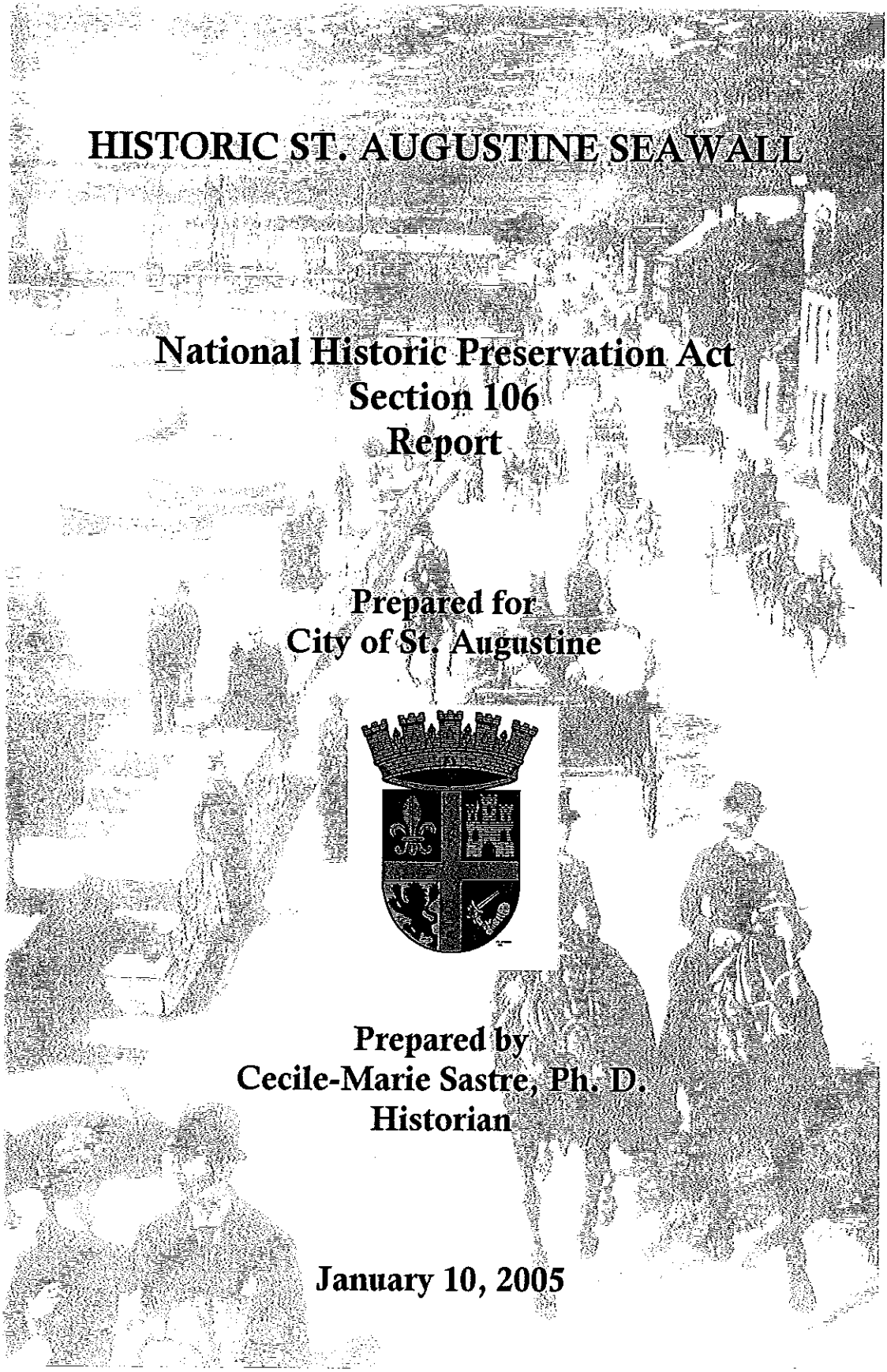

HISTORIC ST. AUGUSTINE SEAWALL

National Historic Preservation Act
Section 106
Report

Prepared for
City of St. Augustine

Prepared by
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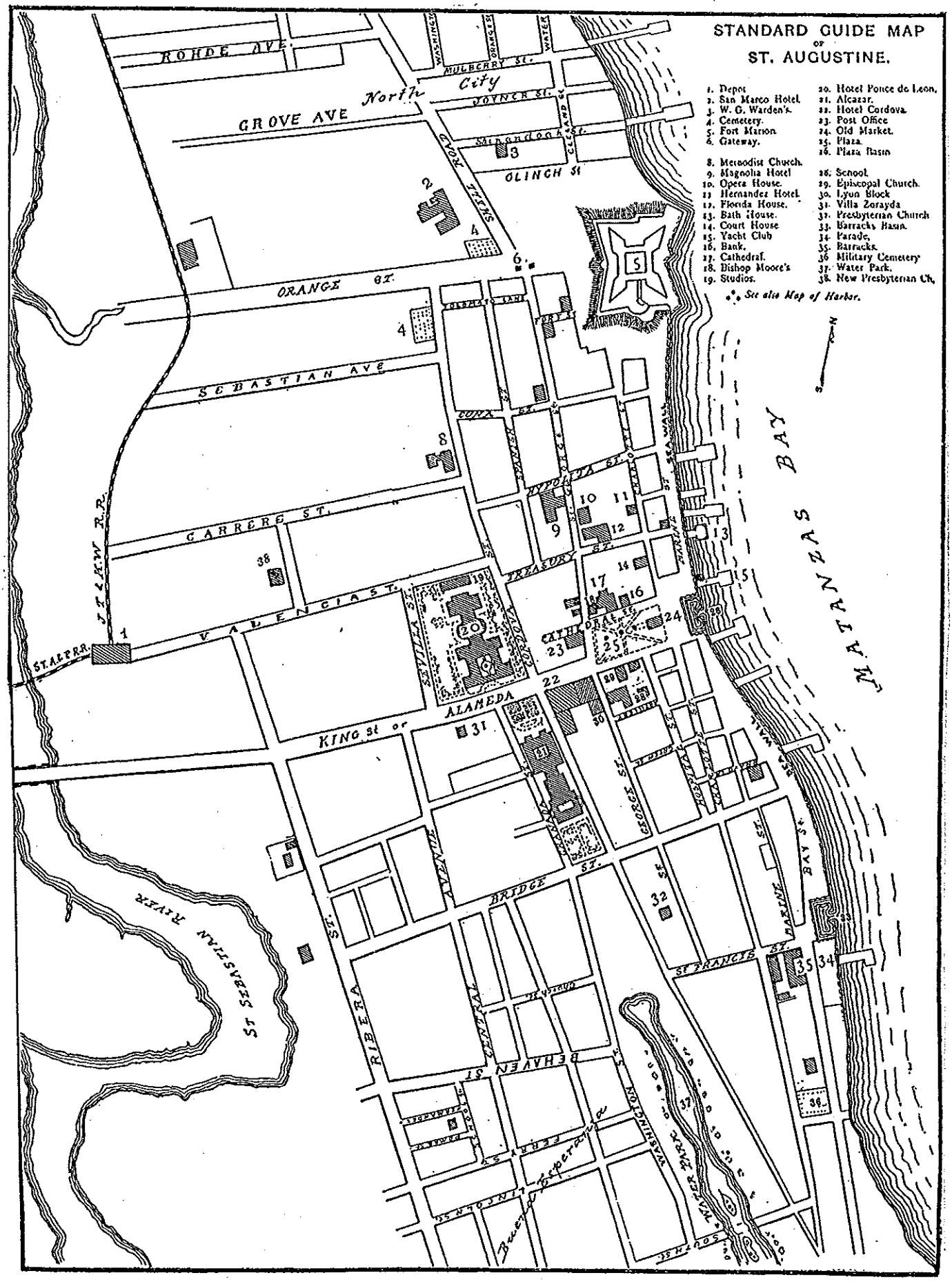
STANDARD GUIDE MAP
OF
ST. AUGUSTINE.
1. Depot
2. San Marco Hotel
3. W. G. Warden's
4. Cemetery.
5. Fort Marion
6. Gateway.
8. Methodist Church.
9. Magnolia Hotel
10. Opera House.
11. Hernandez Hotel
12. Florida House.
13. Bath House.
14. Court House
15. Yacht Club
16. Bank.
17. Cathedral.
18. Bishop Moore's
19. Studios.
20. Hotel Ponce de Leon.
21. Alcazar.
22. Hotel Cordova.
23. Post Office
24. Old Market.
25. Plaza.
26. Plaza Basin
28. School
29. Episcopal Church.
30. Lyon Block
31. Villa Zorayda
32. Presbyterian Church
33. Barracks Basin.
34. Parade.
35. Barracks.
36. Military Cemetery
37. Water Park.
38. New Presbyterian Ch.
*** See also Map of Harbor.
ROHDE AVE.
North City
GROVE AVE
MULBERRY ST.
JOYNER ST.
OLINCH ST
ORANGE ST.
SEBASTIAN AVE
CORA ST.
HYPOLITA ST.
CARRERE ST.
TREASURY ST.
VALENCIA ST.
ST. AUG. & H.R.R.
ST. AUG. R.R.
KING ST. or ALAMEDA
CATHEDRAL
BRIDGE
ST. FRANCIS ST.
BAY ST.
GEORGE ST.
RIBERA
BENAVEN ST
FERRY ST
MARINE ST.
MATANZAS BAY
ST SEBASTIAN RIVER
WATER PARK

DESCRIPTION OF THE PROJECT

The City of St. Augustine proposes to construct a new seawall on the west bank of the Intracoastal Waterway that will run parallel to the existing historic 19th century seawall, a distance of approximately three city blocks, south of the Bridge of Lions. To protect the historic fabric of the seawall, which has deteriorated and, in places, collapsed from battering by tropical storms and hurricanes, the City will construct a new wall approximately twelve feet east of the old one. In the space between the two, earthen fill will support a promenade that will permit pedestrian traffic.

The City is undertaking this project in order to prevent recurrent flooding of the street and properties along the waterfront. As an ancillary benefit, the project will support and thus preserve the historic seawall constructed some 160 years ago to protect the same part of the City. Tropical storm Gabrielle, in September 2001, resulted in the collapse of a segment of the disintegrating old wall and the remainder threatens to topple eastward into the water.

This report has been prepared to satisfy the City's requirements in this project pursuant to Section 106 of the National Historic Preservation Act of 1966 (modified 1990). To that end, the City has conducted archaeological and historical investigations to assess the present condition of the existing segment of the historic sea wall. This report presents the findings of those investigations, outlines the alternative solutions the City considered in crafting a plan to resolve the flooding problem while preserving the historic wall, and describes the option which the City settled upon. In determining its course of action, the City took into account archaeological discoveries and historical data in addition to the suggestions and opinions offered by the State Historic Preservation Office (SHPO) in Tallahassee.

Although this report will cover the history of the entire 19th century, American-era seawall, the proposed construction of a new seawall fronting the existing structure will be limited to the segment of the historic wall stretching from a point about 170 feet north of the Santa Maria Restaurant, south to the northern boundary of the National Guard complex parking lot. This report will

specifically address the impact the construction of the new seawall will have on the affected segment of the historic wall.

DESCRIPTION OF THE PROBLEM

The historic seawall has exhibited signs of deterioration and failure for over a half century. In the most recent decade, segments of the wall have begun to lean seaward noticeably. Cavities within the wall, resulting from long-term erosion of its coquina fabric, precipitated the collapse of one section of the wall in 2001 during tropical storm Gabrielle. It should be noted here that Hurricane Floyd (1999), which hovered offshore for several days, may have caused considerable damage to the seawall, leading to the eventual collapse of portions of the wall the following year in the wake of Gabrielle.

Throughout the past half century, the historic seawall has failed to protect the buildings along the bayfront against even high tides, much less the high water levels that accompany the storm surge of even a modest, level-one hurricane. The threat to the buildings along the bayfront, including the Florida National Guard military compound, requires construction of a higher and more stable wall to provide them adequate protection. For reasons that will be explained in this report, the historic seawall cannot be reinforced, much less raised to a higher elevation.

The historic significance of the existing seawall nevertheless urge its preservation. The challenge to the City in this project is to construct a new seawall that will provide adequate protection against shoreline flooding while preserving the historic wall.

SECTION 106 REVIEW

Section 106 of the National Historic Preservation Act requires a review by the State Historic Preservation Officer (SHPO) of projects that meet the definition of a "federal undertaking" to determine their impact on historic resources. Pursuant to the October 1992 Amendments to the National Historic Preservation Act, an "undertaking" means a project, activity, or program funded

in whole or in part under the direct or indirect jurisdiction of a federal agency, including (A) those carried out by or on behalf of a federal agency; (B) those carried out with federal financial assistance; ©) those requiring a federal permit, license, or approval; and (D) those subject to state or local regulation administered pursuant to a delegation or approval by a federal agency.

The review is designed to ensure that historic properties are considered in the planning and execution of "federal undertakings." The SHPO conducts the initial review on behalf of the Advisory Council on Historic Preservation, an independent federal reviewing agency, which is permitted opportunity by the law to comment on federal undertakings that may have an impact on historic properties. Commonly known as the "Section 106 process," the procedure for meeting Section 106 requirements is defined in regulations of the Advisory Council, "Protection of Historic Properties" (36 CFR Part 800).

For purposes of Section 106, any property listed in or eligible for listing in the National Register of Historic Places is considered historic. The National Register is this country's basic inventory of historic resources and is maintained by the Department of the Interior. The list includes buildings, structures, objects, sites, districts, and archaeological resources. The listed properties are not just of nationwide importance; most are significant primarily at the state and local level. The protections of Section 106 extend to properties that possess significance but have not yet been listed or formally determined eligible for listing.

Once an eligible historic property has been identified within the scope or area of the undertaking, a determination must be made regarding the undertaking's impact on the property. The criteria of effect and adverse effect are used to determine potential effects on historic properties. The criterion of effect states that "an undertaking has an effect on a historic property when the undertaking may alter characteristics of the property that may qualify the property for inclusion in the National Register."[1] The criteria of adverse effect states that "an undertaking is considered to have an adverse effect when the effect on a historic property may diminish the integrity of the property's

location, design, setting, materials, workmanship, feeling, or association."[2]

When applying the criteria of effect and adverse effect, there are three possible findings:

No Effect: There is no effect of any kind, neither harmful or beneficial, on the historic property.

No Adverse Effect: There could be an effect, but the effect would not be harmful to those characteristics that qualify the property for inclusion in the National Register.

Adverse Effect: There could be an effect, and that effect could harm characteristics that qualify the property for inclusion in the National Register.

If the project is determined to have no effect on historic properties, the proposed undertaking may proceed. If the project will have no adverse effect on historic properties, the agency must submit documentation to the Advisory Council for concurrence. If the project will have an adverse effect, the agency must begin consultation with the SHPO and the Advisory Council to minimize the adverse effect.

The project described in this report, proposed by the City of St. Augustine, which will result in the construction of a new seawall along a part of its Intracoastal Waterway shoreline, will exert an impact on properties included within a historic district that is listed in the National Register of Historic Places. The most affected historic resource within that district will be the historic seawall.

The St. Augustine Historic District, also called the St. Augustine Colonial Town Plan Historic District, was listed in the National Register of Historic Places in 1971. In 1986, the district was revised to expand its Period of Significance. The revised nomination form contained a list of "contributing" and "non-contributing" properties within the district, a section of the nomination that did not appear in the 1971 form.

The historic seawall was not listed as a contributing property in either nomination form. The Boundary Description in the 1986 revised nomination makes

it abundantly clear, however, that the seawall lies within the district. The description reads as follows:

> The boundary generally follows the plan of the colonial city of St. Augustine. It follows the lines of the colonial city on the north and west; as defined by Orange Street and Cordova Street respectively. On the east it is defined by the Matanzas Bay, a natural barrier. The southern boundary marks the extent of the concentrated development of the colonial city. The overall boundary extends to the west, beyond the limits of the colonial city, to include the Ponce de Leon Hotel [Flagler College] and the Alcazar Hotel [St. Augustine City Hall and the Lightner Museum], two of the landmark buildings in St. Augustine.[3]

The southern boundary of the "concentrated development" of the colonial city is recognized as San Salvador Street, which is two blocks south of the seawall undertaking.[4] The historic seawall was constructed within the Period of Significance (1565-1935) ascribed to the St. Augustine Historic District. The historic seawall's location, on the west bank of Matanzas Bay and within the described land boundaries of the historic district, leave it clear that it is a contributing element within that historic district.

PHYSICAL DESCRIPTION OF THE SEAWALL

The structure in question is the seawall built by the United States War Department between 1837 and 1846 to replace the coquina wall the Spanish built in 1696 (the seawall begun by Lt. Stephen Tuttle in 1833 was torn down in 1837).[5] The present report will refer to both the Spanish- and American Territorial-era walls. Each will be designated as either Spanish or American when clarification becomes necessary.

Originally, the American-era seawall spanned the City's waterfront from the southern edge of the Water Battery of the Castillo de San Marcos National Monument to the National Guard complex (look into exact extent). Although engineers from the U.S. War Department rebuilt the Castillo's Water Battery around the same time they built a new seawall (the battery functions also as a seawall), the battery will be treated as a separate structure in this report.

As of this writing, those portions of the 19th century seawall still visible run from the southern edge of the Castillo's Water Battery to the southern edge of the grounds of the National Park, and from the municipal marina, south of the Bridge of Lions, past the southern edge of the National Guard complex parking lot.

North of the Bridge of Lions most of the 19th century seawall is not visible; only the portion that lies within the grounds of the Castillo de San Marcos National Monument is visible. The widening of Bay Street (now Avenida Menendez) between 1957 and 1959 resulted in the removal of the top layers of the old seawall between the Castillo and the Bridge of Lions. What remains of the wall is buried beneath the avenue's median.[6] The 1957-1959 seawall, which runs from the southern edge of the National Park to the Bridge of Lions, is an elevated, wide pedestrian promenade with a grassy swath running parallel to its west side at ground level.

South of the Bridge of Lions the American seawall is visible again. The portion of the seawall adjacent to the municipal marina does not front the water; this segment, which runs parallel to the sidewalk, forms the western boundary of the marina complex. Near the pier that leads to the Santa Maria Restaurant, the 19th century seawall once more fronts the water. From there, it stretches without interruption past the southern edge of the National Guard parking lot. Construction of the parking lot did not affect the segment of the seawall fronting the National Guard Complex. Here, the wall is still visible from the water and appears to be in fair to good condition.

Two boat basins were built into the 19th century seawall during the wall's construction; one in front of the plaza, the other, slightly smaller, on the northern edge of the St. Francis Barracks (National Guard complex) and the eastern end of St. Francis Street. The boat basins are no longer visible, but the southeastern corner of the barrack's basin, where the seawall makes a ninety degree angle, is still in existence[7] (see Figures 1 and 2). In 1895 the boat basin fronting the plaza was filled in; this was done in anticipation of the construction of a wooden bridge to connect St. Augustine with Anastasia Island.

The boat basin adjacent to the barracks was filled in at approximately the same time.[8]

The American-era, 19th century, seawall was constructed of coquina laid in ashlar courses and topped with a layer of granite coping stones. The wall, from the Castillo to the St. Francis Barracks measured approximately three quarters of a mile in length. Throughout its length the average height of the wall varied from 6 to 7 feet. It measured approximately 6 feet wide at the base and tapered to 3 feet in width at the granite coping stone. The seaward face lay in a vertical plane while the leeward, or land, side of the wall widened from top to bottom in a series of steps. Massive coquina foundation stones, in excess of 2 feet thick by 7 feet wide supported the wall at its base.[9] When workers laid the foundation in 1842, it sat on marsh sediments that occurred approximately 2 feet above the average low water mark for that year. Lieutenant Henry W. Benham's 1842 drawing of the seawall's elevation placed the average high water mark approximately 4.5 feet below the top of the wall; common gale-force winds blew in at approximately 2 feet below the top of the wall. Only during severe storms and hurricanes would tides overflow the seawall.[10]

Measurements taken during the 2003 archaeological excavations at the base of the seawall verify Lts. Henry W. Benham and Jeremy F. Gilmer's calculations. These show a wall height from the top of the granite coping stone to the top of the foundation stone of 6 feet, 4 inches and 6 feet, 6 inches, respectively. The coquina foundation block, upon which the wall rests, measures in excess of 1 foot, 8 inches in thickness. No attempt was made to determine the width of the foundation stone to avoid adverse impact upon the historic fabric.[11]

Benham's 1842 drawing illustrates the major features of the seawall, the curtain and its foundation stones. Absent from the drawing, however, are the subsequent modifications made to the base of the wall to minimize tidal erosion.[12]

In 1849, Lt. Jeremy F. Gilmer, a military engineer stationed in St. Augustine in 1849-1850, repaired the damage caused by the 1846 hurricane. By the end of the decade, two types of erosion-control features were added seaward,

parallel to the wall's foundation. The first, a course of coquina blocks extended approximately 2.5 feet from the foundation. The archaeological excavations uncovered the blocks at about 7 inches below the foundation.[13] Their present position, however, could be the result of subsidence rather than an indication of their original placement. The archaeologist made no attempt to measure the thickness of these blocks to avoid causing further damage to the stones.

The second erosion-control feature, seaward from, and parallel to the first, formed a type of pavement composed of irregular-sized Coquina stones referred to as pavers by the archaeologist. This structure extends about 5.5 feet from the larger, more regular erosion-control blocks.[14] The pavers, most likely recycled building debris, are believed to protect the base of the seawall from erosion, but a secondary function may be gleaned from a 19th century drawings (see Figures 3, 4, 5 and 6).

At the time of construction, and for some decades after, the pavers were visible at water level. The frontispiece drawing in Sidney Lanier's Florida: Its Scenery, Climate, and History, published in 1875, clearly shows the pavers, at water level, forming a walkway of sorts on the seaward side of the seawall (see Figure 7).[15] It is difficult to determine from the drawing if the pavers were visible at high tide or only at low tide. In any event, in 1875 they were still visible, even if only at low tide. Perhaps they served the dual purpose of shielding the base of the seawall from direct water action as well as providing a ledge from which to hitch small water crafts and provide access to the seaward side of the wall. Such seaward features along seawalls are relatively common.

The pavers are no longer visible; only through archaeological excavation has their existence been confirmed. Since 1875 they have subsided into the shoreline's muck. In some segments of the seawall, the pavers are overlaid by layers of oysters, further obscuring their presence.[16]

SETTING/LOCATION OF ST. AUGUSTINE'S SEAWALL

The American-era seawall, like the Spanish wall, was built on the town's eastern shoreline, on a low-lying, marshy strip of land bounded further east by

the tidal flats and oyster beds of the Intracoastal Waterway (ICW). Ocean water enters during high tides into this stretch of the ICW through St. Augustine's inlet, which opens into Matanzas Bay, and through Matanzas Inlet, fourteen miles to the south. Although daily tidal flows regularly flush this segment of the ICW, giving a relatively clean appearance to the bay's waters, tidal flows regularly deposit and erode sediments along the shoreline.

Over the centuries, tidal action constantly altered the shoreline on the ocean side of St. Augustine, North Beach, Anastasia Island, and the configuration of the shoals off-shore from the bay's inlet. The shorelines of the Intracoastal Waterway, however, have remained relatively unchanged within the span of the region's historic period. Therefore, the Spanish- and American-era seawalls mostly protected the town from periodic flooding brought about by storm surges.

European settlement along the area's shores began with the founding of St. Augustine in 1565. Development of the present waterfront began in earnest after Governor Gonzalo Méndez de Canzo promulgated the establishment of the town plan ca. 1596 as prescribed by the Ordenanzas in the Laws of the Indies. Further development of the waterfront occurred one hundred years later, after the Spanish completed the construction town's first coquina wall in the 1696. After Florida's cession to the United States in 1821, property owners along the bayfront petitioned the United States government for the repair or replacement of the deteriorating Spanish-era seawall to protect their homes and businesses. City officials joined the petitioners out of concern for the integrity of public/municipal property along the waterfront.

THE GEOLOGY OF COQUINA

Coquina, the stone used in the construction of the Spanish- and American-era seawalls, is a lithified sedimentary conglomerate deposited on a developing beach.[17] A soft, friable, stone, coquina is considered an immature limestone which has not yet been subjected to sufficient geological changes (pressure, compaction and chemical reactions) leading to its evolution into a true limestone, a process that takes millions of years. The coarsely-grained stone,

found from Jacksonville to Palm Beach, is composed of sand and shell fragments, including the local Donax, cemented together by the cycle of dissolution, precipitation and deposition of calcium carbonate.

According to geologists Anthony F. Randazzo and Douglas S. Jones "The development of barrier islands and beaches during the Pleistocene can be seen in the stratigraphic record of the [Florida] peninsula. Deposits of coquina...occur well inland from the present coastline. Along the present coastline and inland, from near Jacksonville to West Palm Beach, lithified beach deposits of the Anastasia Formation are sporadically exposed." The Anastasia Formation, which forms the Atlantic Coastal Ridge, is "a multicyclic deposit formed during several transgressions of the sea..." with at least two recognized disconformities within the formation. The Anastasia Formation, which grades into the Miami Limestone Formation in southern Palm Beach County, was probably formed by two separate episodes as suggested by two distinct periods of accumulation.[18]

Coquina's friability and porosity, due to its lack of compaction, makes it an easy stone to quarry and work. Once quarried and removed from its aquatic environment it hardens as it dries. Coquina, however, is stronger when wet than dry. A 1978 report by the National Bureau of Standards identified the need to collect data on the properties of coquina. Subsequent tests investigated the compressive strengths of the stone under wet and dry conditions, confirming earlier assertions that coquina is stronger wet than dry.[19]

However, Coquina exhibits hydrological characteristics which, while it allows for ease in quarrying, contributes to its rapid deterioration, geologically speaking. C. Craig Frazier and Randall Copeland wrote in the Castillo's Historic Structure Report (Vol. II) that

> The presence of moisture aided by capillary movement is believed to be beneficial to some extent because it aids in the stone's cohesiveness and compressive strength. However, extremes of moisture intake should be avoided where possible because the cementitious material in the rock [calcium carbonate] is ultimately soluble in water.
>
> When dry, the surface shell fragments become isolated and brittle, and they easily break off and flake away; when moist, the fragments bond themselves

> together to form a dense and more cohesive material. Rudimentary tests reveal that the stone, when oven-dry, absorbs water up to 20 percent of its weight very rapidly, indicating an extremely high capillary potential.[20]

Although Frazier and Copeland are correct in their assessment of the stone's brittleness when dry, capillary potential when wet and solubility in water, they incorrectly assert that "when moist, the fragments bond together..." Yes, water dissolves the calcium carbonate in the shells, which, when it precipitates out of solution into solid form, creates a bond that cements together the fragments that make up the stone. But the process that creates a solid bond takes a long time. The few hours in each dry and wet tidal cycle to which the fabric of the seawall is exposed may not allow sufficient time for the formation a strong calcium carbonate bond. Coquina would have to be submerged in salt water for a continuous and extended period of time for strong cementation to take place.

The regular wetting and drying cycle the seawall experiences on a daily basis is actually more damaging to the coquina than if the stone remained wet or dry for extended periods of time. The cyclical absorption of water and subsequent drying causes expansion and contraction of the stone at a microscopic level. Minute fractures develop within the stone's fabric with each expansion and contraction, weakening the coquina over time until it deteriorates and crumbles. In the case of the seawall, the hydrological forces exerted by daily tides and occasional storms has accelerated the deterioration of the coquina even further.

Moreover, according to oceanographers Ken Caldeira and Michael E. Wickett the oceanic absorption of high levels of carbon dioxide associated with global warming may result in harmful pH changes in the salt water. This, the result of rising carbon dioxide levels in the oceans, will threaten marine life. Caldiera and Wickett point out that the atmospheric carbon dioxide absorbed by the oceans enters the oceans as carbonic acid, gradually altering the acidity (pH) of salt water. Caldeira, of the Lawrence Livermore National Laboratory, cautions that marine plankton and other organisms whose skeletons or shells contain calcium carbonate, which is dissolved by acid solutions, will be particularly vulnerable

to the rising acidity of the oceans.[21] The prognosis of Caldeira and Wickett does not bode well for St. Augustine's seawall or any other coquina (and tabby) structure of historic significance exposed to acidic water, be it ocean water or rain water. Already acid rain has caused irreparable damage to pyramids and other Mayan structures fashioned out of limestone.

Coquina was the only stone accessible to St. Augustine's colonial settlers. Although limestone forms the substrate of the Florida peninsula, it would have been extremely difficult, if not impossible, for the Spanish to quarry it effectively, that is, had they discovered deposits of this sedimentary rock in the first place. Tabby, a poured mixture of sand, shell fragments, lime and water, and coquina, remained the predominant materials used in masonry construction until the cession of Florida to the United States in 1821.[22] The Spanish did not use bricks in construction until the beginning of the 18th century; when they did employ bricks, they did so infrequently. The British in Florida (1763-1784) used bricks more often, as did the Spanish during their second occupation of the colony (1784-1821).[23] The United States War Department imported granite into St. Augustine for use as coping stones in the construction of the new seawall. This was the first major use of granite in the town.

Although the Spanish first discovered the existence of coquina on Anastasia Island in 1580, during the administration of Governor Pedro Menéndez Márquez, it appears the stone was not employed in construction until a masonry powder magazine was built between 1596 and 1598 by order of Governor Méndez de Canzo.[24]

During the colonial era, workers quarried Coquina in stratigraphic layers from surface and near-surface deposits on Anastasia Island.[25] From the quarries the stone was transported in barges to St. Augustine, where the Coquina was shaped into blocks prior to construction. A lime mortar made from water, sand and calcined oyster shells was used to bond the blocks together.[26]

Throughout the colonial period, the predominant method of raising Coquina walls consisted of laying the stone in ashlar courses with its laminae (layers) aligned horizontally; both the Spanish- and American-era seawalls were constructed using this technique.[27]

HISTORY

For thousands of years humans have constructed palisades and masonry bulkheads to protect their settlements and fortifications from the ravages of tides and floods. The military engineers who built St. Augustine's sea walls employed techniques, taught in the military academies, with antecedents dating to antiquity. The Persian, Greek and Roman empires rose to prominence, in great part, as a result of their superior engineering capacity. Much of their construction involved the control of water: to transport and channel water safely into urban cisterns and agricultural fields, to carve out and shore up harbors for merchant and war fleets, to protect urban centers from unwanted water intrusion and to create moated and shoreline fortifications in which water played a defensive role.

From the time of its founding in 1565 until the present, St. Augustine has served as a military outpost; for Spanish and British colonial troops, for the United States Army (and the Confederate Army briefly), and, presently, as the headquarters of the Florida National Guard. Consequently, along with the construction and maintenance of the town's defenses, it fell on the military to build, repair and reconstruct its sea wall.[28]

The men who built St. Augustine's sea walls formed part of a cadre of career officers formally trained in military academies in the art of fortification and associated public works. For most of western civilization, it has been the military engineers who have constructed the public works upon which urban centers depended. It was no different in the case of St. Augustine, in the Spanish and British colonial periods as well as in the century and a half following the 1821 cession of Florida to the United States.[29]

Located on the western shore of Matanzas Bay, on low-lying land edged by saltwater marshes, the City of St. Augustine has endured periodic flooding since its founding. Although protected by the barrier islands that enclose the bay, the City's waterfront has nevertheless been vulnerable to hydrological forces. Normal tidal erosion and deposition, combined with rapid shoreline alterations caused

by storms and hurricanes coming off the Atlantic Ocean threatened to wash away portions of the town's bayfront throughout the colonial period.

The first known attempt to protect the length St. Augustine's seaward flank occurred after Sir Francis Drake sacked and burned St. Augustine in 1586. The rebuilding of the town following the raid included the construction of a palisaded wall along the waterfront. A map from the 1590s reveals a stockade extending from the triangular wooden fort, across open fields, to the town, located south of the fort. The map's detailed legend describes the stockade as a structure composed of a palisade with a terreplein.[30] The terreplein, an earthen and/or wooden platform upon which soldiers stood to shoot over the palisade, ran the length of the wall's backside. Normally, most terrepleins built behind such palisades were wide enough to accommodate ordnance pieces. The 1590s map does not provide sufficient information to determine if the stockade's terreplein could, in fact, accommodate cannons. Given the map's description of the stockade, it is clear, however, that it not only functioned as a sea wall, it also functioned as a defensive bulwark.

Spanish engineers began construction of a masonry seawall in 1696, the year after the completion of the Castillo de San Marcos. The wall extended south from the south salient of the fort's water battery to the plaza. At its southern extremity, the wall veered out into Matanzas Bay and terminated in a step-shape breakwater. Wharves fronting the Castillo, and at various other points along the seawall were built, demolished and rebuilt over the 140-year history of the wall.[31]

Although the Spanish in St. Augustine made every attempt to maintain the town's defenses and public works, by the time of the cession of Florida to the United States in 1821, the seawall showed signs of deterioration and in places, threatened to collapse. To make matters worse, sometime after 1821 the U.S. military had demolished portions of the seawall to use the coquina blocks in the construction of a stone wharf in front of the St. Francis Barracks. The resulting breach in the wall, which caused flooding along the waterfront, spurred residents in 1832 to launch a campaign to secure federal funding for the reconstruction of

the seawall. In March 1833 President Andrew Jackson signed into law an act establishing engineering and ordnance departments within the military stationed in St. Augustine. The legislation included $20,000.00 for the repair of the fort and the reconstruction of the seawall.[32]

In the fall of 1833 Lt. Stephen Tuttle began construction of the new coquina seawall. By the time he was court martialed in 1834 for incompetence and squandering most of the funds allocated, a third of the wall he was in the process of erecting had been built on top of the Spanish wall. Lieutenant Francis L. Dancy, stationed in St. Augustine at the time, and hoping to replace Tuttle, reported that not only was Tuttle's wall badly constructed, but that building it atop the old wall did not make good engineering sense.[33]

After Tuttle was found guilty, Chief Engineer, General Charles Gratiot, Tuttle's superior, appointed Dancy to direct the repairs at the fort and the reconstruction of the seawall. After much prodding Dancy succeeded in convincing Washington, with the help of irate citizens, to allow him to demolish Tuttle's 870-foot wall and begin construction of a new one about 30 feet seaward from the Spanish wall. Because the Spanish wall curved with the topography of the shore, Dancy preferred to build the new wall with a straight alignment to widen the 15-foot wide Bay Street.[34]

Lieutenant Henry W. Benham replaced Dancy in 1839 and remained in St. Augustine until he completed the wall in 1846. Upon its completion, the new American wall extended south from the south salient of the water battery of the Castillo to a point about 500 past the St. Francis Barracks, a distance of approximately 3,800 feet. The northern portion of the wall began near the point where the Spanish wall met the water battery, but veered seaward, away from the old wall, in a straight alignment as its course proceeded southward. A layer of granite coping stones capped the wall. However, the top surface of the wall was left uneven in some portions as workers hurried to place the granite coping stones and neglected to level the wall first.[35]

In October 1846 a hurricane put the new seawall to the test. Although the wall performed relatively well, the storm caused a segment of the wall to

collapse. Between 1849 and 1850 Lt. Jeremy F. Gilmer repaired the breach and other damaged portions of the wall. To protect the seawall from tidal erosion he laid, at the base of the wall, the coquina blocks and pavers uncovered during the 2003 archaeological excavations of the seawall.[36]

In the 1850s remains of the old Spanish wall could still be seen along the center of Bay Street (present-day Avenida Menendez), where, according to George Fairbanks, "it occasionally appears above the level of the street."[37]

St. Augustine's seawall not only served its intended purpose of protecting the waterfront from innundation, for by the last quarter of the 19th century it had become a popular promenade for lovers. To disregard the seawall's social and cultural aspects would be to ignore quite an important part of St. Augustine's Victorian-era history. The promenade was an important social institution of 19th and early 20th century Euro-American culture. After dinner, weather permitting, people ventured outdoors for an evening stroll to engage in what was known as a "promenade," a walk around the local square to meet friends, lovers or prospective spouses. In the case of St. Augustine, the evening promenade took place along the seawall as well as the plaza (see Figures 8 and 9).

Sidney Lanier, in his 1875 work "Florida: Its Scenery, Climate, and History," wrote that "There are many persons who have found occasion to carp at this sea-wall, and to revile the United States Government for having gone to the great expense involved in its construction, with no other result than that of furnishing a promenade for lovers."[38]

Lanier, who was hired to write the book by the Great Atlantic Coastline Railroad Company to promote travel to Florida, enticed his readers by describing the purpose of a promenade along St. Augustine's seawall thus:

> Whatever may have been the motives of the federal authorities in building it, its final cause...is certainly love; and there is not a feature of its construction which does not seem to have been calculated solely with reference to some phase of that passion. It is just wide enough for two to walk side by side with the least trifle of pressure together; it is as smooth as the course of true love is not, and yet there are certain re-entering angles in it (where the stairways come up) at which one is apt to break one's neck as one

> is to be flirted with, and in which, therefore, every man ought to perceive a reminder in stone of either catastrophe; it has on one side the sea, exhaling suggestions of foam-born Venus and fickleness, and on the other the land, with the Bay Street residences wholesomely whispering of settlements and housekeeping bills; it runs at its very beginning in front of the United States barracks, and so at once flouts War in the face, and pursues its course, - happy omen! - towards old Fort Marion, where strife long ago gave way to quiet warmths of sunlight, and where the wheels of the cannon have become trellises for peaceful vines; and finally it ends - How shall a man describe this spot where it ends? With but a step the promenader passes the drawbridge, the moat, the portcullis, edges along the left wall, ascends a few steps, and emerges into the old Barbican. ...it is Love's own trysting place.[39]

The old seawall was never truly effective against hurricanes. A hurricane in 1944 flooded Bay Street and the water reached houses along the waterfront.[40] St. Augustine's waterfront lies at or near sea level and was prone to flooding before the construction of the seawalls (see Figure 10).

In 1959 the waterfront north of the Bridge of Lions was considerably altered when Avenida Menendez (A1A) was widened and its sharp corner in front of the Castillo slightly straightened.[41] A new, wider seawall was constructed to the east of the old one, leaving the remains of its predecessor buried under the newly widened road. The 1959 segment of the seawall forms a wide promenade popular today with tourists and citizens alike. A grassy strip separates this portion of the seawall from the road's curb, along which horse carriages park awaiting fares.

ARCHAEOLOGICAL INVESTIGATIONS AT TWO SITES ALONG THE SEAWALL SOUTH OF THE BRIDGE OF LIONS

The following account of the archaeological investigations conducted at two separate sites along the segment of the seawall south of the Bridge of Lions has been incorporated here verbatim from the report written by City Archaeologist Carl D. Halbirt (Archaeological Investigations Along the Seaward Side of St. Augustine's Historic 19th Century Sea Wall, Planning and Building Department, City of St. Augustine, January 20, 2004, pp. 9-12). Halbirt's citations will be included in the general bibliography. Text in brackets did not appear in Halbirt's report and have been added for clarity.

Archaeological documentation at two locations along the seaward side of the historic sea wall by the City (Figure 2) provides information useful in assessing the accuracy of the historical documents. Those documents are the physical depiction provided by Lt. Benham in his 1842 illustration and statements provided by Lt. Gilmer pertaining to steps taken to ensure the stability of the wall.

The two locations were selected based on differences in the aquatic terrain adjacent to the wall. Site A was placed in an area containing extensive oyster beds and associated shell debris, which are exposed during low tide. The oyster bed and shell debris enabled sediment to accumulate along the seaward side of the wall, thus forming an extensive tidal flat during low tide. Site B was placed just south of a bend in the sea wall. This location is outside the oyster bed area, but is still within the tidal flat during low tide. The extent of the tidal flat at Site B is less than half that of Site A. In each location, a 10-foot long by 3-foot wide test trench was excavated that exposed the historic fabric of the sea wall along the shoreline (Figure 3). No attempt was made at this time to determine the physical characteristics of the sea wall along the leeward side. Previous archaeological monitoring in locations where the City installed new storm basin backflow valves revealed that the upper portion of the wall consisted of a vertical face to a depth of 3 feet.

Historical documentation of the sea wall's physical characteristics, as provided by Lts. Benham and Gilmer, is supported by the City's archaeological investigation. Measurements show that the wall height from the top of the foundation stone to the top of the granite coping stone is 6 feet 4 inches and 6 feet 6 inches, respectively (Figure 11); both are within the estimates calculated from Benham's drawings. The foundation stone on which the wall rests is in excess of 1 foot 8 inches, which also is in agreement with the historical illustration. At this time, no attempt was made to determine the thickness of the foundation stone due to the potential impacts that such activity would have on the existing sea wall. None of the foundation stones or coquina-stone paving along the embankment was disturbed at this time given the erosional uncertainties that may have ensued from daily bimodal tidal fluctuations.

Two types of erosional support mechanisms are found along the sea wall, neither of which is mutually exclusive. The first is a series of large coquina blocks placed directly adjacent and parallel to the foundation stones [on the seaward side]. The blocks extended an average of 2.5 feet from the foundation stone[s] and were 7 inches lower than the foundation stone[s]. The function of this alignment was probably similar to the concrete-filled trench proposed by Lt. Gilmer to protect the foundation. No attempt was made to determine the thickness of this component of the sea wall, as per the reason given for the foundation stone[s]. In front of the blocks was a 5 ½ foot pavement of broken coquina stones, which were intentionally laid flat along the sloping edge of the Matanzas River. These stones are

assumed to represent recycled building debris used as a rip-rap to limit the surface displacement of marsh deposits in front of the sea wall. The paver stones vary in size (Figure 9/4), but were on the average 6 inches thick.

No in situ coquina stone was found beyond this approximate 10-foot barrier. What was apparent was a thick deposit of shell debris within a coarse-grain, sandy clay matrix (Figure 11). Below this matrix were the fine-grain marsh sediments over which the historic sea wall had been constructed.

The preservation of these erosional support mechanisms is more pronounced toward the south end of the existing historic sea wall and not at the north end, where the stones have been either displaced or scoured by tidal currents. This is clearly a function of the relationship between the sea wall and the tidal currents of the Matanzas River. At Site A, sediment and shell debris varies from 5 inches to 15 inches thick and provides a cover protecting that portion of the sea wall in the bay. At Site B, the amount of sediment and shell debris is substantially less, and many of the paver stones have been displaced or up-ended and the coquina blocks in front of the foundation stone covered in algae (Figure 5).

St. Augustine's historic nineteenth-century sea wall is not limited to the visible component that residents or tourist[s] view on any given day. Rather, the historic fabric of the wall extends another 10 feet east along the [sloping shoreline] of the Matanzas River where a system of coquina-stone blocks and pavers were placed to control the effects of tidal erosion. Although this system was observed at Sites A and B, the historic Fabric of the sea wall is better preserved at Site A - the south end of the wall. At Site B, which is near the bend in the wall, preservation is poorer.

During the City's investigation, numerous locations within the coquina-stone wall contained cavities where the stone had been removed and the opening scoured through tidal action. Most of the cavities occur toward the base of the wall, near the foundation stones (Figures 3 and 5). In some areas, these cavities are 3 feet deep - approximately half the thickness of the wall. Although these cavities were not measured, the one near Site B is very large. This site also happens to be near the location where the wall collapsed into the Matanzas River (Lewis 2001). The cause of this failure was attributed to tropical storm Gabrielle [2001]. Although conjectural, another cause for this failure may be attributed to the sloping nature of the wall and the poorly preserved erosional control system along this section of the wall.

Development of the City of St. Augustine's planned construction of a new wall in front of the historic sea wall will need to take into consideration those other elements of the wall that are part of the erosional control system. As such, the 10-foot distance, which was originally proposed between the old sea wall and the new sea wall in community workshops and to the city commission, will need to be changed if these additional elements are considered. An alternative distance - one that would protect the historic fabric of the sea wall

from adverse construction activities - is 12 feet. This is beyond the limits of the coquina stone pavers.

It is recommended that additional archaeological investigations be carried out along the historic sea wall in conjunction with construction activities, especially after a coffer dam system has been constructed. This system will enable archaeological investigations to occur without impediment by daily tidal fluctuations. Work is especially recommended for those locations adjacent to known historic docks. The information recovered has the potential for addressing questions regarding maritime industry in St. Augustine.

The abovementioned recommendation for additional archaeological investigations to monitor construction activities may delay the construction of the new seawall, therefore adding to its cost. With proper planning, archaeological monitoring can be done with minimal delays or added expense. Monitoring, however, should be carried out to ensure the protection of the historic wall and its foundation.

ARCHAEOLOGICAL EXCAVATIONS OF A SEGMENT OF THE SEAWALL WITHIN THE GROUNDS OF THE CASTILLO DE SAN MARCOS NATIONAL MONUMENT

Between April 26 and 28, 2004, archaeologists from the Southeast Archeological Center (SEAC) conducted excavations on a segment of the landward side of the Castillo's seawall south of the water battery. The excavation was undertaken to determine the extent to which erosion is undermining the integrity of the historic seawall in that sector of the shoreline.

The excavation revealed "several possible causes for the erosional problems. The primary cause of erosion is tidal action. Two daily high tides allow water to collect behind the seawall through spaces in the coquina. When low tide occurs the water trapped behind the seawall flows beneath the seawall carrying with it small amounts of soil. This bi-daily action is the main cause for the erosion. Secondly [,] rain that accumulates on the land side of the seawall must percolate through the soil until it can escape beneath the seawall. As with the tidal action the percolating rain water also carries minute amounts of soil beneath the seawall. Lastly [,] storm surges which occur infrequently would also have an adverse effect to the seawall in the same ways as described above. SEAC recommends that a management plan be designed by the park that could

deal with alleviating the drainage problem along the seawall thus preventing further erosion in the area."[42]

Mapping of the excavated portion of the seawall revealed a stepped foundation, progressively thicker from top to bottom, on the landward side.[43] The shape of the Castillo's segment of the seawall uncovered by the SEAC excavation is consistent with previous archaeological findings along the seawall south of the Bridge of Lions.

ALTERNATIVES/OPTIONS CONSIDERED FOR THE CONSTRUCTION OF THE SEAWALL

Since 2002 the City of St. Augustine has examined a number of alternatives for the restoration and/or new construction of the seawall south of the Bridge of Lions. After a period of public comment, consultation with historians, archaeologists, architects and engineers, the City narrowed the proposed options to four alternatives.[44]

Alternative #1, take no action. This alternative left the historic seawall in its present condition. There are two major disadvantages to this option. One is that the existing coquina seawall is not structurally sound and is in danger of collapsing during a tropical storm or hurricane. The other disadvantage is that the existing wall is not high enough to prevent flooding during Category 1 storms. The average mean sea level (MSL) top elevation of the historic wall is 6.4 feet and the average MSL water elevation of a Category 1 storm surge is 7.4 feet.

Alternative #2, rehabilitate existing seawall. Structural rehabilitation of the historic seawall consisted of drilling vertical boreholes into the wall's coquina fabric and inserting stainless steel rods along the entire wall and tie the back of the seawall with stainless steel rods anchored to a concrete dead-man constructed along the land side of the seawall as shown on Figure ####. This alternative is not feasible for two reasons. Coquina is a very brittle stone, therefore the historic wall could be seriously damaged during the drilling of the boreholes. Moreover, the existing wall is not high enough to prevent flooding during Category 1 storm surges.

Alternative #3, construct a new seawall four feet from the existing wall. This alternative contemplated the construction of a new seawall four feet seaward from the existing wall. The proposed new seawall will have a MSL top elevation of 7.7 feet to prevent flooding during Category 1 storm surges. The new wall will help preserve the historic seawall by shielding its fabric from damage from storm surges. This alternative, however, is not feasible as it will have an adverse effect on the pavers and foundation of the historic wall.

Alternative #4, construct a new seawall ten feet from existing wall. The construction of a new seawall ten feet seaward from the existing wall is the most feasible alternative for the preservation of the historic structure. The new wall will have a MSL top elevation of 7.7 feet (see Figure 12).

Ultimately, City officials decided to build a new seawall east of, and detached from, the historic wall in order to preserve its integrity.

Alternative number four was the preferred alternative before City Archaeologist Carl Halbirt discovered, during excavations at the base of the seawall, coquina pavers extending about ten feet seaward from the base of the wall. The pavers, covered by silt and oyster beds, are not visible at low tide, when portions of the base and shore are exposed. While the pavers were originally laid at water level and formed a ledge or walkway, over the last century and a half they have subsided and disappeared into the shoreline's muck. Upon the discovery of the pavers, alternative number four, the final decision, was modified. To preserve the pavers, an integral part of the historic wall, the new seawall should be constructed about twelve feet from the existing wall rather than the proposed ten.

RECOMMENDATIONS/SOLUTIONS

After studied consideration, and consultation with Carl Halbirt, the City Archaeologist, and the State Historic Preservation Office in Tallahassee, the City of St. Augustine decided to build a new seawall and to encapsulate the historic wall for its preservation. The new seawall will be constructed approximately twelve feet distant from the historic wall in order to preserve a

course of rough coquina pavers that extend outward from the base of the old wall for approximately twelve feet.

The pavers, discovered by Halbirt during excavation of two test trenches, were laid out at sea level during the wall's construction and formed a kind of ledge or walkway on the seaward side of the wall. A drawing dating to ca. 1875, in Sidney Lanier's Florida: Its Scenery, Climate, and History, clearly shows the pavers above water level (see Figure 7).[45] Over time, the pavers subsided into the silty bottom of the shore. Today these stones are no longer visible at low tide; layers of silt and the ubiquitous oyster beds cover them.

City officials decided to leave the silt and oyster cover in place to prevent additional disturbance of the coquina pavers. The construction of the new wall will not affect the historic wall or most of the pavers. Only at four locations will the pavers be disturbed: at the three existing sites of storm outfall pipes where concrete Storm Water Pollutant Removal Vortex Boxes will be installed as required by the Florida Department of Environmental Protection (FDEP), and where the southern terminus of the new seawall will tie into the historic wall.

The space between the old and new walls will be filled in and paved to create a pedestrian walkway similar to the one north of the Bridge of Lions. Rods inserted to secure the new wall will be anchored to a "dead man" laid within the new wall's fill horizontally and parallel to the old wall, but at a distance from it to avoid any adverse impact on the historic structure.

A small segment of the historic seawall will be left exposed to facilitate viewing by the public. An interpretive sign will be placed in this section to explain the history of the old wall. Acrylic panels may be installed to protect the visible section of the old wall from wear and tear.

ALTERNATIVES/OPTIONS CONSIDERED FOR THE CONSTRUCTION OF THE SOUTHERN TERMINUS OF THE SEAWALL

The City of St. Augustine considered three design alternatives for the southern terminus of the new seawall in consideration of the following: (1) to preserve as much as possible the integrity of the historic wall; (2) to provide

a sound structural solution for the southern terminus; (3) to prevent pedestrian traffic on the new seawall from inadvertently trespassing onto the National Guard portion of the seawall; and (4) to minimize the impact of the new seawall upon the National Guard segment of the historic wall.

The historic seawall generally parallels Avenida Menendez. At the southern end of Avenida Menendez, the wall makes a right angle turn towards the west, extends about 20 feet west, and then makes another right angle turn towards the south. From that point, the historic seawall extends south along the waterfront of the National Guard Complex. While the Florida National Guard retains ownership of the seawall fronting its complex in St. Augustine, the City of St. Augustine owns the submerged land fronting the entire length of the historic seawall, from the Castillo de San Marcos to its southern terminus within the National Guard complex. Although the historic seawall extends south to the National Guard waterfront, the City of St. Augustine's proposed new seawall project ends at the northern boundary of the National Guard complex, at the south end of Avenida Menendez.

Although the proposed new seawall will be erected approximately twelve feet from the historic wall to protect the pavers, construction of the southern terminus will unavoidably disturb the pavers at the site where the new wall will tie into the old one (see Figure 13). To ensure the stability of the southern terminus of the wall, the engineers determined it would be necessary to tie the new wall onto the old structure.

Alternative #1 would extend the new seawall somewhat south of Avenida Menendez, tying in to the historic wall in front of the National Guard complex, south of the two right angle turns of the wall. To minimize impact to the historic wall, the new wall would abut, but not penetrate, the historic wall. The end of the new wall will likely require a support piling (such as a king pile) placed as closely as possible to the historic wall. Grout would fill the joint between the old and new walls. Rock rip-rap would protect the seaward face of the joint between the historic and new walls. Impacts to the new wall would be

restricted to the grout joint and any paver stones lying beneath the new seawall as it turns to join the historic wall (see Figure 13).

Alternative #2 would extend the southern end of the new seawall westward, penetrating the historic wall and terminating on the landward side of the historic wall. This alternative would allow the southern end of the new wall to have a continuous section anchored at its western terminus landward of the historic wall. This alternative would require dismantling a few feet of the historic wall. The joint between the historic and new seawalls would be filled with grout and protected by rock rip-rap on the seaward side of the joint. Any paver stones lying beneath the new seawall and rip-rap would be affected (see Figure 14).

Alternative #3 would end the new seawall at the southern end of Avenida Menendez, abutting the new wall against the seaward corner of the historic wall. To minimize the impact to the historic wall, the new seawall would abut, but not penetrate, the historic wall. The end of the new wall will likely require a support piling (king pile) placed as close as possible to the historic wall. Grout would fill the joint between the old and new walls. Rock rip-rap would protect the seaward face of the joint between the historic and new walls. Impacts to the old wall would be restricted to the grout joint and any paver stones lying beneath the new seawall as it turns to join the historic wall (see Figure 15).

Selection of one of these alternatives will depend upon engineering, historic preservation and property ownership issues. Both the first and third alternatives preserve intact the corners of the historic seawall at the end of Avenida Menendez. The first of these provides greater protection but would require construction abutting the historic wall fronting the National Guard complex. Since the second alternative brings the terminus of the new wall inside, and landward, of the historic wall, it offers the greatest protection to Avenida Menendez should portions of the historic wall fail. Construction of this alternative, however, would require dismantling a few feet of the historic wall.

STORM WATER OUTFALLS

The section of the Avenida Menendez seawall between the Santa Maria Restaurant and the Florida National Guard complex presently contains three storm water outfall pipes that penetrate the seawall and carry rain water from the City to the Matanzas River (Intracoastal Waterway). Present FDEP rules require storm water to be treated for sediment, oil and grease removal before it is discharged into the Matanzas River. To meet this requirement, the City of St. Augustine will install at each outfall location a concrete Storm Water Pollutant Removal Vortex Box. Each box will be installed on the site of the existing outfall pipes between the historic wall and the new wall. The installation of the vortex boxes will affect the adjacent coquina pavers. Pavers on the sites where the vortex boxes will be installed may have to be removed; if so, they will be placed elsewhere along the historic wall in those areas where pavers are missing. Each box will affect approximately 21 linear feet of pavers along the seaward toe of the seawall for a total of 63 linear feet (see Figure 16).

CONSTRUCTION TECHNIQUES

Specific construction techniques will depend on the final design of the new seawall. Nonetheless, construction of the new seawall will require that the contractor take precautions to prevent disturbance of the historic seawall. The new seawall's proximity to the historic wall suggests that the new seawall's panels be installed by jetting rather than driving. Driving the panels into place could induce vibrations that could damage the historic wall. Jetting the panels into place would reduce risks of vibration damage. The engineers anticipate that construction will occur with the contractor simultaneously placing the new seawall panels and filling the space between the historic and new walls. The construction of the seawall could occur with a combination of barge-based equipment and long-reach equipment operated from Avenida Menendez. As the construction proceeds, small equipment would operate in the filled area between the historic and new seawalls.

ENDNOTES

1.*Code of Federal Regulations*, 36 CFR 800.9(b).

2.Ibid.

3.St. Augustine Historic District, Nomination Form, National Register of Historic Places, National Park Service, United States Department of the Interior, 1986 revision, copy on file at the Florida Department of State, Division of Historical Resources, Tallahassee.

4.Mariano de la Rocque, *Plano Particular de la Ciudad de Sn. Agustin de la Florida*, 1788, copy on file at the St. Augustine Historical Society.

5.Edwin C. Bearss and John C. Paige, "Historic Structure Report for Castillo de San Marcos National Monument St. Johns County, Florida" (hereafter HSR) (Denver: Denver Service Center, National Park Service, 1983), 53-55, 65-73, 93-96.

6.Carl D. Halbirt, "Archaeological Investigations Along the Seaward Side of St. Augustine's Historic 19th Century Sea Wall" (St. Augustine: City of St. Augustine Planning and Building Department, 2004), 8.

7.Henry W. Benham, *Survey of the Sea Wall of St. Augustine With the City proper and the adjacent shore*, September 30, 1842, copy at the Castillo de San Marcos National Monument.

8.See the Sanborn Fire Insurance maps at the St. Augustine Historical Society.

9.Henry W. Benham, *Survey of the Sea Wall of St. Augustine*, 1842.

10.Halbirt, "Archaeological Investigations Along the Seaward Side of St. Augustine's Historic 19th Century Sea Wall," 8.

11.Ibid., 10.

12.Ibid., 9; Benham, *Survey of the Sea Wall*.

13.Ibid., 6-7, 10.

14.Ibid., 10.

15.Sidney Lanier, *Florida: Its Scenery, Climate, and History*, facsimile reproduction of 1875 edition (Gainesville: University of Florida Press, 1973).

16.Carl D. Halbirt, "Archaeological Investigations Along the Seaward Side of St. Augustine's Historic 19th Century Sea Wall," unpublished manuscript (City of St. Augustine: Planning and Building Department, 2004).

17.Anthony F. Randazzo and Douglas S. Jones, eds., *The Geology of Florida*, (Gainesville: The University Press of Florida, 1997), 66.

18.Ibid.

19.C. Craig Frazier, Randall Copeland and Luis Arana, "Historic Structure Report, Volume 2, Castillo de San Marcos National Monument" (Denver: Denver Service Center, National Park Service, 1986 draft), 147 and 439.

20.Ibid., 43.

21.Ken Caldeira and Michael E. Wickett, *Nature*, September 25, 2003.

22.See Albert Manucy, *The Houses of St. Augustine 1565-1821* (St. Augustine: The St. Augustine Historical Society, 1978) for a thorough treatment of this topic.

23.Ibid., 62, 73, 98, 120, 124.

24.Manucy, *The Houses of St. Augustine*, 17.

25.Jean Parker Waterbury, *Coquina* (St. Augustine: St. Augustine Historical Society, 1993), 6, 7 and 9.

26.Manucy, *The Houses of St. Augustine*, 17 and 67; Luis Rafael Arana and Albert Manucy, *The Building of Castillo de San Marcos* (St. Augustine: Eastern National Park and Monument Association, 1977), 17 and 18.

27.Manucy, *The Houses of St. Augustine*, 68 and 70.

28.See Luis Rafael Arana, "Castillo de San Marcos: First Spanish Period, 1668-1763, Section I" (St. Augustine: Castillo de San Marcos National Monument, National Park Service) and "Castillo de San Marcos: Second Spanish Period, 1784-1821, Section II"(St. Augustine: Castillo de San Marcos National Monument, National Park Service); and Bearss and Paige, "HSR," Volumes I and II, for a detail account of the construction and maintenance of the Castillo de San Marcos and its outworks, and the seawall.

29.Cécile-Marie Sastre, "Defense-in-Depth: The Development of St. Augustine's Defensive System, 1702-1763," *El Escribano*, 2002, 87-89.

30.Hernando de Mestas (attributed to), *Mapa del Pueblo, Fuerte y Caño de San Agustín*, copy at the St. Augustine Historical Society (hereafter SAHS), 1590s.

31.Arana, "Castillo de San Marcos, Section I," 88-89; Luis Rafael Arana and Albert Manucy, *The Building of Castillo de San Marcos* (St. Augustine: Eastern National Park and Monument Association, 1977), map inside back cover.

32.Bearss and Paige, "HSR," 46-47, 51-53, 59-62; Cécile-Marie Sastre, "Castillo de San Marcos NM, History of the Cultural Landscape for the Cultural Landscape Report" (hereafter CLR) (St. Augustine: Castillo de San Marcos National Monument, National Park Service, 2000), 85.

33.Sastre, "CLR," 85-89.

34.Bearss and Paige, "HSR," 93-94.

35.Bearss and Paige, "HSR," 107-238.

36.Ibid., 239-244.

37.George Fairbanks, *The History and Antiquities of the City of St. Augustine, Florida*, facsimile reproduction of 1858 edition, (Gainesville: The University Presses of Florida, 1975), 130.

38.Lanier, 41.

39.Lanier, 41-43.

40.Karen Harvey, *St. Augustine and St. Johns County, A Pictorial History* (Norfolk: The Donning Company, 1980), 177.

41.Albert C. Manucy, *Seawall Changes at St. Augustine, plan, 1958*, revised, 1960. Copy on file at the Government House archives and library, St. Augustine. The plan shows, relative to each other, St. Augustine's historic seawalls as drawn by Mariano de la Rocque, 1784; Clements, survey map, 1834; Henry W. Benham, map, 1842; and the outline of the concrete bulkhead built in 1958-1959.

42.R. Steven Kidd, "Trip Report on Excavations Along the Southern Seawall at Castillo de San Marcos, April 26-28, 2004" (Tallahassee: Southeast Archeological Center, National Park Service), 6.

43.Ibid., 5.

44.William G. Mendez, P.E., City of St. Augustine Engineering Manager to Cécile-Marie Sastre, Ph.D., historian, correspondence, March 22, 2004.

45.Lanier, frontispiece.

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Sastre, Cécile-Marie. "Castillo de San Marcos NM, History of the Cultural Landscape for the Cultural Landscape Report." St. Augustine: Castillo de San Marcos National Monument, National Park Service, 2000.

Waterbury, Jean Parker. *Coquina*. St. Augustine: St. Augustine Historical Society, 1993.

FIGURES

Figure 1. Survey of the Sea Wall of St. Augustine, 1842, Henry W. Benham.

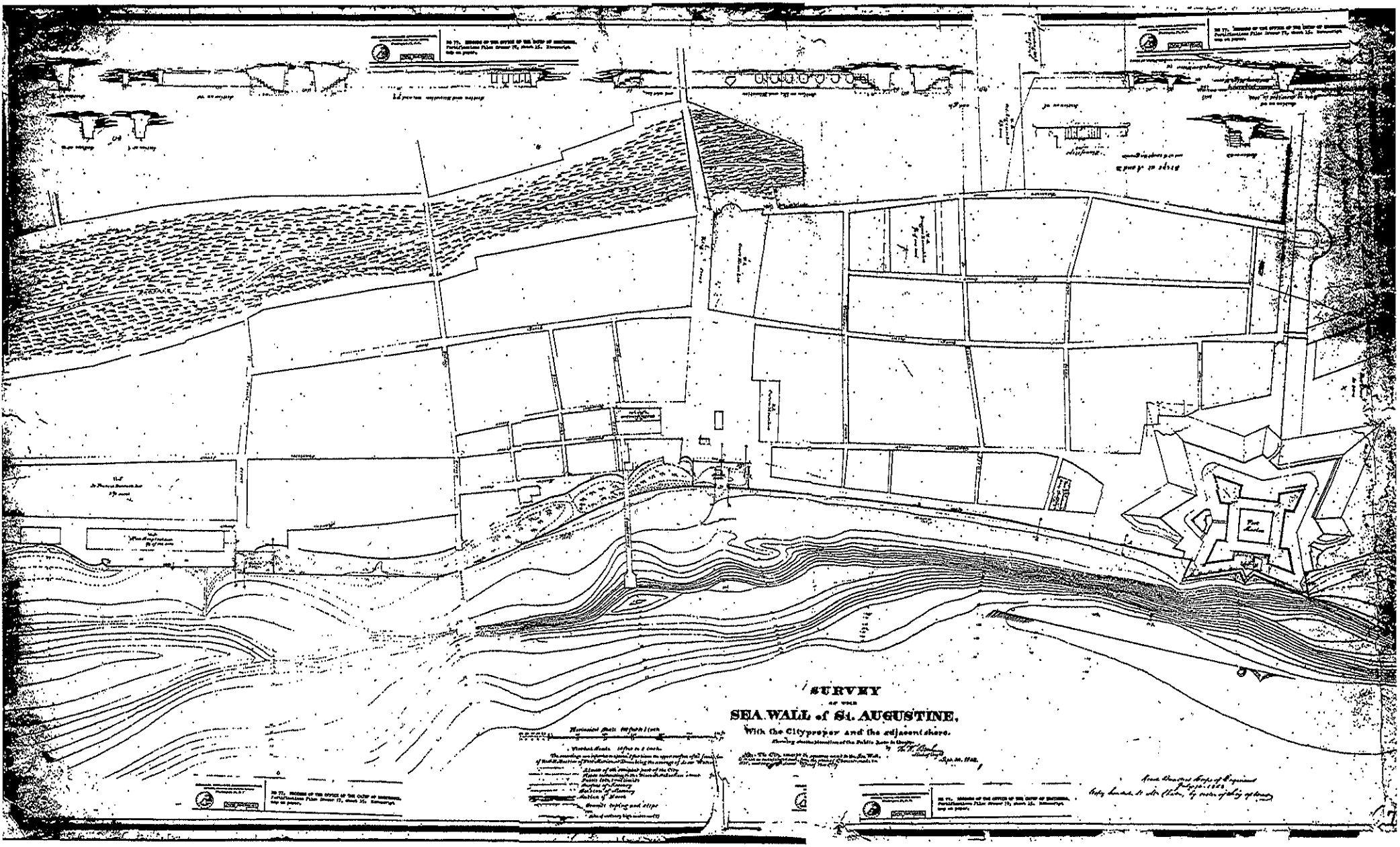

SURVEY
OF THE
SEA WALL of St. AUGUSTINE,
With the City proper and the adjacent shore.

Figure 2. Aerial view of the location of the archaeological trenches excavated in 2003 by City Archaeologist Carl D. Halbirt, labeled Site A and Site B.

Archaeological Investigations along the Historical Seawall

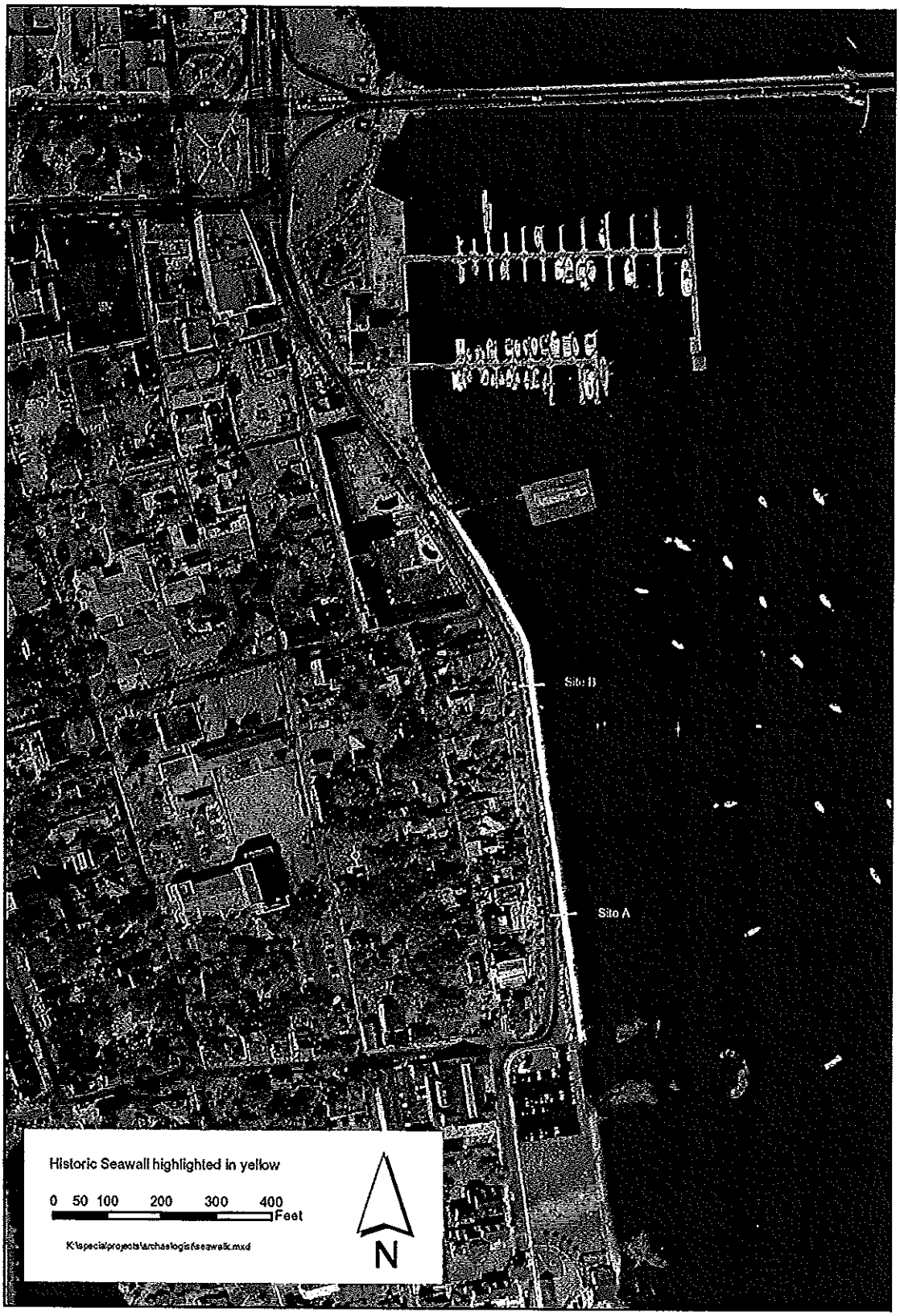


Figure 3. Photograph of Site A trench and historic seawall.

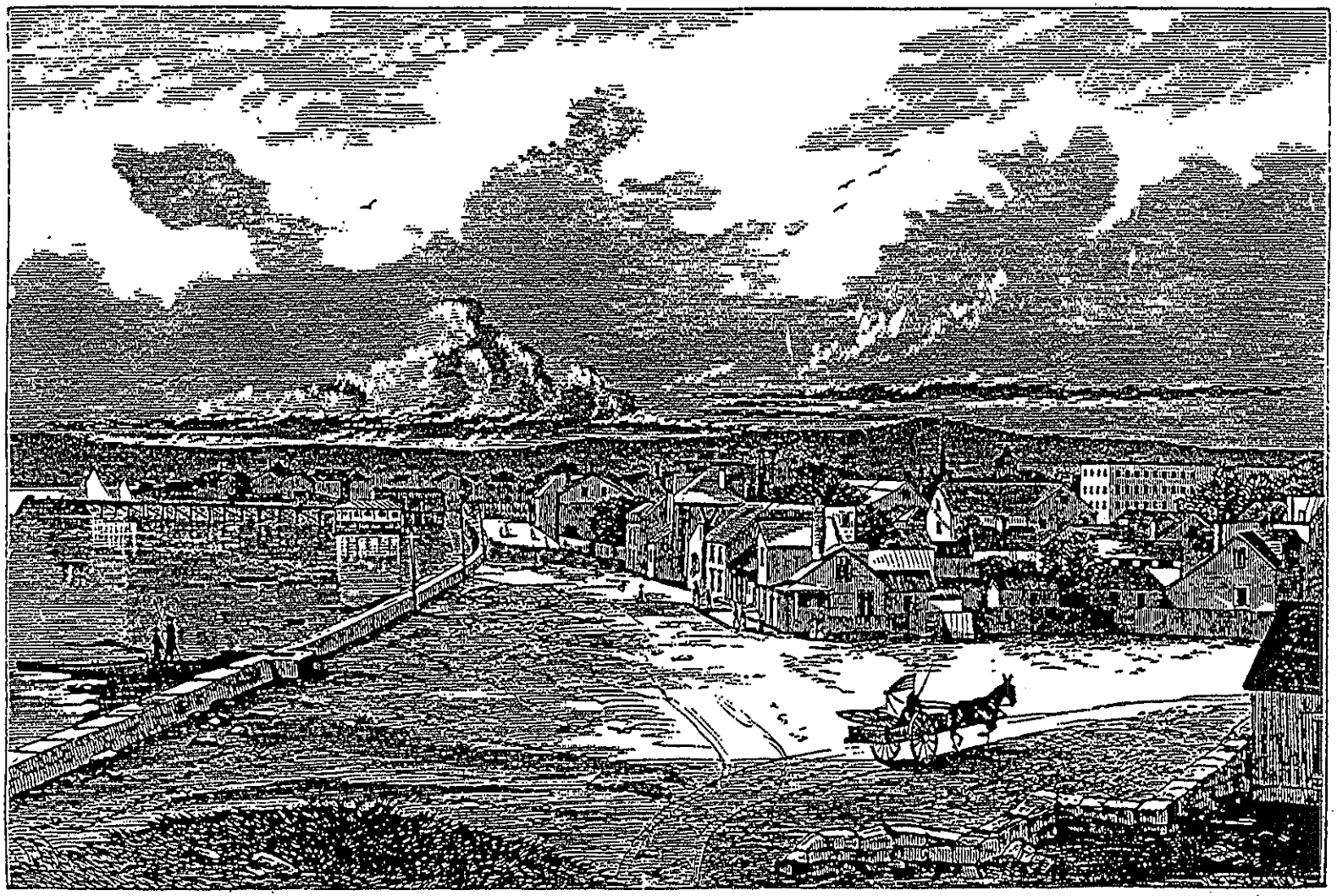

VAC-CON

Figure 4. Photograph of "pavers" at Site A in marsh deposits.

Figure 5. Photograph of archaeological trench and historic seawall at Site B.

Figure 6. View of historic seawall from the shore of the Intracoastal Waterway.

Figure 7. Late 19th century drawing of St. Augustine's seawall and waterfront showing pavers extending out from the seawall.

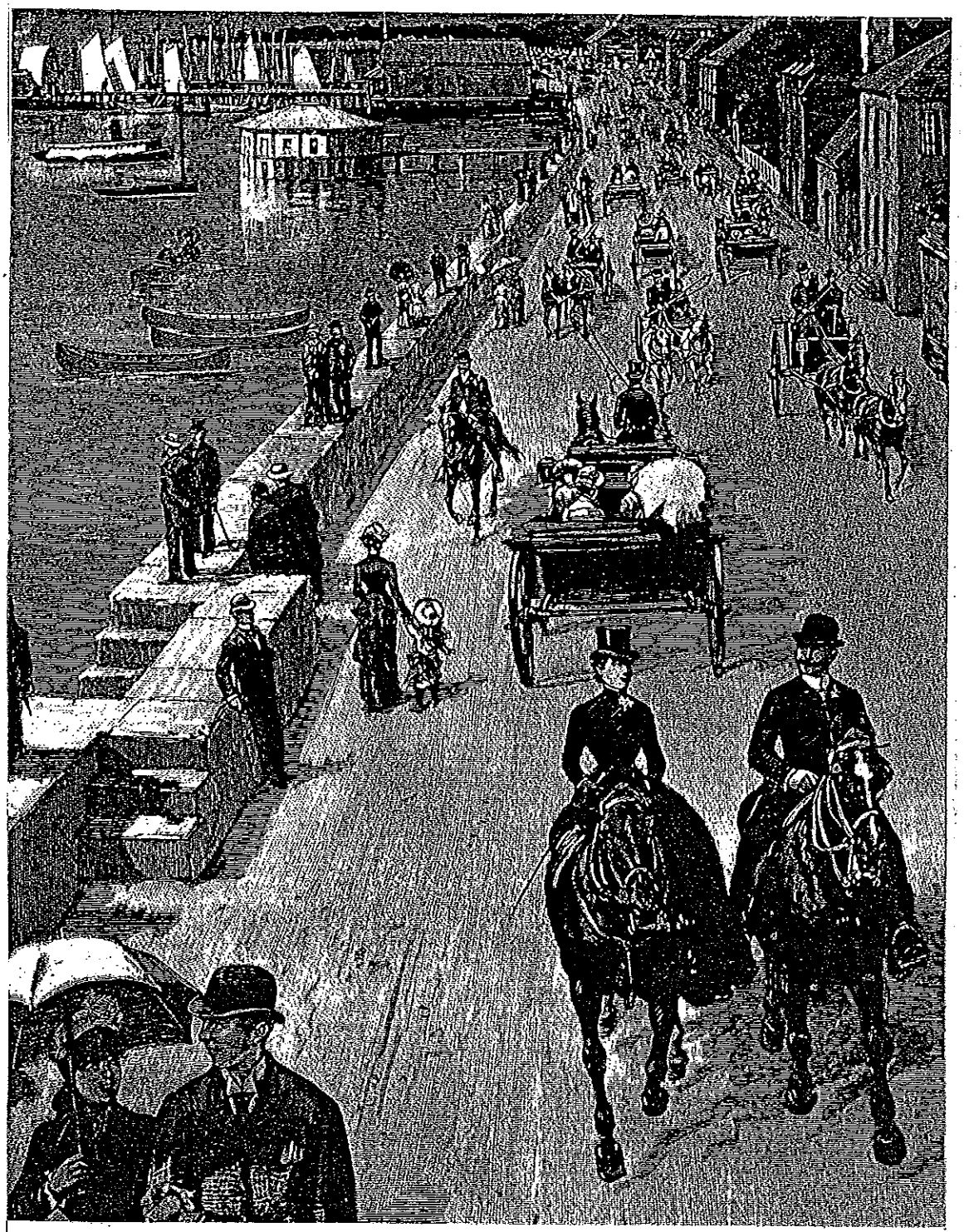


Frontispiece.] ST. AUGUSTINE.—SEA-WALL; LOOKING FROM FORT MARION.

Figure 8. Late 19th century drawing of St. Augustine's seawall and waterfront.

SEA WALL.—ST. AUGUSTINE, FLORIDA.

Figure 9. A March Day in St. Augustine, Florida, sketch by F.H. Taylor, Harper's Weekly, Vol. 29, No. 1479, April 25, 1885.



A March Day in St. Augustine, Florida From a sketch by F. H. Taylor in *Harper's Weekly,* Vol. 29, No. 1479 April 25, 1885, p. 265.

Figure 10. LIDAR-Generated topographic map of the colonial downtown district, St. Augustine, Florida.

Topographic Elevations of Downtown St. Augustine based on LIDAR

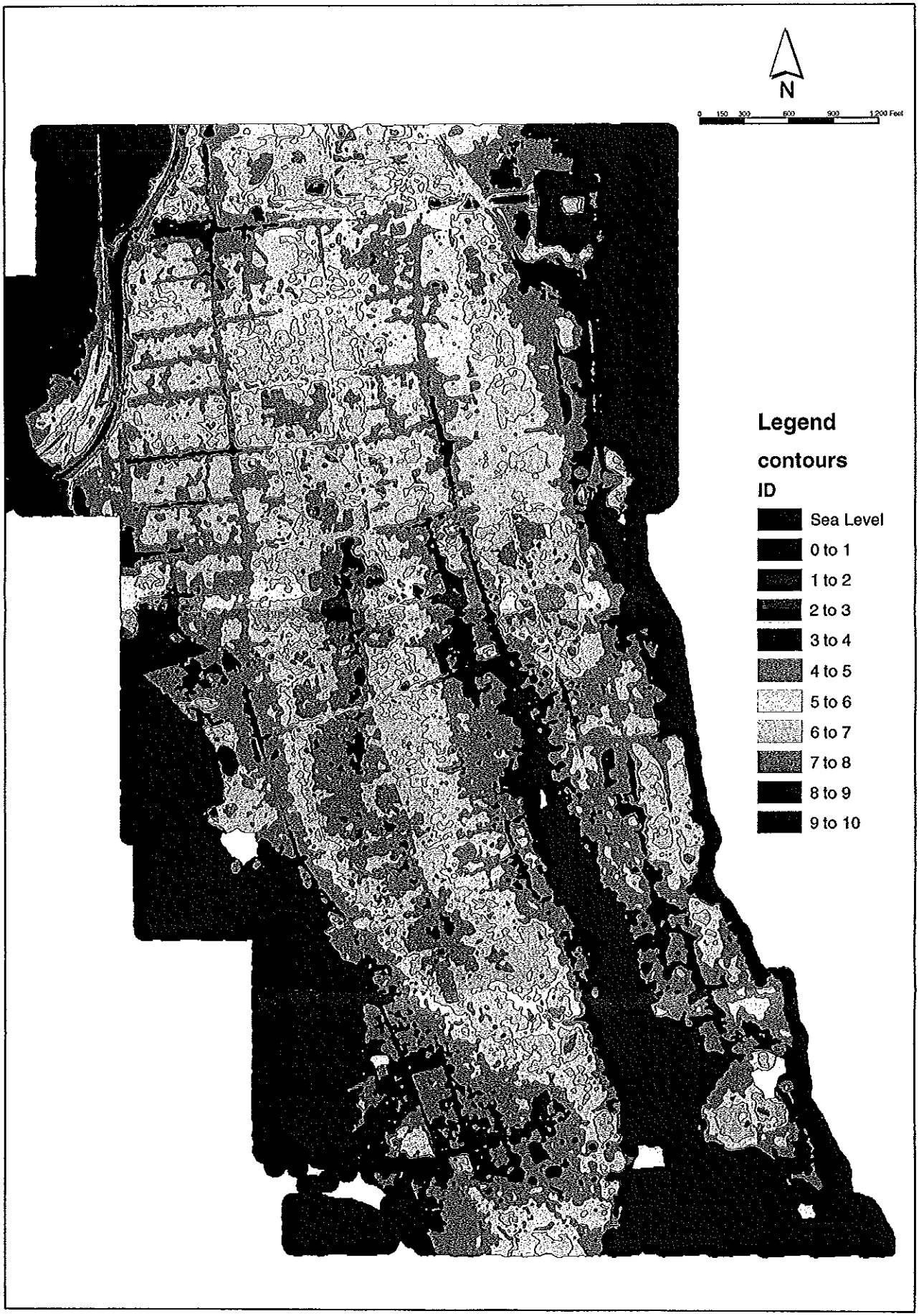


Figure 11. Field sketch of the archaeological profile of the historic seawall features and associated sediments at Site A.

Nov. 25, 2003

a. 3m x 1m trench excavated on seaward to determine nature of sea wall and sediments. The wall formation extended 3m east of granite coping stone. The pavers were sloped and averaged 15 cm in thickness. Pavers appear to occur directly atop marsh sediments. About and extending east of the pavers was a dense deposit of oyster, with some clam, shell. Cultural debris consisted of one ginger beer bottle fragment and one brass furniture tack. Excavation occurred during at the lowest tide level (ca. 3 pm). Excavation carried out by means of shovel, pick, water spray, and vacuum to remove shell overburden.

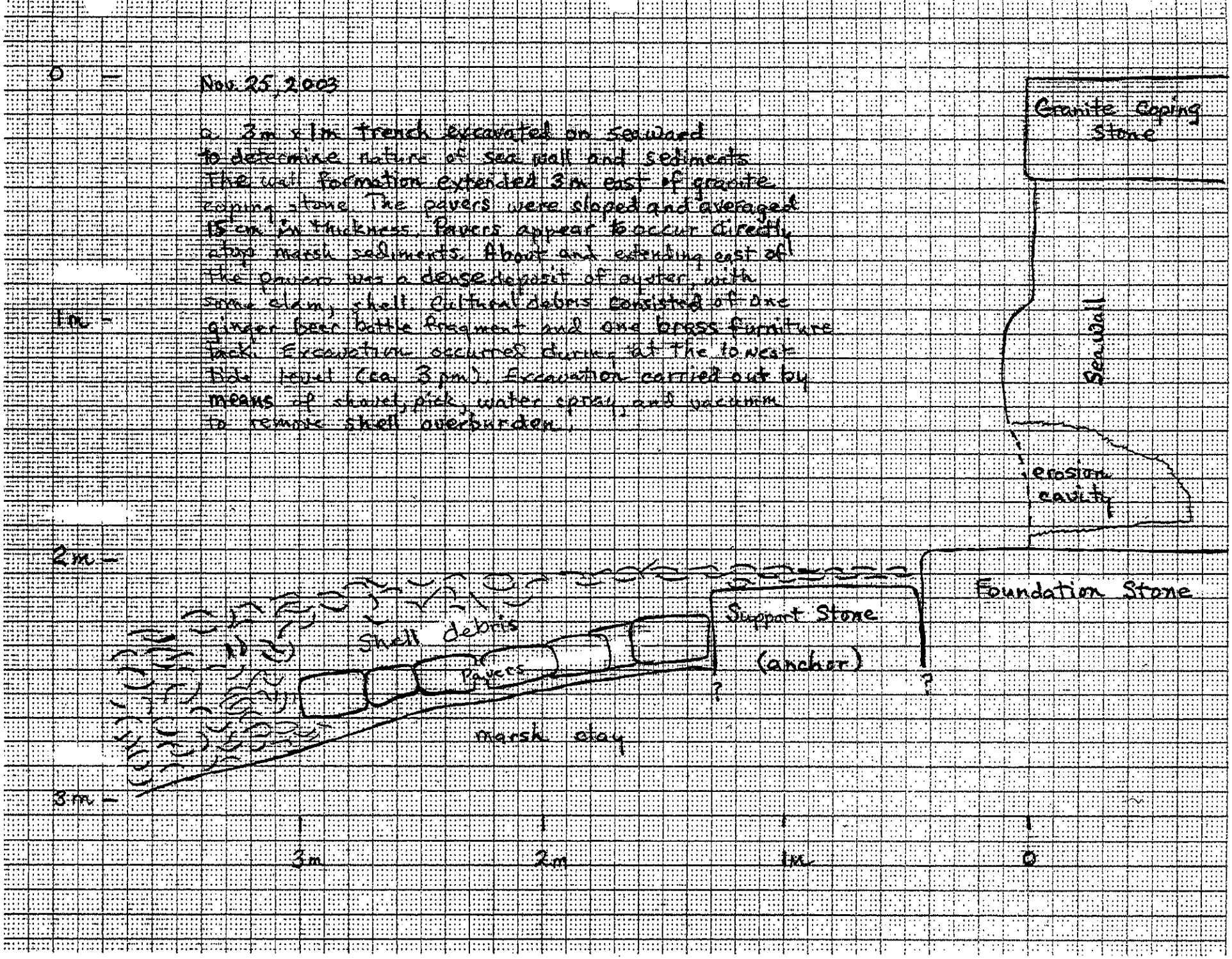
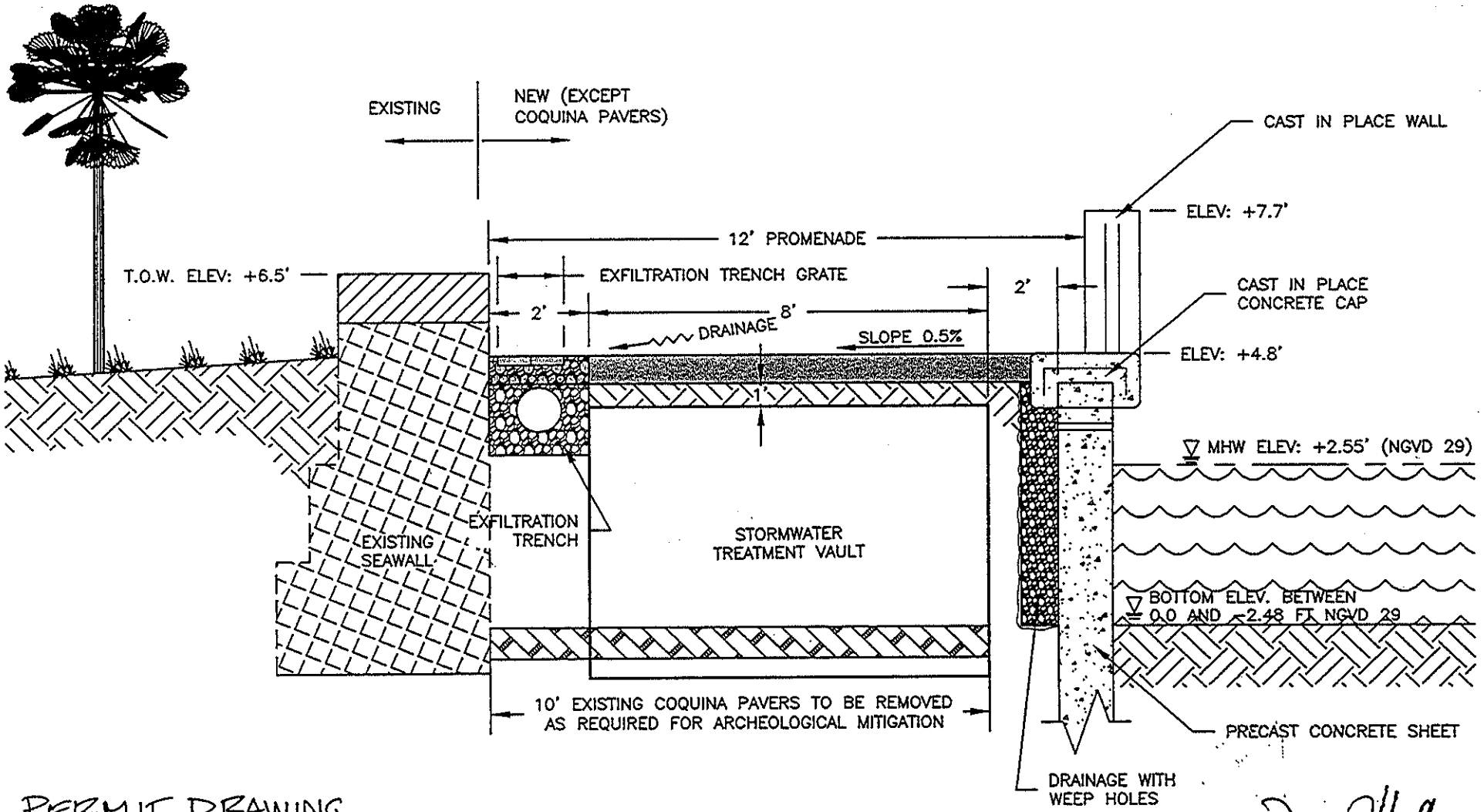


Figure 12. Cross-section of proposed seawall.



PERMIT DRAWING
NOT FOR CONSTRUCTION

CONCEPTUAL SECTION

SCALE: N.T.S.

T. J. Hull
7/30/04
TERRENCE J. HULL P.E.# 42600

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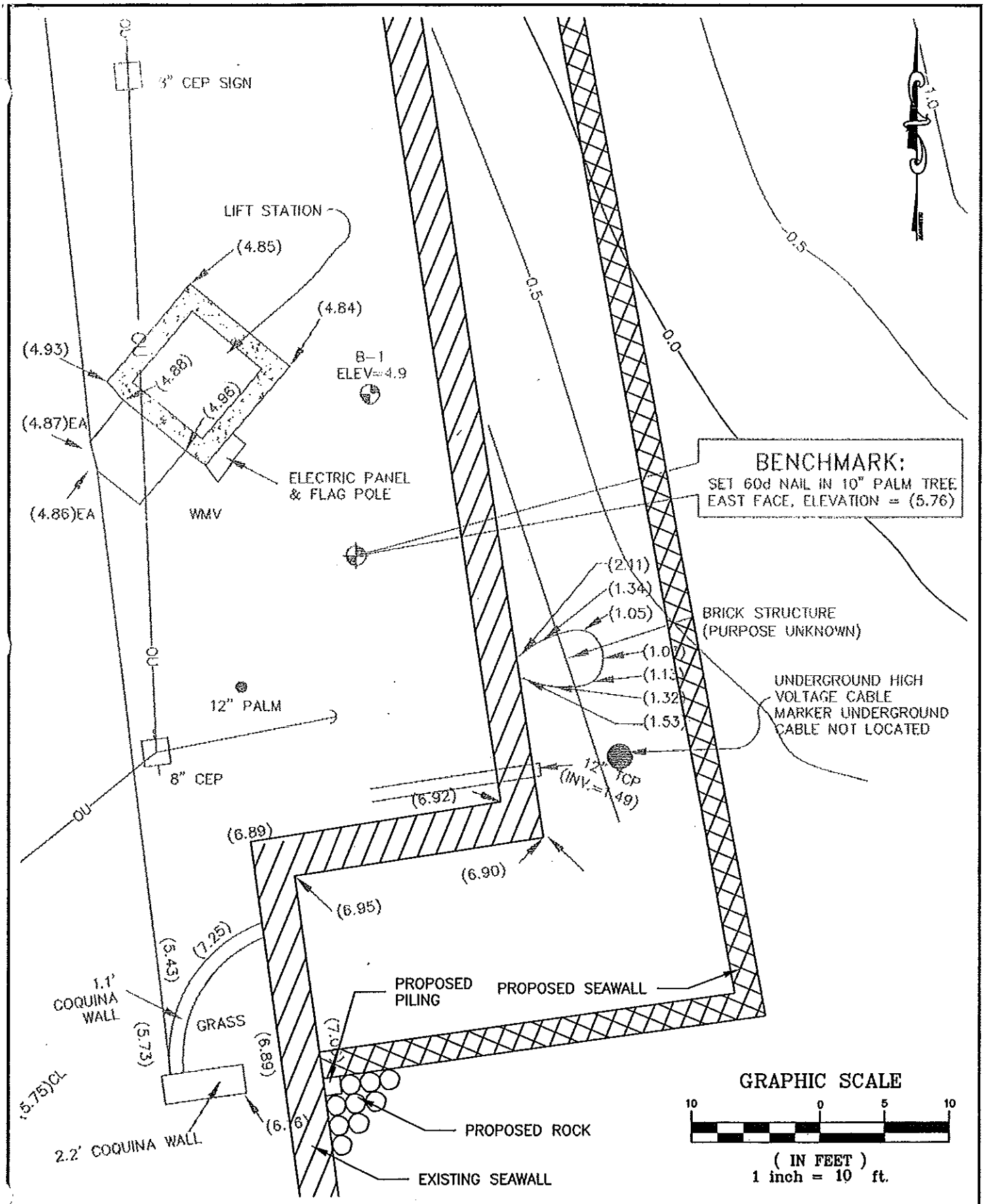
JACKSONVILLE, FLORIDA 32256

FIGURE C6
AVENIDA MENENDEZ PROPOSED SEAWALL
CROSS SECTION W/ STORMWATER TREAMTENT VAULT
ST. AUGUSTINE, ST. JOHNS COUNTY, FLORIDA

PROJECT	C2003-048
DRAWN BY	ER
SHEET	1 OF 1
DATE	JULY 2004

Figure 13. Proposed southern terminus of seawall.



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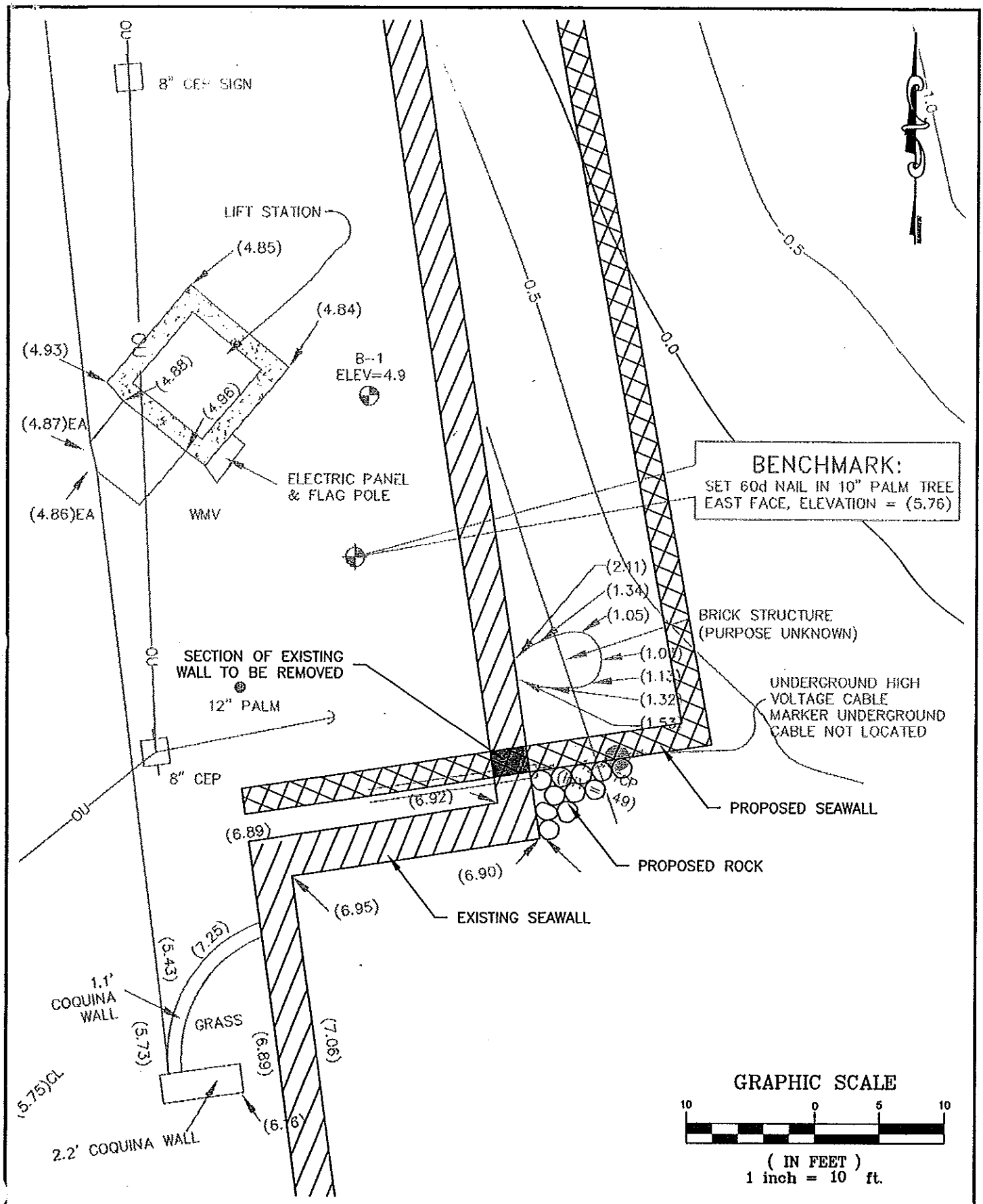
CONCEPT 1
SOUTHERN TERMINUS
AVENIDA MENENDEZ PROPOSED SEAWALL
ST. AUGUSTINE, ST. JOHNS COUNTY, FLORIDA

PROJECT	C2003-048
DRAWN BY	ERAFF
SHEET	1 OF 3
DATE	AUGUST 2004

Figure 14. Proposed southern terminus of seawall.



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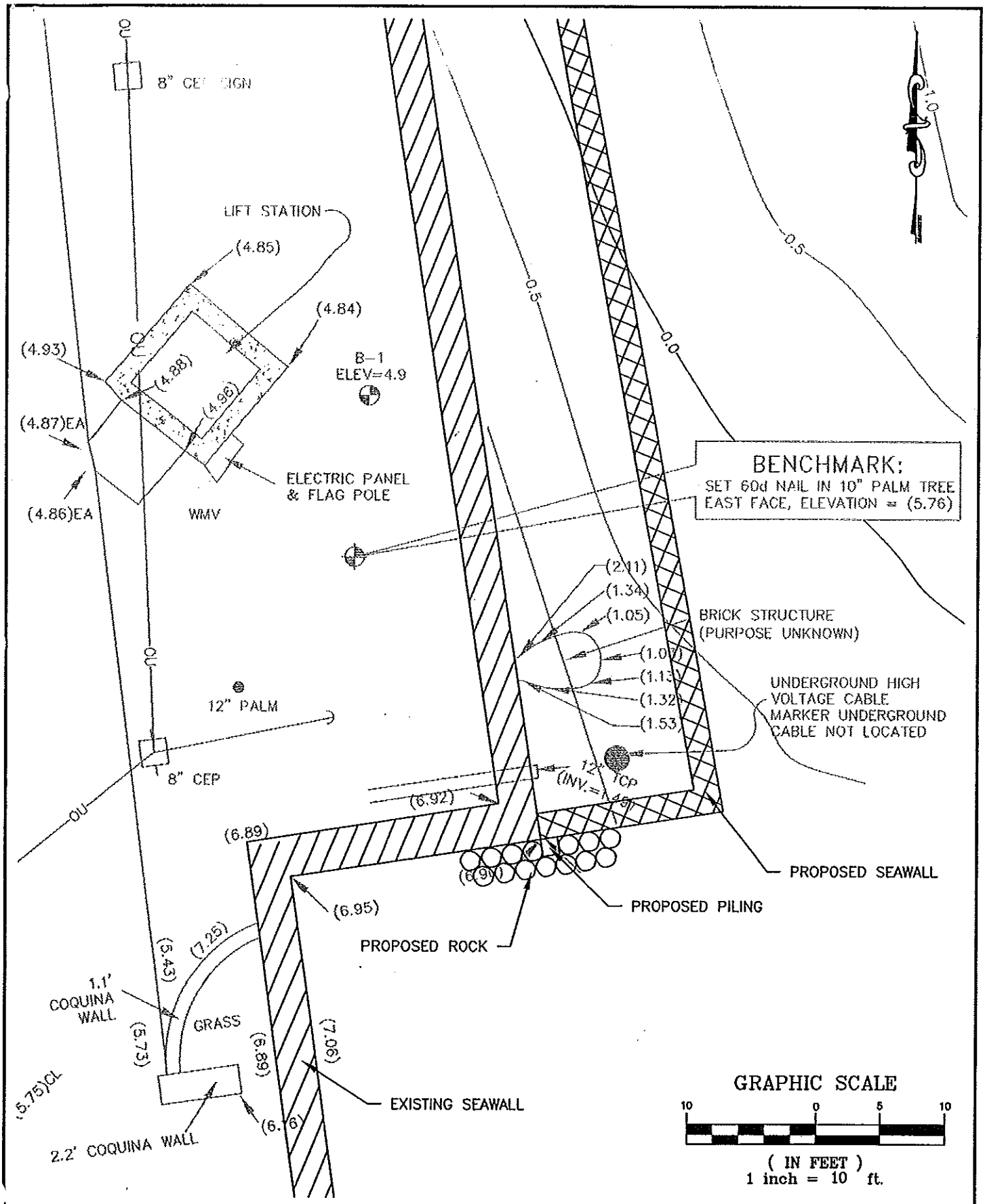
CONCEPT 2
SOUTHERN TERMINUS
AVENIDA MENENDEZ PROPOSED SEAWALL
ST. AUGUSTINE, ST. JOHNS COUNTY, FLORIDA

PROJECT	C2003-048
DRAWN BY	ERAFF
SHEET	2 OF 3
DATE	AUGUST 2004

Figure 15. Proposed southern terminus of seawall.



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CONCEPT 3
SOUTHERN TERMINUS
AVENIDA MENENDEZ PROPOSED SEAWALL
ST. AUGUSTINE, ST. JOHNS COUNTY, FLORIDA

PROJECT	C2003-048
DRAWN BY	E.RAFF
SHEET	3 OF 3
DATE	AUGUST 2004

Figure 16. Stormwater Pollutant Removal Vortex Box System-Footprint Area of Impact.

STORMWATER POLLUTANT REMOVAL VORTEX BOX SYSTEM-
FOOTPRINT AREA OF IMPACT

TOTAL NUMBER OF SYSTEMS = 3
TOTAL LINEAR FOOTAGE OF IMPACT ALONG SEAWALL TOE = 63 FT
TOTAL AREA OF IMPACT = 513 S.F.