print)

Signature Date

Return Status:

__ Complete __ Partial (list catalog numbers and date of return):

Extension Termination Date:

Return of Loan:

The undersigned is an authorized agent of the lender. Signature acknowledges receipt of all material in good condition or in condition as noted on this agreement or in attached object condition report(s). A signed copy is sent to the borrower to acknowledge the return of the loan.

Authorization Name (Please print)

Signature Date