Volume 2020 Article 148

2020

Marine Archaeological Survey at the Texas Park and Wildlife Department's Rhodes Point Reef Site, Keller and Lavaca Bays, Calhoun County, Texas

Micheal C. Tuttle

John Rawls

Michael Quennoz

James Hughey

Marine Archaeological Survey at the Texas Park and Wildlife Department's Rhodes Point Reef Site, Keller and Lavaca Bays, Calhoun County, Texas

GRAY & PAPE
HERITAGE MANAGEMENT

Marine Archaeological Survey at the Texas Park and Wildlife Department's Rhodes Point Reef Site, Keller and Lavaca Bays, Calhoun County, Texas

Texas AntiquitiesPermit No. 9295

Lead Agency:
United States Army Corps
of Engineers (USACE),
Galveston District

Prepared for:
Texas Parks and Wildlife Department
4200 Smith School Road
Austin, Texas

Prepared by:
Gray & Pape, Inc.
110 Avondale Street
Houston, Texas 77006

TEXAS PARKS & WILDLIFE
Life's better outside.

20-80001.001

TEXAS PARKS & WILDLIFE

Life's better outside.®

In accordance with Texas State Depository Law, this publication is available at the Texas State Library and other depository libraries throughout the state.

Project No. 20-80001.001

Marine Archaeological Survey at the Texas Park and Wildlife Department's Rhodes Point Reef Site, Keller and Lavaca Bays, Calhoun County, Texas

Texas Antiquities Permit No. 9295

Lead Agency:
United States Army Corp of Engineers (USACE), Galveston District

Prepared for:
Texas Parks and Wildlife Department
4200 Smith School Road Austin, Texas
Contact: Michael Strutt
(512) 389-4800

Prepared by:
Michael C. Tuttle, Ph.D., RPA
John Rawls, M.A. RPA
Michael Quennoz
James Hughey, M.A., RPA

Gray & Pape, Inc.
110 Avondale Street
Houston, Texas 77006
(713) 541-0479

Michael Tuttle, Ph.D.
Principal Investigator
August 20, 2020

ABSTRACT

Under contract to the Texas Parks and Wildlife Department, Gray & Pape, Inc., of Houston, Texas, conducted a Phase I marine archaeological survey for the Texas Parks and Wildlife Department's Rhodes Point Reef Project in Keller Bay, Calhoun County, Texas. The archaeological survey was sponsored by the Texas Parks and Wildlife Department. The Area of Potential Effects for the proposed Rhodes Point Reef Project is a 129.09-hectare (319-acre) trapezoidal tract within the mouth of Keller Bay, at its confluence with Lavaca Bay. Work was completed under Texas Antiquities Permit Number 9295. The United States Army Corps of Engineers, Galveston District has been identified as the lead federal agency, and the conduct of the project meets the requirements contained in Section 106 of the National Historic Preservation Act of 1966, as amended, the regulations of the Advisory Council of Historic Preservation (30 CFR Part 800), the National Environmental Policy Act of 1969, as amended. All marine fieldwork and reporting activities were completed with reference to state law (Antiquities Code of Texas [Title 9, Chapter 191 of the Texas Natural Resources Code] and Texas State rules found in the Texas Administrative Code [Title 13, part 2, Chapters 26 and 28]) for cultural resources investigations. All project records are curated at the Texas Parks and Wildlife Department in Austin, Texas.

The Texas Parks and Wildlife Department's proposed project is designed for oyster reef restoration and requires survey of the bay bottom to determine existing hazards/obstructions, generally characterize the substrate type, and document any magnetic anomalies that could represent historic shipwrecks for avoidance during the proposed undertaking. Oyster reef habitat will be restored by placing approved cultch material on the bay floor in historical oyster reef areas in mounds or in a uniform layer. The Phase I underwater archaeological investigation assessed the number, locations, cultural affiliations, components, spatial distribution, data potential, and other salient characteristics of potential submerged cultural resources within the proposed reefing project area.

The marine field investigations of the Rhodes Point Reef Project survey area consisted of a magnetometer and side-scan sonar investigation of the Area of Potential Effects in safely navigable waters on March 14, 2020. The comprehensive analysis of the magnetic data recorded resulted in the identification of nine magnetic anomalies (RP1–RP9) within the survey area, three (RP1–RP3) of which are interpreted as potential cultural resources (i.e. historic shipwrecks). The remaining magnetic anomalies (RP4–RP9) are interpreted as modern debris associated with recreational and commercial fishing activities, miscellaneous debris from previous tropical storms, existing pipelines, and an abandoned gas well, and as such do not represent significant cultural resources. Side-scan sonar imagery did not indicate any potentially significant cultural material laying above or on the bay bed within the survey area. It did, however, reveal bottom disturbances in the form of trawl scars associated with commercial fishing activities were observed. One acoustic target is located outside of the Area of Potential Effects and is interpreted as a plugged and abandoned gas well. The recommended management action for the Rhodes Point Area of Potential Effects is avoidance of bottom disturbance activities within the 50-meter (164-foot) avoidance areas, as mandated by Texas Administrative Code, Title 13, Part 2, Chapter 26, for magnetic anomalies RP1, RP2, and RP3. If avoidance is not possible, then Gray & Pape, Inc. recommends archaeological diver-ground truthing to identify and evaluate the potential for National Register of Historic Places significance of each anomaly.

TABLE OF CONTENTS

LIST OF FIGURES

1.0 INTRODUCTION

Gray & Pape, Inc. (Gray & Pape), of Houston, Texas, in conjunction with BIO-WEST. Inc. (BIO-WEST), also of Houston, conducted a Phase I marine cultural resources survey for the Texas Parks and Wildlife Department's (TPWD's) Rhode's Point Reef Project in Keller Bay, Calhoun County, Texas. The Texas Parks and Wildlife Department plans to create a new shallow artificial reef for oyster restoration and requires survey of the bay bottom to determine existing hazards/obstructions, characterize the substrate type, and document any magnetic anomalies that could represent historic shipwrecks for avoidance during the oyster reef project.

The submerged land for the Rhodes Point Reef Project of Potential Effects (APE) is in State Tract numbers 57 and 61, which are administered by the Texas General Land Office (TxGLO), an agency of the State of Texas created to manage the public domain. As such, the Antiquities Code of Texas (Texas Natural Resource Code, Title 9, Chapter 191) applies. Marine fieldwork and reporting activities were completed with reference to state standards (Antiquities Code of Texas [Title 9, Chapter 191 of the Texas Natural Resources Code] and Texas State Guidelines found in the Texas Administrative Code [Title 13, Part 2, Chapters 26 and 28]) for cultural resources investigations. Work was completed under Texas Antiquities Permit Number 9295 issued by the Texas Historical Commission (THC) on February 25, 2020. As the project is within the navigable waters of the United States, the United States Army Corps of Engineers (USACE) has been identified as the lead federal agency, and the conduct of the project meets requirements under Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, the regulations of the Advisory Council of Historic Preservation (30 CFR Part 800), and the National Environmental Policy Act of 1969, as amended.

1.1 Project Overview

The project area is located along the Texas Gulf Coast. The Rhodes Point Reef plot is a 129.09-hectare (319-acre) trapezoidal tract within the mouth of Keller Bay, at its confluence with Lavaca Bay (Figure 1-1).

Oyster reef habitat will be restored by placing approved cultch material on the bay floor in historical oyster reef areas in mounds or in a uniform layer. The areas chosen must have a bottom firm enough to support materials. The cultch may be laid in either a uniform layer or in mounds. Cultch spread in a uniform fashion will range from 1 meter (3 feet) to 2 meters (6 feet) in depth. Mounded cultch material will be laid in a diameter not to exceed 3 meters (10 feet) in diameter and no taller than 0.6 meters (2 feet) high. It is important to note that mounded cultch will not be a navigation hazard as mound crest will be greater than 1 meter (3 feet) from the surface of the water at Mean Lower Low Water (MLLW).

REMOVED FROM PUBLIC COPY

Figure 1-1. The Rhodes Point Reef project area location, Keller Bay, Calhoun County, Texas.

1.2 Report Organization

This report is organized into seven numbered chapters. Chapter 1.0 provides an overview of the project. Chapter 2.0 presents an overview of the environmental setting and geomorphology of the project area. Chapter 3.0 presents a discussion of the cultural context associated with the project area. Chapter 4.0 presents the research design and methodology developed for these investigations. The results of these investigations are presented in Chapter 5.0. Chapter 6.0 presents the investigation summary and provides recommendations based on the results of field survey. A list of all references cited is provided in Chapter 7.0.

1.3 Curation

No diagnostic or non-diagnostic artifacts were collected in the course of the current survey. As a project permitted through the THC; however, Gray & Pape submitted project records to TPWD in Austin, Texas.

1.4 Acknowledgements

The successful completion of this project was made possible by a joint effort between BIO-WEST and Gray & Pape personnel. BIO-WEST provided all equipment and watercraft necessary for the survey. Research on various aspects of this project was conducted by Project Manager Jim Hughey, M.A., RPA, Principal Investigator Michael Tuttle, Ph.D., RPA, and Marine Archaeologist Michael Quennoz. Background research included consultation of online research archives maintained by the THC, resources maintained by the Soil Service Staff of the Natural Resources Conservation Service of the United States Agriculture Department (SSS NRCS USDA), and numerous marine targets datasets.

The marine survey was conducted on March 14, 2020. The survey team included BIO-WEST's Matt Chastain, Captain Richard Williamson, and Gray & Pape's Dr. Michael Tuttle. Magnetic and acoustic data analysis was conducted by Marine Archaeologist John Rawls, M.A., RPA, and reviewed by Michael Tuttle. John Rawls, Michael Tuttle, Michael Quennoz, and Jim Hughey prepared the report. Duncan Hughey and Tony Scott produced graphics, M.A. Jessica Bludau edited and produced the report.

2.0 PHYSICAL SETTING

2.1 Physiography and Geomorphology

The present coastline of the Texas Gulf Coast has fluctuated relatively little in the past approximately 3,000 years. However, prior to 8,000 B.C., the Gulf Coast extended to the southeast. Towards the end of the Pleistocene era 20,000 years ago, global temperatures rose, and sea levels rapidly began to rise. By 8,000 B.C., shorelines worldwide had progressed inland, with the flooding of the valleys of major streams along the Texas coast, such as the Trinity, Lavaca, Guadalupe, Aransas, and Nueces Rivers (Ricklis and Weinstein 2005). As a result, the earliest forms of the modern coastal bays found in Texas were created.

Keller Bay is an extension of Lavaca Bay and is separated from the Gulf of Mexico by a postglacial barrier island of dunes and wash over fans. Depths are greatest in the middle portions of the bay, approximately 1.8 meters (6 feet) maximum depth and shallower along the shoreline, approximately 0.30 meters (1 foot) in depth. Freshwater inflow into Keller Bay mostly comes from Keller Creek which empties into the bay.

2.2 Soils

The terrestrial environmental setting found nearest to the Rhodes Point Reef project area consists of the Telferner-Edna soil association (s7675). It is described as a "nearly level, non-calcareous, somewhat poorly drained, and poorly drained loamy soils" on the upland coastal plain and on some high terraces of the uplands (Mowery and Bower 1978:4).

2.3 Natural Environment

2.3.1 Climate

Calhoun County's proximity to the Gulf of Mexico tends to influence the temperature, rainfall, and relative humidity of the region, producing a humid subtropical climate. Winds usually trend from the southeast or east, except during winter months when high-pressure systems can bring in polar air from the north. Summers are warm, and winters tend to be mild. The mean daily maximum temperature for the year is 26.5° Celsius (79.7° Fahrenheit), and the mean daily minimum temperature is 16.2° Celsius (61.1° Fahrenheit). Precipitation comes in both thunderstorms and trace amounts. Hurricanes are known in the region producing high winds and copious amounts of rain. Average annual rainfall for Calhoun County is 65.8 centimeters (25.9 inches) (Mowery and Bower 1978).

2.4 Tide

The project area is in Texas' shallow coastal bay and experiences tidal influences. During the field activities for this project, the tide at the Port Lavaca Station (ID 8773259), the closest tide monitoring station, was reported to range from a high of 0.26 meters (0.85 feet) to a low of 0.02 meters (0.07 feet) for a total range of 0.24 meters (0.78 feet). The reported extreme tides for March were at a high of 0.32 meters (1.06 feet) on March 5, 2020 and a low of -0.07 meters (-0.18 feet) on March 6, 2020, for a total range of 0.39 meters (1.24 feet) (NOAA 2020b). The tide, although not dramatic, does have an influence on the area surveyed.

3.0 CULTURAL CONTEXT

3.1 Prehistoric Context

3.1.1 Paleoindian Period

Evidence is sparse for Paleoindian habitation, and much of what is known about the period in the current project area comes from a compilation of materials gathered from around the state of Texas and North America. At the close of the Pleistocene, large-game hunters crossed the Bearing Strait, and within a few millennia had penetrated South America (Newcomb 1961). The Paleoindian people traveled in small bands and were mega-fauna hunter-gatherers with the bulk of their meat protein derived from mammoths, mastodons, giant bison, and giant sloths. It is believed that in south Texas, the Paleoindian people traveled in small groups of non-specialized hunters and gatherers rather than the larger groups normally associated with the big game hunters of the Great Plains (Hester 1976). These groups carried with them an easily recognizable stone tool material culture, though little is known about their wooden or bone tools or their clothing types. Diagnostic spear points such as fluted Clovis, Folsom, and Plainview points can be used to identify a site's Paleoindian component, and the nature of these points demonstrate the population's hunting style. Paleoindian-era points are large and designed to be attached to a spear. No evidence of bow and arrow hunting has been found associated with this period (Newcomb 1961).

3.1.2 Archaic Period

After the Pleistocene, the Gulf of Mexico's encroachment onto the Texas coast created estuaries along the shoreline. The formation of these estuaries provided the Archaic people of the Texas coast with a ready supply of marine food resources (Jurgens 1989). This shift in food supply is seen as the pivotal transition point between the Paleoindian and Archaic periods in the region (Aten 1984; Newcomb 1961). Within the boundaries of the south Texas coast, the Aransas complex has been identified based on a suite of tools indicative of a lifestyle based on marine resources (Campbell 1958; Corbin 1974). Material culture recovered from Archaic sites within the south Texas region includes shell artifacts such as conch columella gouges, adzes, and awls. Stone projectile points recovered from Archaic sites in the region include Abasolo, Palmillas, Ensor, Refugio, and Tortugas types (Turner and Hester 1993).

3.1.3 Late Prehistoric

The Prehistoric period continues from the end of the Archaic period to the Historic period ushered in by the Spanish missions and Anglo-American settlers. During the Late Prehistoric stage in south Texas, two cultural complexes appear to have existed. The first complex was located further east on the coast and appears to have been affiliated with the Goose Creek complex, while the second complex has been called the Rockport complex (Jurgens 1989). During this period, there is a shift to the almost exclusive use of arrow points such as Perdiz and Scallorn (Turner and Hester 1993), and almost every group had pottery. It is during this period that two similar cultural groups, known today as the Coahuiltecans and the Karankawas, are identifiable both ethnographically and archaeologically.

Within south Texas, these two dominant cultural groups extended south of Galveston Bay to the Rio Grande and as far west as present-day San Antonio. The coastal group was known as the Karankawas and the inland group was known as the Coahuiltecans. Most of what is known of both groups comes from the time that Cabeza de Vaca spent with them as a captive and trader (Newcomb 1961).

The Coahuiltecans dominated the majority of the land of present-day Aransas County. Their language group, which is related to the Hokan group of languages of California, extended from the Gulf Coast far west to present day San Antonio (Aten 1984). The Coahuiltecans were subdivided into over two hundred small bands with four or five groups living within the south Texas region. The Aranamas dwell primarily between the San Antonio and Guadalupe rivers. South of the Aranamas was a group known as the Orejons, who lived along the lower Nueces River. The Pachal group lived near the junction of the Frio and Nueces rivers and possibly even crossed the Rio Grande.

The Karankawas, whose language was also in the Hokan group (Aten 1984), extended from Galveston Bay southwestwards as far as the present site of Corpus Christi Bay. As described by Newcomb (1961), seven proper names are associated with the culture. Researchers subdivide these names into five distinct groups based on geography. The Capoques and the Hans lived in the area between Galveston Bay and the Brazos River. The Kohanis lived south of the Capoques and the Hans at the mouth of the Colorado River. The Karankawa proper (which included the Korenkake, Clamcoets, and Carancaguacas) lived in the region of Matagorda Bay. Along Copano Bay and St. Joseph Island, were the Kopanos (Newcomb 1961).

3.2 Historical Context

3.2.1 Historic Period

With the discovery of the New World by Columbus in 1492, the Spanish conducted numerous other voyages of exploration along the American continents during the early sixteenth century. J.H. Parry (1966) indicates that the Spanish had three general stages of growth in the New World: the island stage, the Mexican stage, and the Isthmian or Peruvian stage. After the Caribbean Islands were exploited of their easy wealth, Cortes' conquest of Mexico 1519-1521 encouraged the settlement and exploration of the continent proper. From 1522, the average size and number of ships sailing from Spain to the Americas steadily increased (Parry 1966). It was during this period when the Texas coast was initially examined, and at a high cost.

The earliest Spanish examinations along the west Gulf Coast was that of Alonso Alvarez de Pineda, which was initiated in 1518. From Florida to Mexico, via the Mississippi and the coast of modern-day Texas, new discoveries were made. Unfortunately, the natives of the region were hostile and many of the explorers were killed and all but one ship lost; however, the Gulf of Mexico was successfully mapped (Morison 1974; Johnson 2002). The next voyage to the region was that of Panfilo Narvaez in 1527-1528. Like that of Pineda this exploration ended in tragedy, which was slightly self-imposed. Narvaez sailed to Florida with five vessels and several hundred soldiers, sailors, and colonists. Dismissing his vessels, he and 260 of his men landed and attempted to venture around parts of the Gulf and meet the ships at a prearranged point. All did not go as planned, the natives were hostile, the ships never reestablished contact, and somewhere near the Mississippi River new vessels were constructed in an attempt to return to Mexico. Only four adventurers survived the expedition to make their way to safety. One of the survivors was named Alvar Nunez Cabeza de Vaca, who left an account of this 8-year misadventure on the Texas coast and interior (Morison 1974; Johnson 2002).

Another failed Spanish mission that may have encountered Matagorda Bay was that of the famed Hernando de Soto. Like Narvaez, de Soto landed in Florida and during 1539 began his adventures to the north and west. After encountering the Mississippi River in 1541 and exploring further west along the larger tributaries, De Soto died in 1542. Luis de Moscoso Alvarado took command, built several vessels during the spring of 1543, sailed down the Mississippi to the Gulf of Mexico, and followed the coast to the Panuco River, in Spanish held territory. It is conjectured that they may have entered Matagorda and Corpus Christi Bays along the coast of Texas for water and provisions, however, little was made of the discoveries (Morison 1974; Johnson 2002).

With the confines of the Gulf of Mexico known and mapped by the mid-sixteenth century, the region was not the focus of intensive exploration. During the later sixteenth and early seventeenth centuries, while the Spanish were consolidating and exploiting their New World empire, focusing on the mineral wealth of Mexico and South America, other European nations began to send explorers and adventurers to claim lands unoccupied by the Spanish. Most of the lands claimed by other European nations were in North America well removed from Spanish habitations and active opposition. The Frenchman Robert Cavalier, Sieur de La Salle, commonly known as La Salle, ranged throughout the continent and eventually claimed the Mississippi River system for his king in 1682.

During a return voyage to establish a French outpost at the mouth of the Mississippi, through a navigation error or other seventeenth century technological failure, La Salle ultimately landed on the Texas coast in the region of Matagorda Bay in 1685. Unfortunately, one of his three vessels, *L'Aimable*, wrecked at Pass Cavallo, the entrance to the bay. The other two vessels, *La Belle* and *Le Joly*, made it safely into the bay. The captain of the *Le Joly* had orders to carry supplies for the expedition and once his task was complete left for France taking several of the would-be colonists with him. La Salle was left with one ship, 180 people, and little idea of where he was. A camp called Fort St. Louis was made at the head of Lavaca Bay on the banks of Garcitas Creek. After several misadventures, including the loss of *La Belle*, La Salle decided to march with a small group of survivors to Canada so that a rescue mission could be organized, but he was murdered by his disgruntled men in March of 1687 (Bruseth and Turner 2006). La Salle's was an early failed attempt by Europeans to colonize Texas.

At Fort St. Louis, La Salle had left hardly more than 20 persons with the crippled Gabriel Minime, Sieur de Barbier, in charge. They consisted of women and children, the physically handicapped, and those who for one reason or another had incurred La Salle's disfavor. The Indians, learning of La Salle's death and the disunity among the French, attacked the settlement by surprise around Christmas 1688, sparing only the children (Weddle 2011).

The Spanish, jealous of their possessions and not wanting the French to establish a base, sent out an expedition to find and eliminate the threat that La Salle posed once they heard of it from a sailor named Denis Thomas, who jumped ship from the voyage and was ultimately captured while buccaneering. The Spanish found the wreck of La Salle's *La Belle* in early April of 1687 but did not locate Fort St. Louis. It was a couple of years later when the Spanish became aware of the ultimate demise of the French at Fort St. Louis. Another expedition to the east Texas region was informed by the local Karankawa Indians that all the French were killed, and as proof the natives had many war trophies in the material possessions of the dead (Bruseth and Turner 2006). The wreck of La Belle is highly significant for its historical value and is listed among several early wrecks in the northern Gulf of Mexico region that have been archaeologically examined (Borgens 2011).

3.2.2 Civil War

During the American Civil War, the Union placed a naval blockade, quickly to be labeled the Anaconda Plan, almost immediately upon the seceding southern states. Unprepared for the war, the north could not establish an effective blockade immediately, but over time resources were developed and employed to strangle southern trade. The Confederate government did not have a well-developed naval or merchant marine infrastructure at the beginning of the conflict, nor did it have the resources to develop one. However, southern blockade runners had great success at the beginning of the war getting through the porous Union effort. Later in the war, when the Federal forces were more effective, and the laws of supply and demand were intensified, blockade running was a financial boon for successful ventures. As the Union Anaconda Plan began to be effective along the Atlantic coast of the Confederacy, the coast of Texas became more appealing to those who wished to move cotton out and various military and luxury goods into the Confederacy.

Texas, geographically at the western end of the Confederacy, was at the margins of strategic thinking, as the Mississippi River and the Atlantic Coast regions were initially focused upon. However, this did not inhibit the natives of the region from attempting to protect their shores and repel northern attacks and occupations. Although the port of Galveston and the Sabine Pass to the north were the sight of several major operations throughout the war, Matagorda Bay was also the scene of some belligerent activity. During the first months of the war, the *Star of the West*, famous in part for being fired upon by the Confederates in Charleston Harbor in January of 1861, was on another Federal mission to help evacuate northern soldiers from Texas. The *Star of the West*, chartered to carry Union baggage and supplies out of Texas, was captured in the waters of Matagorda Bay off Indianola by a small number of troops from Galveston using the vessel *General Rusk* on the 17th of April (Scharf 1996).

Matagorda Bay was entered by Federal gunboats as there were no real Confederate naval assets to stop them. Union vessels bombarded Indianola which was also briefly occupied and looted in the autumn of 1862. Just days later, Lavaca, a hub of military activity at the western edge of the Confederacy containing a Confederate arsenal and small-arms factory, was bombarded. Hosting several garrisons at various occasions throughout the war and having an active artillery battery, Union forces soon retired from the town. Late the next year, 1863, Union troops returned to occupy both towns. About six months later, in June of 1864, Federal troops evacuated the Matagorda Bay area (Malsh 2017; Maywald 2010). In addition to being the scene of minor naval engagements, other activities such as blockade running, and commerce raiding took place in and from Matagorda Bay.

The Confederates used the tactic of commerce raiding throughout the war as they did not have the ability to produce naval vessels in quantity or quality to match the output of the North. Therefore, they tried to destroy northern commerce as they could not challenge the Union Navy. Near the end of the war, February of 1865, the Confederate privateer *Anna Dale* was waiting in Pass Cavallo for the remainder of her crew before she tried to slip the blockade to wreak havoc on Union shipping. Federal crews attempted to cut out the *Anna Dale* before she could make a cruise but ended up burning her when she grounded (Porter 1998). Thus, naval actions and maritime stratagems, although not central to the conflict, can be seen to have played out in Lavaca and Matagorda Bays from the beginning through to the end of the war.

3.2.3 Post-Civil War

After the Civil War, the bayside communities of Lavaca and Indianola rebuilt their infrastructure that was destroyed during the conflict. Railroads were rebuilt by both communities with service into the interior of the state to complement their shipping facilities. Competition between the two communities as a regional transportation hub appeared to favor Indianola. Unfortunately, the low-lying region was devastated by a hurricane in 1875 and again by the hurricane and fire of 1886. These tragedies devastated Indianola and the town was soon abandoned and Lavaca, to the north, began to prosper in its stead. Lavaca became the county seat in November 1886. The next year a railroad service to Victoria and to the interior was reestablished and an era of growth began, and the town began to be known with the prefix Port (Malsh 2017; Maywald 2010).

3.2.4 Twentieth Century

Transportation developments changed the face of Port Lavaca. Cattle shipments, once a primary industry, were lost out to the railroad's expanding network. However, the railroad also created new opportunities. From the interior came a new commodity, tourists, people that would spend their resources enjoying the attractions of the bay. The bay also became a place of work as the federal government began waterway improvement projects such as dredging. In 1910, a channel was completed from Port Lavaca all the way to Pass Cavallo, the inlet at the Gulf of Mexico.

Three years later the Gulf Intra Coastal Waterway was completed giving Port Lavaca a protected water link to a major deep-water port to the north, Galveston. Fishing, in particular shrimping, became a leading industry for the region. Port Lavaca became a national leader in seafood shipments during the 1920s. This growth contributed to further expansions in the local infrastructure that affected the bay. A causeway was completed between Port Lavaca and Point Comfort in the 1930s. Additionally, gas and oil were discovered in the region during this period. Harbor improvements were also completed adding to an infrastructure that would attract business (Malsh 2017; Maywald 2010).

In the post-World War II era, large companies such as Alcoa, Union Carbide, Du Pont, and others established industrial facilities in the nearby communities. In 1953, residents 3.2 kilometers (2 miles) east of Port Lavaca, across Lavaca Bay, voted to become the county's third incorporated city, Point Comfort. By the early 1960s, the town was a mini industrial center supported by large aluminum plant and chemical industries. With the growing economic base, the need for access to better shipping infrastructure in the form of a deep navigation channel through Lavaca and Matagorda Bays to the Gulf of Mexico was recognized. Although hurricane Carla caused a large amount of damage in 1961, which ultimately lead to the causeway, a major transportation feature, being abandoned, the region persevered. In 1963, the port of Port Lavaca-Point Comfort was designated a port of entry for customs purposes. Two years later the deep-water channel from Point Comfort, with a side channel to Port Lavaca, known as the Matagorda Ship Channel (MSC) was completed (Malsh 2017; Maywald 2010).

As can be seen from the earliest days of Spanish exploration, through to the era of the Texas Republic and Civil War of the nineteenth century into the twentieth century, the waterways of Matagorda and Lavaca Bays have been utilized, and even depended upon, for transportation, communication, industry, and fishing. This robust utilization of the resource indicates that there may be resources of historical significance located beneath its waters. This is most strikingly illustrated by the recently located and removed seventeenth century ship *La Belle*, associated with La Salle's exploration and settlement activities in Matagorda and Lavaca Bay region. However, most of the historic activity took place along the western boundaries of the bays, while much of the development has taken place in the modern era.

3.2.5 Keller Bay Communities

3.2.5.1 Olivia

The nearest community located to the APE is the town of Olivia. It is situated at the confluence of Keller Creek and Keller Bay east of the APE. Olivia, established in 1892, was named for Olivia Haterius, wife of the Rev. Carl J. E. Haterius, a Swedish Lutheran minister who purchased land in the area and advertised a new settlement to other Swedish immigrants in the Midwest (THC 1992, THC Atlas Number 5057003855).

The first public building in Olivia was a one-room schoolhouse where children were taught during the day and parents attended classes at night to learn English. The Eden Lutheran Church held services in the schoolhouse until

1910, when a sanctuary was built. John Lind, who built the first store in the community on Carancahua Bay in 1894, moved his store to the center of the townsite in 1900. The post office was housed in Lind's store and mail was delivered once a week. In 1906, Edward Wilson, another Swedish immigrant, bought the Olivia store and was appointed postmaster. Other businesses included a hotel, doctor's office, grocery store, blacksmith shop, and cotton gin. Since 1900, the thriving community has changed and grown but retains its proud Swedish heritage (THC 1992, Atlas Number 5057003855).

3.2.6 Maritime Context

Researching the types of watercraft ubiquitous to region throughout history can aid in the identification and temporal association of encountered shipwrecks and vernacular watercraft within the APE. Probing historic documentation of vessel losses is another avenue to assist in identifying submerged cultural resources reportedly lost within a specific area.

Various types of watercraft have been used to ply the waters of coastal Texas and its associated rivers from the earliest prehistoric inhabitants to the modern-day local residents and commercial enterprises. Vernacular watercraft were developed, constructed, and modified for use in the shallow lakes and bayous and shoaled, snag-filled rivers throughout coastal Texas, while sea-going vessels with deeper drafts were confined within a maintained navigation channel or dispersing their cargo among smaller vessels or boats for transport inland. During travel, vessels from prehistoric canoes to historic sailing vessels to steamboats were subject to overloading, foundering, snagging, collision, and even boiler explosion. As such, many vessels have been lost throughout the centuries in these waterways. Though there are no specific watercraft that are unique to the project area, a discussion of the types of watercraft that were used in and around the project area throughout prehistory and history and the requisite characteristics of each will be presented to demonstrate changes in morphology and continued trends that may be evident in the archeological record. A discussion of the types of watercraft known to have operated on the waters surrounding the project area is presented.

3.2.6.1 Aboriginal Watercraft

The dugout canoe, also called a pirogue or piragua, represents one of the earliest forms of vernacular watercraft to ply the waters of the APE. These watercrafts were utilized by the Karankawa and other indigenous groups of coastal Texas. The dugout canoe typically is a long, narrow, flat-bottomed, double-ended vessel that could be paddled or rowed. They were primarily used for transpiration within the shallow waters of lagoons and inlets (Francaviglia 2010:36). The early dugout canoe was constructed in a manner that involved felling of a tree and using fire and hand tools to burn and hollow out the log. Cypress was typically the wood of choice, though Native Americans in the region also used cottonwood (Comeaux 1985:164). The degree of variation in size of the dugout depended largely of the size of available logs and for function. For maneuverability and portability, the Karankawa probably restricted their length to not much longer than 6.1 meters (20 feet) with a beam of 0.8 meters (2.5 feet) (Francaviglia 2010:38).

There is one archaeological example of a dugout canoe located in Calhoun County, Site 41CL51. It was located in 1974 by Jack Purcell on Vanderveer Island in Espritu Santo Bay (THC 1974). It measured 6.1 meters (20 feet) in length and weighed approximately 350 lbs. Information regarding other attributes to the vessel such as wood type are not available on the Atlas site form. Due to the lack of any potential magnetic components, the probability of identifying a dugout canoe buried beneath bottom sediments via remote sensing survey is not possible; however, a dugout canoe could possibly be identified in the sonar record if exposed on the sea floor.

3.2.6.2 Historic watercraft

Although there are no specific accounts of the types of vessels used in the waters of the APE during the early historic period, it is likely that historic watercraft used in Keller Bay were similar to those used on other western rivers and coastal harbors along the Texas Coast. Gearhart (2017: Table 1) and Borgens et al. (2012: Table 1) provide samples of reported wrecks in Matagorda Bay system which indicate some of the types of vessels that regularly plied the waters of the APE and surrounding area. These most common vessels to navigate the waters surrounding the project area include schooners, sloops, luggers, and steamboats, as well as gas-powered vessels. The distinct characteristics of each are described below.

3.2.6.3 Schooners

The schooner is a type of sailing vessel whose name refers to its sail configuration and is typically a sharp-built vessel, with two masts of considerable length and rake, with small top mast, and fore and aft sails. Schooners are usually larger than sloops due the larger sail area required a deeper hull, which resulted in a deeper draft. As such, these vessels were regularly used for longer voyages transporting cargoes in the coastwide trade.

Schooners can be divided and further specified according to type of rigging, function, or region of use. Originally rigged with square topsails, early schooners were referred to as topsail schooners. Later schooners were referred to as fore-and-aft schooners due to their rigging with Bermuda sails aligned fore and aft rather than squared to the masts (Saltus 1987:68). This variety was further divided into two, three, and four-masted schooners. The variability in schooner size, a two-masted scow schooner had a typical size range of 7.19 to 26.82 meters (23.6 to 88 feet) in length, 3.04 to 7.46 to meters (10 to 24.5 feet) in beam, and 0.76 to 2.86 meters (2.5 to 9.4 feet) in depth of hold (Saltus 1988:90).

When defined by their function, schooner types included: pilot schooners, trading schooners, fishing schooners, and packet schooners. Those defined by hull form included: scow schooners, barge schooners, pungy schooners, file bottom schooners, and ram schooners (Saltus1988:90). Schooners defined by region of use included: Chesapeake Bay schooners, Great Lakes schooners, and Coastal schooners (Saltus 1987:68). Saltus argued that, "the diagnostic attribute is the vessel's shallow draft and wide beam, dictated by the environment, depth, and functional need" (Saltus 1988:90).

The most common type of schooner to operate in the western Gulf Coast region is the Gulf scow schooner. Its versatility allowed the schooner to operate in the open ocean, shallow bay waters, rivers, or inland lakes of southern Texas. The vessel evolved from the scow, a versatile flat-bottom sailing craft that has been used in shallow harbors and inland waters along the East Coast since the early nineteenth century. By the late nineteenth century, the Gulf Coast builders developed a V-bottom scow. The V-bottom scows were framed and planked lengthwise on the bottom with deep transom at bow and stern, with the bow transom set at a great rake; and measured 9.75 (32 feet) to 15.24 meters (50 feet) long. These vessels were very popular from New Orleans westward to the Mexican border (Chapelle 1951:333–334). A typical schooner operating in coastal Texas is presented in Figure 3-1 which shows a two-masted, cargo-laden schooner in transit in Galveston Bay taken in 1910.

Review of the Atlas database indicates that there are 9 reported schooners (*Alice* [THC Shipwreck No. 990], *Annetta* [THC Shipwreck No. 995], *Caroline* [THC Shipwreck No. 993], *Eclipse* [THC Shipwreck No. 539], *Mattie* [THC Shipwreck No. 996], *Sea Gull* [THC Shipwreck No. 966], *Tom and Able* [THC Shipwreck No. 1185], Unknown [THC Shipwreck No. 1020], and *William and Mary* [THC Shipwreck No. 1001) lost in Calhoun County (THC 2019; Borgens et al. 2012:Table 1). While none of the schooners are of the reported lost within or near the APE, a low to moderate probability of discovering a historic schooner within the project area remains.

Figure 3-1. Photograph taken in 1910 on Galveston Bay showing a two-masted scow schooner in transit loaded with cargo (photograph courtesy: The Portal to Texas History).

3.2.6.4 Sloops

The sloop, another versatile sailing craft, can be described as a vessel with one mast like a cutter but having a jib stay, which a cutter does not. Also, sloop is the general name of ships of war below the size of frigates (Brande 1856 as presented in Saltus 1987:71). Like the schooner, sloop also refers to sail configuration. Other varieties of the sloop include the sloop-of-war, ship-sloop, brig-sloop, and corvette (Saltus 1988:92). Sloops were also capable of sailing in various environments including the narrow inland rivers and the open ocean.

The "Texas scow sloop", also known as the "Port Isabel sloop" and "Laguna Madre sloop" evolved to meet the unique conditions within the various and many shallow lagoons of the Texas coast (Figure 3-2). The basic form and rig consist of a gaff-rigged sloop with a single mast, with transom ends, a bit of V-bottom fore and aft, and two trunk cabins. The rigging configuration, along with a centerboard, made the Texas scow sloop very maneuverable in the variable winds of the lagoons. The vessel's shallow draft, drawing less than 0.61 meters (2 feet) of water, allowed for navigation into shallow waters in the vicinity of shoals and oyster beds.

The length of these vessels ranged from 7.92 to 9.75 meters (26 to 32 feet) in length and 3.04 to 3.65 meters (10 to 12) feet in beam, and draft of 1 foot, with the centerboard raised into the hull (Doran 1987:54). These vessels were constructed of local yellow pine and cypress; and near the Mexican border, boat builders used mesquite knees in lieu of cypress crooks. They were built upside down using the frames and the end-transoms as molds, retained chine logs, and were cross planked on the bottom (Chapelle 1951:336). A typical Texas scow sloop operating in coastal Texas is presented in Figure 3-3 which is a historic photograph of a scow sloop in transit.

Figure 3-2. A historic photograph (date unknown) showing a Texas scow sloop underway (as presented in Chappelle 1951:175).

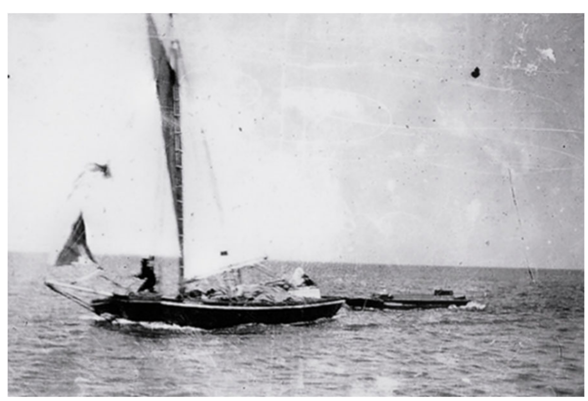

Figure 3-3. A historic photograph (date unknown) showing a Texas scow sloop underway (photograph courtesy: https://thedolphintalk.com/?p=10537).

Texas scow sloops were constructed by small-boat builders from the mid-1850s until as late as 1952 (Francaviglia 2010:247–248) and were very popular in the commercial fishing industry. These vessels would fish in pairs with gill nets extended between them which could yield thousands of pounds per netting. Overfishing method nearly decimated the fisheries in coastal Texas, and in 1952, Texas banned the use of gill nets, essentially marking the end of the Texas scow sloop. A replica of a Texas scow sloop, La Tortuga, built in 1990, is on display at the Texas Maritime Museum in Rockport, Texas (Figure 3-4).

Figure 3-4. Photograph of *La Tortuga*, a replica Texas scow sloop (photograph courtesy: Dolphin Talk 2020).

Review of the Atlas database indicates that there is reported sloops lost in Calhoun County, the *Prouty* (THC Shipwreck No. 991) and a commercial sloop (THC Shipwreck No. 1003). The *Prouty* capsized and sank in 1886 at Indianola (Borgens et al. 2012: Table 1). It is Texas State Antiquities Landmark (SAL), however, it remains undiscovered and not a verified archaeological site. There is no information available regarding the unidentified commercial sloop other than she beached at Indianola. Although there are no reported sloops lost near the APE, there is a moderate probability of discovering a historic sloop within the project area.

3.2.6.5 Lugger

The early lugger, whose name is derived from the rig of Mediterranean sailing boats, had rounded hulls and used centerboards (Pearson et al. 1989:198; Comeaux 1985:172). Employed as work boats for oystering and shrimping activities, luggers operated frequently in the shallow coastal lakes, bayous, and marshes as well as the deeper bays. Construction of the boats was conventional consisting of sawn frames, carvel planking, and the usual plank keel of the centerboard. The timbering and plank were often local longleaf pine and cypress (Pearson et al. 1989:198).

With the advent of the motorized lugger, older sailing luggers were surpassed in quantity and popularity. Motorized luggers, omitting the centerboard, allowed for rapid transport of fishing commodities to the market unlike the slower sailing luggers (Comeaux 1985:172). These luggers included a cabin to house the engine and operating controls. Motorized luggers appear typically as flat-bottomed, small craft, generally 20 to 30 feet long. More seaworthy luggers, of 40 to 50 feet length, were introduced later to access offshore oyster and fishing resources (Comeaux 1985:172).

An example of a historic lugger reported lost in Calhoun County is *U & I* (THC Shipwreck No. 1947) which burned and sank in the 1920s (Gearhart 2017: Table 1). There are no luggers reportedly lost near the project area; therefore, the probability of locating a historic and modern lugger in the project area is a low.

3.2.6.6 Steamboats

Steamboats represent one of the most technologically innovative watercraft used in the nineteenth century, especially on the Lavaca River as well as the bay. Propelled by steam engines, boilers, and paddlewheels, they were designated as side-wheelers or sternwheelers according to where the paddlewheel(s) were located on the vessel. Steamboats developed on the eastern rivers in the early nineteenth century, but rapidly spread throughout the western rivers (Pearson et al. 1989:107).

By the 1840s and early 1850s, the western river steamboat began to take the attributes of the classic riverboat. The most significant change during this time was hull design. Rounded hulls became less preferred to rectangular, single-framed hulls with either no keel or only a vestige keel (Pearson and Saltus 1993: 15). The purpose of the this design allowed boat builders to construct a hull that could transport as much cargo as possible and at the same time draw as little of water a possible to allow maneuverability with sufficient speed in shallow water, as well as to reduce listing tendencies, a feature critical to steam power plant operation (Tuttle 2001: 13). The most buoyant and stable hull was a duplication of the form of a flatboat; a long, flat bottom intersecting two short sides at right angles. Besides the stability, the cost of constructing a straight-lined hull with flat surfaces was more economically feasible than constructing one with the sheered lines of a sailing ship (Tuttle 2001:13).

After the Civil War, sternwheel propulsion became preferred over sidewheel propulsion. This attributed to the removal of the paddle wheel from its recess at the stern; the application of two engines to cranks fixed at right angles to each other at opposite ends of the paddle wheel shaft; the incorporation of the paddle wheel assembly in the hog chain system; and the introduction to the multiple balance rudder (Hunter 1949:172-173, as presented in Tuttle 2001:17). Cheaper to construct and more effective in shallower water depths than sidewheelers, stern wheelers became the most common vessel type by 1870.

Review of the Atlas online database indicated that there is one reported steamboat lost in Calhoun County, *Exchange* (THC Shipwreck No. 997). Information on its dimensions and propulsion or the date which it was lost is not available on the Atlas database. An archaeological example of a steamboat that represents the type of steam vessels operating in the region is the *Mary Somers* (41JK9; THC Shipwreck No. 44) which sank in 1864 in the Lavaca River in neighboring Jackson county. There are no reported steamboat losses reported near the project area.

3.2.6.7 Post-Civil War and other Modern Craft

Post-Civil War watercraft continued to utilize steam engine technology until they were gradually phased out by the invention of diesel and gasoline-powered motors. The slow-moving steamboats gave way to the towboats and barges for transporting large quantities of goods. According to Pearson et al. (1989:180), towboats and barges became the predominant mode of commercial freight transportation since the beginning of steamboating on western waterways (Pearson et al. 1989:180). However, railroads also played a significant role in the demise of the steamboat.

Modern watercraft in the coastal Texas region have evolved from the earliest vessels used in the expansion of the native and American populations and growth of commerce and industry. These vessels are often designated by terms that also refer to markedly different historic vessel types such as bateau, flatboat, or barge. As such, these vessels will not be described in great detail as early watercraft forms were described above. Modern watercraft are used primarily for transportation of commodities and raw materials, pleasure craft, or participation in the seafood procurement industry throughout the project area. These vessels have typically abandoned the sailing rigging for motorized propulsion though a few old-fashioned holdouts still remain. Modern watercraft include skiffs, john boats, yachts, and trawlers. However, there is a low probability for that may be discovered within the project area.

<u>Trawler</u>

In the early-twentieth century, the exploitation of shrimp as part of the seafood industry brought the motorized shrimp trawler to the fleets of vessels traveling to deeper waters in the Gulf of

Mexico. Initially introduced by outsiders, the South Atlantic trawler, of 15.24 to 19.81 meters (50 to 65 feet) in length, was modified to become the shrimp trawler, a smaller version designed to trawl the bays and nearshore waters of the Gulf Coast (Figure 3-5; Comeaux 1985:172). Trawlers exhibit substantial forward sheer, high, flaring bows, with a nearly vertical stem, and broad, flat hulls. Larger versions, designed for deeper waters, are known as Florida-type shrimp trawlers. Trawlers are constructed of wood or steel and have been readily adopted and adapted to suit the needs of the seafood industry and the constraints of the environment. Though the deeper drafted Florida-type shrimp trawlers are found among the deepwater ports throughout the Gulf Coast, the smaller, coastally adapted trawlers can be found within the project area. Due to the prevalence of trawlers employed in the seafood industry in coastal Texas, there is a moderate probability of locating historic trawlers that have foundered or were abandoned within the waterways of the project area.

Figure 3-5. Photograph of a trawler docked at a slip in Olivia, Texas (photograph courtesy: Gerald Massey).

3.2.7 Preservation of Submerged Cultural Resources

The natural environment and human action are the two factors that directly influence the preservation of submerged cultural resources. The nature of the marine environment can aid in the preservation of wrecks or it can initiate rapid degradation of these fragile resources. For example, changes in a river course can lead to complete burial and eventual land-locking of shipwrecks that originally were lost in riverine locations. Vessels abandoned along a riverine embankment can be filled with sediments or scoured by a high current. Storm surges from hurricanes also carry a high sediment load and are likely to bury historic shipwrecks lost within the project area under tens of feet of silt and sand forming a protective anaerobic environment. As such, there is a greater chance of preservation. However, scouring actions from storm surges also can cause dispersal of hull fragments and artifacts along the bottom or allow the hull to settle lower and lower into soft bottom. Upon settling down to hardpan, though, the vessel is exposed above the sea floor and then becomes subject to erosion.

Another environmental factor that is detrimental to the preservation of a shipwreck's wooden components and artifacts in saltwater environments is the naval shipworm (*Teredo navalis*), a species of wood consuming bivalve mollusks in the family *Teredinidae*. The bivalve is called a shipworm because it resembles a worm in general appearance. At the anterior end it has a small shell/mantle with two valves which are adapted to boring into wood. Degradation of wooden components is also exacerbated by other marine organisms, such as the sheepshead (*Archosargus probatocephalus*), which destroys the already infested wood while foraging for teredo worms. Additional damage can result from stone crabs (*Menippe mercenaria*) which not only dismember wood in search of inhabiting teredo worms but will also break apart ships timbers in an effort to create a nest or den.

Human action can cause as much destruction to historic shipwrecks as the above-mentioned environmental factors. Salvage activities remove valuable (and diagnostic) machinery and structural elements. Diagnostic artifacts can be disturbed or entirely removed from their context making identification of a shipwreck much more difficult. Historical dredging and snag removal operations often destroyed and removed shipwrecks from the archeological record. Wake from passing vessels, both small craft and commercial boats, can create substantial wave action to dislodge fragments of wooden-hulled wrecks. Repetitive wave action against shallow or partially exposed wrecks will rapidly accelerate their destruction. Finally, looting is a recurring problem that dramatically affects the ability of the archeologist to identify a shipwreck site. Often, diagnostic artifacts and vessel components such as bells, anchors, rudders, or propellers are removed by treasure seekers and souvenir hunters, thereby removing much of a vessel's identity. The above factors must be acknowledged when determining the likelihood of preservation of watercraft within the project area. The probability of preservation is high if bottom sediments buried vessels quickly. Preservation is low in areas where vessels lie exposed to the elements and human activities. Those vessels lost or abandoned near shore may have been picked clean by salvage, eroded by scouring, or damaged by repetitive exposure to boat wakes and/or wind generated waves.

4.0 FIELD METHODOLOGY

4.1 Site File and Literature Review

Prior to field investigations, a desktop review was conducted that included a state site file search. Consulting the online Texas Archeological Sites Atlas database resulted in a listing of all recorded marine archaeological sites, shipwrecks, and National Register of Historic Places (NRHP) properties within 1.6 kilometers (1 mile) of the project APE. The site file research was used as a basis for developing a historical context and to gather information about past cultural resource survey activities near the project area. Background historical research incorporated material and data gathered during previous archaeological investigations and primary and secondary historical sources. The historical research aided in identifying potential types of marine resources that may have been deposited in the vicinity of the project area and determining the nature and extent of subsequent activities that may have removed or disturbed such resources. Data sources available for background research include historical maps, primary and secondary shipwreck lists, primary historical accounts, newspapers, the National Oceanic and Atmospheric Administration (NOAA), Office of Coast Survey's Automated Wrecks & Obstructions Information System (AWOIS) and THC online Atlas databases, and county and thematic histories. Information gleaned from these sources aided in developing a list of potential resources as well as identifying resources that may be expected to be located within the project area.

Additionally, the TxGLO Coastal Resource Management Map was reviewed for the project area (TxGLO 2020a). The current survey area overlies parts of Keller Bay Tract Numbers 57 and 61. It is reported that Tract 61 contains potentially sensitive cultural material areas as represented by the "MK" Resource Management Code. The "MK" code is defined as "State Antiquities Landmarks or other cultural resources protected by state law are known to be or may be located on this tract and should not be disturbed. An archeological remote-sensing survey, issued under a Texas Antiquities Permit, may be required prior to commencement of activities. Consult with the Texas Historical Commission for more information" (TxGLO 2020).

4.2 Field Methods

Field investigation of the project consisted of an intensive marine survey. The underwater survey employed a variety of remote sensing technologies deployed from a survey vessel to examine the bays' beds and locate anomalies and acoustic targets on or buried in submerged sediments that might be affected by project activities. On Saturday morning March 14, 2020, the survey crew assembled at the Olivia Fishing Pier boat ramp in Olivia, Texas. Located on the north side of Keller Bay, it was conveniently located in proximity to the survey area, approximately 3.21 kilometers (2 miles) to the south. Weather was relatively cool, with a southern breeze. The survey area was in general protected from wind generated waves.

4.2.1 Underwater Archaeological Survey

The survey vessel used for the present project was BIO-WEST's 8.2-meter (26-foot) aluminum work vessel (Figure 4-1). The vessel's attributes (ample deck space, shallow draft, high maneuverability, davits, and winches) made it an excellent platform from which to conduct survey while towing numerous pieces of gear. The vessel was propelled by two 130 horsepower (HP) outboard motors and has a top speed of 25 knots to transit to the survey site, while a survey speed of approximately 4 to 5 knots could easily be obtained. The onboard 5-kilowatt power system provided more than enough electricity to power all the remote sensing equipment, computers, navigation gear, deck hoists and winches, and safety equipment. The survey crew consisted of Matt Chastain and Captain Richard Williamson operating under the direction of Principal Investigator Dr. Michael Tuttle of Gray & Pape.

Figure 4-1. BIO-WEST's project survey vessel.

Positioning is considered a critical aspect of marine remote sensing projects. There are few landmarks on the water to use for orientational reference. In order to recreate or relocate survey targets, accurate positioning is critical. For navigation and positional control, BIO-WEST utilized a Hemisphere® VS110 differentially corrected global positioning system (DGPS) receiver. Vessel guidance, position, and data logging was accomplished with a navigation processor utilizing Trimble® HYDROpro™ Navigation software. Positional information for the survey vessel and each instrument sensor, via layback calculations, was stored in the navigation processor at a rate of one reading per second. The navigation system was the basis around which the survey was built. Project area coordinates and pre-plotted survey lines were pre-programed into the computer. The onboard computer converted positioning data from the DGPS receiver to NAD 83, Zone Texas South Central in U.S. Survey feet, in real time that were established at 20-meter (65-foot) offsets. These coordinates were then used to guide the survey vessel precisely along the predetermined track lines (Figures 4-2). While surveying, vessel positions were continually updated on the computer monitor to assist the vessel operator while the processed easting and northing data were continually logged to the computer storage disk for post-processing and plotting. All survey lines were positioned down the pre-plotted tracklines that had the general orientation of north south. The entire area was safely navigable, and the project area fully covered.

To examine the seabed, an EdgeTech 4125 dual frequency all digital side-scan sonar system was used (Figure 4-3). The dual frequency, 400/900 kilohertz (kHz), side-scan sensor collected and gave a real time display of the acoustic data throughout survey operations. Due to the shallow waters of the bay, the sonar towfish was deployed from the port side of the survey vessel 0.5 meters (1.6 feet) deep in conjunction with a pole mount and side bracket, in an effort to obtain the most diagnostic acoustic images of the bay bottom (Figure 4-4). The sonar unit was operated at a 75-meter (164-foot) range along each of the survey lines spaced at 20 meters (65 feet) apart to provide comprehensive overlapping coverage and detail of the project area. The EdgeTech system collected both acoustic data with real-time positioning data that were merged for post processing and analysis.

Magnetic data were collected with a *Geometrics G-882 Cesium* marine magnetometer (Figure 4-5). Its operating principal is based on self-oscillating split-beam Cesuim vapor, with an operating range of 20,000 to 100,000 nano-tesla (nT) and a counter sensitivity of 0.004 nT. Water depth of the project area is approximately 1.2–1.8 meters (4–6 feet) deep. Due to the shallow waters of the Bays, the magnetometer sensor was floated at the surface using life preservers and was towed 15.24 meters (50 feet) behind the survey vessel (see Figure 4-4). On more than one occasion, the magnetometer tow fish made abrupt contact with the seabed in the shallower (southern) portions of the survey area and created magnetic data spikes, which were noted to be ruled out as magnetic anomalies.

REMOVED FROM PUBLIC COPY

Figure 4-2. Planned and actual survey tracklines for the Rhodes Point Reef project area, Calhoun County, Texas.

Figure 4-3. EdgeTech 4125 dual frequency side-scan sonar system.

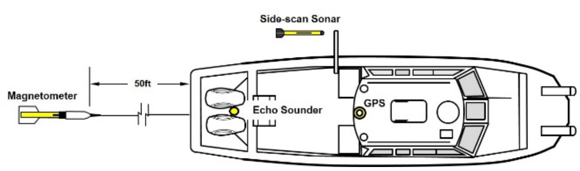

Figure 4-4. Hydrographic survey equipment layout.

Figure 4-5. Geometrics G-882 Marine Magnetometer with life preservers attached for towing in shallow water.

Magnetic readings were recorded at a rate of 1 per second. The magnetometer could detect, if present, ferrous-based objects indicative of steel pipelines or "metal" debris below the vessel track line. If the sensor passes materials below, on, or projecting above the seafloor containing ferrous metal masses or magnetic properties large enough, fluctuations created within the earth's local magnetic field would be recorded. Fluctuation is measured in gammas or nT and proportional relative to the distance of the sensor to the mass of ferrous metal contained in the sensed object. Due to the relative proximity of the bay bed to the sensor, it is considered that any anomaly observed would generally be represented as larger than if the sensor was flown at a traditional survey height above bottom of approximately 6 meters (20 feet).

4.2.1.1 Data Products- Side-scan Sonar

The side-scan sonar derives its information from reflected acoustic energy that is recorded onto a desktop survey computer. Side looking sonar transmits and receives swept high frequency bandwidth signals from transducers mounted on a sensor that is towed from a survey vessel. Two sets of transducers mounted in an array along both sides of the towfish generate the short duration acoustic pulses required for high resolution images. The pulses are emitted in a thin, fan-shaped pattern that spreads downward to either side of the towfish in a plane perpendicular to its path. As the fish is towed along the survey trackline, this acoustic beam sequentially scans the bottom from a point beneath the towfish outward to each side of the trackline.

Acoustic energy reflected from any bottom discontinuities (exposed pipelines, rocks, unexploded ordnances [UXOs] or other solid submerged objects) is received by the set of transducers, amplified, and transmitted to the survey vessel via a tow cable. The digital output from units is essentially analogous to a high angle oblique photograph providing detailed representations of bottom features and characteristics. Sonar allows display of positive relief (features extending above the bottom) and negative relief (such as depressions) in either light or dark opposing contrast modes on a video monitor. Additionally, reflectivity of bottom sediments can indicate transitions between harder and softer seabed materials.

Examination of the images thus allows a determination of significant features and objects present on the bottom within a survey area.

Side-scan sonar data present a near photographic presentation of an area examined from reflected sound. Sonar images capture only what is above or on the seabed, and in some cases can discriminate between various densities of seabed. However, any buried material that does not affect the surface of the seabed in any way cannot be discerned. In some ways, the analysis of side-scan sonar data is relatively easy, one sees what is observable. Interpreting the nuances of side-scan sonar records is another matter. Acoustic targets are normally defined according to their spatial extent, configuration, location, and environmental context. Characteristics of an acoustic target to be scrutinized in a sonar image are spatial extent, association or configuration, location and the environmental context. Shipwrecks are generally easy to discern as are other large, regular, articulated cultural features. Additionally, many natural features, rock outcrops, oyster reefs, sunken logs, and even schooling fish create images that can be identified in the data. The difference between a log and a length of pipe are a bit harder to make based solely upon side-scan data, but in conjunction with other remote sensing technologies and knowledge of the local environment may aid in making an interpretive determination of the created images.

Sonar data was saved in individual files for each survey lane. Each sonar record was initially inspected for potential man-made features and obstructions present on the bottom surface using Edge Tech's Discover 4200-SP Dual Frequency Side-Scan Sonar Software, while the side scan sonar (SSS) mosaic of the APE was accomplished using Chesapeake Technology's SonarWiz© V7.05.

4.2.1.2 Data Products-Magnetometer

The Geometrics G-882 Marine Magnetometer measures the earth's ambient magnetic field strength at the sensor's location. Although the earth's magnetic field does change with both time and distance, over short periods and distances the earth's field can be viewed as relatively constant. The presence of magnetic material and/or magnetic minerals, however, can add to or subtract from the earth's magnetic field creating a localized magnetic anomaly. Rapid changes in total magnetic field intensity, which are not associated with normal background fluctuations, mark the locations of these anomalies. Magnetic data were edited for detailed analysis and to create a magnetic contour map. Magnetic data were edited prior to review raw data (of individual survey lines) to delete any artificially induced noise or data spikes. After all survey lines for each area were edited, data was converted to an XYZ file (easting and northing coordinates in Texas [South] State Plane [NAD83], and magnetometer data – measured in gammas). When graphically represented by generating a magnetic contour map, anomalies can easily be plotted out in the project area.

4.2.2 Remote Sensing Interpretation-Magnetometer

The magnetometer and side-scan sonar are the basic tools of marine archaeology. The magnetometer can indicate metal objects, which are some of the main components of shipwrecks, while the side scan can create a near photographic image of the seabed that allows for detailed analysis of recorded objects. Unfortunately, the analysis and interpretation of remote sensing data is a process that is not 100 percent accurate in identifying a target source. While a physical examination is the only way to positively identify the source of a remote sensing target, in most cases, it is economically unfeasible to examine every recorded anomaly. Therefore, a rational method has to be used to discriminate the likelihood that a magnetic anomaly source or side-scan sonar image represents a potentially significant cultural resource. Numerous factors should be considered while interpreting remote sensing data.

For the current survey, the magnetometer data were collected and processed with Trimble Hydropro© V2.3. Raw datasets were exported via Trimble Hydropro© V2.3 and corrected using diurnal calculation to Excel file (.xlsx) types for processing. It was then projected as x, y, z, with z as magnitude value utilizing Hypack to create the project magnetic contour maps.

The factors that make up the basis for remote sensing interpretation are just as important as quality data acquisition. Magnetometer data present several properties which can be used for analysis. One characteristic examined is magnetic amplitude, or the deviation recorded from background readings. The change from background may be either positive or negative or both. If the amplitude change is only in a single direction it is known as a monopole, if it has a single positive and negative change it is a dipole. If the anomaly source has more than two opposing peaks, it is complex. Another significant characteristic for analysis is the anomaly's duration and how long it occurs in the record. Again, an anomaly is a local event and the closer the sensor is to its source the greater the amplitude recorded. Within this local field, the recorded duration will increase from and die out to background readings where it is no longer detected by the sensor. Another attribute of an anomaly that has been receiving more attention in analysis lately is its orientation, the way the poles of the anomaly are oriented relative to the earth's magnetic field. During the present field research, it must be noted that the sensor was held approximately 1.1 to 1.8 meters (3.5 to 6 feet) from the seabed. Magnetic deviation recorded is, in part, a function of distance between the sensor and magnetic source material, for example the closer the sensor to the material, the larger the reading.

Effective analysis of magnetic remote sensing data depends on quality data collection, knowledge of the environment from which the data are collected, and experience with examining anomaly sources. Through the years, several authors have created models to aid in interpreting remote sensing data, especially magnetometer data. Garrison et al. (1989) created an early model based on selected shipwrecks in the Northern Gulf of Mexico. The authors suggest that a magnetic signature for the vessels' remains they examined would cover an area of between 10,000–50,000 meters squared (107,639–538,195 square feet). That converts to an area between approximately 100 by 100 meters (328 by 328 feet) to 223 meters by 223 meters (733 by 733 feet) or put in another way 1–5 hectares (2.47–12.35 acres). These are rather large areas and do not appear to be representative of smaller, wooden vessels that would be of great interest to historians and archaeologists. History has indicated that this model, although a good early start as a baseline for analysis, could be refined.

Later, Pearson et al. (1991), considering the earlier work, developed a new model in order to suggest the presence of shipwrecks based on observed magnetic amplitude and duration of a known sample of shipwreck sites. Threshold data for potential shipwreck sites were set at 50-gamma total magnetic deflection from background with a linear duration of greater than 24 meters (80 feet). Notice the duration is greatly decreased and a minimum element of magnetic deflection is introduced. Recently, Linden and Person, "recognizing a considerable amount of variability," has revised Pearson's initial quantitative measurements downward to eliminate targets with magnetic signatures of 50-gamma deflection and less than 20 meters (65 feet) duration (Linden and Pearson 2014). In addition to these quantitative limits, Pearson with Hudson (1990) have argued for a qualitative assessment of remote sensing data as well. The environmental context in which an anomaly is located is an important factor in its analysis and interpretation.

The present project area environments consist of relatively shallow areas within Texas' Bays.

Maritime activity, within the Gulf Intracoastal Waterway, which exists in proximity to the survey areas, allows access to and through the bays. Besides commercial vessels transiting the areas, recreational vessels are also common in the bays. Additionally, the survey area is noted to be adjacent to oil/gas well structure and pipeline areas. Review of the Railroad Commission of Texas Public GIS Viewer revealed that there are three existing pipelines and a plugged oil well located immediately outside of the current study area (Railroad Commission of Texas 2020). These environmental and cultural factors should be taken into consideration while conducting an analysis of the project anomaly data.

A third model, which has been more recently developed, does not rely exclusively on a specific magnetic deflection or area of coverage but on the very essence of the earth's magnetic field and the orientation characteristics of a recorded magnetic anomaly. In order to increase the efficiency of magnetic analysis as, "Only a tiny fraction of seafloor magnetic anomalies are associated with shipwrecks," Gearhart (2011:91) has created a model for identifying shipwreck sites based, in part, on the principles of magnetic orientation. Using 29 known shipwreck sites comprising a varied selection of vessel types exhibiting a wide range of horizontal dimensions and magnetic amplitudes, the basis of other magnetic interpretive models, Gearhart highlights the orientation of the represented anomaly itself, an overall dipole configuration. One unique magnetic characteristic of all known shipwrecks in the sample presented is the magnetic orientation of the anomaly over all shipwreck sites, the negative component of a dipolar anomaly unfailingly resides to the geographic north. Additionally, it is recognized that the magnetic deviation of the graphically represented signature did not vary greater than 26 degrees from magnetic north (Gearhart 2011). Thus, a dipolar anomaly with a positive gamma deflection to the north is not consistent with known shipwreck sites and therefore should not be considered a potential shipwreck. The smallest shipwreck located by this method is known as Site 41CL92. The magnetic anomaly for this site had a total magnetic deviation of 191 gamma made up of a positive and negative component and could be detected over an area of 1,580 square meters (0.4 acres) at a 5-gamma interval. The site, when examined by divers, measured roughly 7 by 16 meters (23 by 52 feet) and is thought to be the remains of a nineteenth century sailing vessel (Gearhart 2011).

Several models have been created and refined to aid in the interpretation of magnetic data based on quantitative data relative to aid in the identification of potentially significant shipwreck sites. Another important aspect of remote sensing data interpretation is the context in which a survey was conducted, as argued by Pearson and Hudson (1990). It is important to understand and take into account the cultural and environmental variables that may contribute to the archaeological record; from debris deposition through to various seabed/shoreline modifying activities as well as construction, or obvious fishing/oystering activities

A study in a context very different from the present research, Boston Harbor, examined 67 previously identified remote sensing targets. The historic importance of the water body to American history cannot be discounted. The examination found approximately 15 percent of the initially identified materials were mobilized and could not be recreated; the sources for the remaining targets were identified. The materials examined spanned the gamut from metal debris, pipes, and chain to fishing gear and several watercraft. Four barges, one modern vessel, and the remains of a potentially significant wooden hulled shipwreck were observed. In the context of a harbor that has had historic traffic and is still actively used today, only one potentially historic site was located (Tuttle 2004). Locating one potentially significant site indicates the rarity and difficulty of distinguishing remote sensing data as significant archaeological sites. However, it also indicates the necessity to examine anomalies in the proper context to ensure that the rare sites that are indicated in the record are protected.

Interpreting the context of an archaeologically surveyed area relative to remote sensing analysis is the grayest of the evaluation criteria. There are no baseline numbers or qualitative assessments to be referred to or consulted. Experience and in some respects common sense are required to make a subjective evaluation based upon the variables pertaining to the environment worked in. The only way to know the source of every magnetic anomaly or side-scan image is to have a complete examination either by an archaeological diver or remotely operated vehicle. "Hands-on inspection of every buried anomaly source may not be an economic possibility, so researchers must trust their interpretive abilities" (Gearhart 2011). In the context of the present research, the environmental and historic considerations will be one of the factors considered while interpreting for potential significance of the sources of magnetic anomalies.

For the present investigation, in the shallow bays of Texas where there has been considerable development and use, utilizing the above-mentioned methods to filter anomalies to determine potential significance is considered prudent, as every anomaly is not a shipwreck. The main filter employed is the model developed by Gearhart (2011). Any anomaly that contains a positive magnetic deflection to magnetic north, in an overall dipole representation, was not considered potentially significant and thus removed from consideration of potential significance. Also, any anomaly that did not fit the minimum quantitative and orientation criteria as expressed in Site 41CL92, amplitude, area of coverage, negative pole to the south, was not considered potentially significant. Small single point sources were not considered significant either.

5.0 RESULTS OF INVESTIGATIONS

The four primary goals of Gray & Pape's investigation of the project area and its APE were as follows: 1) identification of previously identified cultural resources or listed NRHP properties located within a 1.6-kilometer (1-mile) radius of the project area; 2) identification of previous cultural resource investigations conducted in or near the project area; 3) identification of previously unidentified and intact cultural resources within the project area through an marine geophysical survey; and 4) provide management recommendations based on the results of background research and survey activities.

5.1 Result of Site File and Literature Review

5.1.1 Previously Recorded Surveys

Background research revealed that no portion of the APE has ever been surveyed for submerged cultural resources (Figure 5-1). Research also revealed that there has been one terrestrial archaeological survey (Atlas No. 8500001302) conducted within 1.6 kilometers (1 mile) of the project area, while there have been no marine archaeological surveys within 1.6 kilometers (1 mile) of the APE. The nearest marine survey, Borgens et al. (2012; TAC Permit No. 4080), is located 2.5 kilometers (1.56 miles) south of the APE.

The nearest archaeological survey consisted of a shoreline survey of Rupert Point, is located just south of APE and northwest 1.6 kilometers (1 mile) (Atlas No. 8500001302; see Figure 5-1). The survey was conducted in 1973 and was sponsored by the TxGLO. The survey resulted in the identification of three archeological sites (41CL40–42).

5.1.2 Previously Recorded Cultural Resources

Background research revealed no previously recorded archaeological sites or National Register Properties within the project APE. There are two previously recorded archaeological sites (41CL40 and 41CL41) within the 1.6-kilometer (1-mile) research buffer (Figure 5-1). All are located on Rupert Point. They are described below.

Originally recorded in 1972, Site 41CL40 has both prehistoric and historic components. The site was located on the surface amongst shell fragments along the shoreline. Shovel testing reveled that the shell deposit was natural and not a midden feature. Prehistoric artifacts recovered include projectile points, projectile point fragments, flakes, Prehistoric ceramic sherd, and cores. Information regarding specific the cultural component was not provided in the site form on the Atlas database; however, the presence of the ceramic sherd suggests an Undifferentiated Woodland component. Historic artifacts recovered include glass and a green wine bottle base. The recommended NRHP status for 41CL40 is unknown (THC 1972a, THC Atlas Number 9057004001).

Site 41CL41 is a prehistoric midden deposit. It was originally recorded in 1972 and is located on a shell beach below an eroded 1.52-meter (5-foot) bluff. The site measures 45.72 meters (150 feet) long x 30.48 (100 feet) wide. Artifacts density was light and consisted of a prehistoric ceramic sherd, a core, and a flake. One piece of glass was recovered as well. Information regarding the specific cultural component was not provided in the site form on the Atlas database; however, the presence of the ceramic sherd suggests an Undifferentiated Woodland component. The recommended NRHP status for 41CL41 is unknown (THC 1972b, THC Atlas Number 9057004101).

REMOVED FROM PUBLIC COPY

Figure 5-1. Previous cultural resources surveys and cultural resources with 1.6 kilometers (1 mile) of the APE.

5.1.3 Previously Recorded Shipwrecks and Obstructions

Review of the AWOIS database, which also integrates reported shipwreck locations documented in NOAA's Electronic Navigation Charts (ENCs) revealed that there are no reported shipwrecks or reported obstructions within or partially within the APE. While there are no reported shipwrecks within the 1.6-kilometer (1-mile) study radius of the APE, there is one reported obstruction (AWOIS 5345) within the study radius (Figure 5-1). Two reported shipwrecks (ENC Wrecks and THC Shipwreck No. 937) lie approximately 3.31 kilometers (2.05 miles) 3.85 kilometers (2.39 miles) of the APE, respectively. Based on the positional accuracy of 0.8 kilometers (0.5 miles) for the THC Shipwreck No. 937, it is likely that these two shipwreck locations represent the same vessel.

5.1.4 State Antiquities Landmarks and Historical Markers

Review of the Texas State Atlas reveals that there are 67 State Antiquities Landmarks in Calhoun County. Not any are located within 1.6 kilometers (1 mile) of the APE. The landmarks consist of 63 vessels, 2 lighthouses (Devros Point Light Station and the Matagorda Lighthouse), one structure (Calhoun County Jail Museum), and a commemorative marker (La Salle monument).

Review of the Atlas database also revealed that there are no historic markers located within 1.6 kilometers (1 mile) of the APE. The Olivia Historic Marker (Atlas no. 5057003855; Figure 5-2) is the nearest to the APE. Is situated in the town of Olivia along State Highway 172, 4.21 kilometers (2.61 miles) northwest of the APE. Erected in 1992, the marker measures 68.58 x 106.68 centimeters (27 x 42 inches).

5.1.5 National Register of Historic Places

Review of the NRHP searchable online database revealed that there is only one NRHP-listed property (Matagorda Lighthouse [National Register 84001624]) in Calhoun County and that there are no NRHP-listed properties within the 1.6-kilometer (1-mile) study radius (NRHP 2020).

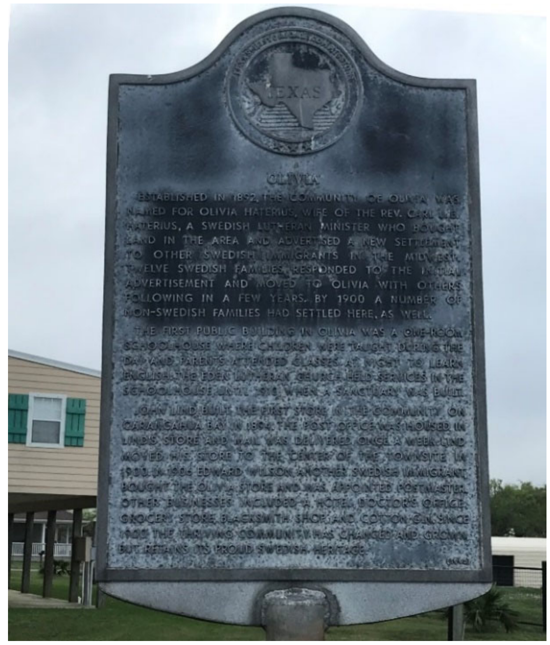

Figure 5-2. Olivia State Historic Landmark.Results of Field Investigations

The Rhodes Point Reef area was surveyed by an intensive marine archaeological survey utilizing both magnetic and acoustic profiling instruments. Depths in the survey area did not exceed 1.8 to 2.1 meters (6 or 7 feet). Due to the shallows, the magnetometer was towed at the surface behind the vessel while the side-scan sonar was towed just below the surface. Magnetometer and side-scan sonar data were recorded in the entirety of the survey area. These data were analyzed to determine any existing hazards/obstructions on or below the seabed and document any magnetic anomalies that could present historic shipwrecks for avoidance during project activities.

5.1.6 Magnetometer

The predetermined grid for the remote sensing survey within the open waters of Keller Bay consisted of a total of 69 track lines (Lines 1–69) at 20-meter (65.6-foot) line spacing. Lines 2–69 were oriented north-south within the survey tract and Line 1 collected data immediately outside of the APE (Figure 5-3). After magnetic data were edited, processed, and contour plotted, anomalies were looked for and analyzed according to: magnetic intensity (total deviation from the magnetic background measured in gammas); pulse duration (detectable signature duration); signature characteristics (monopolar, dipolar, or multi-component); and spatial extent (total area of disturbance).

Comprehensive analysis of the magnetic data recorded in the survey area resulted in the identification of nine magnetic anomalies (RP1–RP9; see Figure 5-3) that meet the magnetic orientation and spatial criteria established by Gearhart's 2011 model. Of the nine magnetic anomalies, three anomalies (RP1– RP3) exhibit both the magnetic orientation and spatial criteria established by Gearhart's 2011 model and the Linden and Pearson (2014) 50-gamma/ 20-meter (65-foot) criteria and therefore retain the potential for a shipwreck site (Figures 5-4–5-6). Magnetic anomaly RP1 and RP2 as well as the associated buffer zones are located within the APE. Anomaly RP3 is located immediately outside of the survey area, however, the 50-meter (164-foot) avoidance buffer zone partially extends into the APE. Evaluation of anomalies RP4–RP9 suggest they do not meet our double filter analysis using Gearhart (2011) and Linden and Pearson (2014) criteria. While all anomalies RP4–RP9 adhere to Gearhart's magnetic orientation, five anomalies (RP5–RP6, RP8, and RP9) of the six anomalies were detected on only a single survey line. The one anomaly (RP7) that was detected on two survey lines does not meet the minimum criteria of both methods of analysis (Figures 5-7–5-12). Two anomalies (RP4 and RP8) do not meet the minimum Linden and Pearson 2014 criteria, and the final three anomalies (RP5, RP6, and RP9) do not meet Gearhart (2011) spatial criteria. RP4–RP9, as well as the remaining magnetic anomalies, are interpreted as modern debris associated with recreational and commercial fishing activities, and miscellaneous debris from previous tropical storms as well as existing pipelines and an abandoned gas well; and as such do not represent significant cultural resources.

5.1.7 Side-Scan Sonar

Overall, the side-scan sonar data for the survey area was in general flat. Data were collected from each channel of the towfish along each transect to create over 200 percent coverage (Figure 5-13). An examination of the side-scan sonar records indicates that there are no above or on seabed bed acoustic targets that had qualities indicating cultural materials. The project area appears to have a variable density as exhibited by the differing return signatures representing the bay bed within the study area. Softer sediments have a lower reflectivity than hard sediments, which reflect more energy back to the side-scan sonar transducer. Portions of the seabed within the APE, however, exhibit bottom disturbances (i.e. trawl scars) from commercial fishing activities. These disturbances are very apparent in the sonar record (Figure 5-13) and are caused from commercial fishermen dragging the trawl nets along the bottom. One acoustic target is located outside of the APE and is attributed to a plugged and abandoned gas well (Figure 5-14).

REMOVED FROM PUBLIC COPY

Figure 5-3. Magnetic contour map of the Rhodes Point Survey Area, Calhoun County, Texas, at 10 Gamma Contours.

REMOVED FROM PUBLIC COPY

Figure 5-4. Detail plan view of magnetic anomaly RP1.

REMOVED FROM PUBLIC COPY

Figure 5-5. Detail plan view of magnetic anomaly RP2.

REMOVED FROM PUBLIC COPY

Figure 5-6. Detail plan view of magnetic anomaly RP3.

REMOVED FROM PUBLIC COPY

Figure 5-7. Detail plan view of magnetic anomaly RP4.

REMOVED FROM PUBLIC COPY

Figure 5-8. Detail plan view of magnetic anomaly RP5.

REMOVED FROM PUBLIC COPY

Figure 5-9. Detail plan view of magnetic anomaly RP6.

REMOVED FROM PUBLIC COPY

Figure 5-10. Detail plan view of magnetic anomaly RP7.

REMOVED FROM PUBLIC COPY

Figure 5-11. Detail plan view of magnetic anomaly RP8.

REMOVED FROM PUBLIC COPY

Figure 5-12. Detail plan view of magnetic anomaly RP9.

REMOVED FROM PUBLIC COPY

Figure 5-13. Side-scan sonar mosaic of the Rhodes Point Reef Survey Area, Calhoun County, Texas.

REMOVED FROM PUBLIC COPY

Figure 5-14. Screenshot of the side-scan record showing the feature attributed to a plugged and abandoned gas well outside of the APE.

5.1.3 Previously Recorded Shipwrecks and Obstructions

Review of the AWOIS database, which also integrates reported shipwreck locations documented in NOAA's Electronic Navigation Charts (ENCs) revealed that there are no reported shipwrecks or reported obstructions within or partially within the APE. While there are no reported shipwrecks within the 1.6-kilometer (1-mile) study radius of the APE, there is one reported obstruction (AWOIS 5345) within the study radius (Figure 5-1). Two reported shipwrecks (ENC Wrecks and THC Shipwreck No. 937) lie approximately 3.31 kilometers (2.05 miles) 3.85 kilometers (2.39 miles) of the APE, respectively. Based on the positional accuracy of 0.8 kilometers (0.5 miles) for the THC Shipwreck No. 937, it is likely that these two shipwreck locations represent the same vessel.

5.1.4 State Antiquities Landmarks and Historical Markers

Review of the Texas State Atlas reveals that there are 67 State Antiquities Landmarks in Calhoun County. Not any are located within 1.6 kilometers (1 mile) of the APE. The landmarks consist of 63 vessels, 2 lighthouses (Devros Point Light Station and the Matagorda Lighthouse), one structure (Calhoun County Jail Museum), and a commemorative marker (La Salle monument).

Review of the Atlas database also revealed that there are no historic markers located within 1.6 kilometers (1 mile) of the APE. The Olivia Historic Marker (Atlas no. 5057003855; Figure 5-2) is the nearest to the APE. Is situated in the town of Olivia along State Highway 172, 4.21 kilometers (2.61 miles) northwest of the APE. Erected in 1992, the marker measures 68.58 x 106.68 centimeters (27 x 42 inches).

5.1.5 National Register of Historic Places

Review of the NRHP searchable online database revealed that there is only one NRHP-listed property (Matagorda Lighthouse [National Register 84001624]) in Calhoun County and that there are no NRHP-listed properties within the 1.6-kilometer (1-mile) study radius (NRHP 2020).

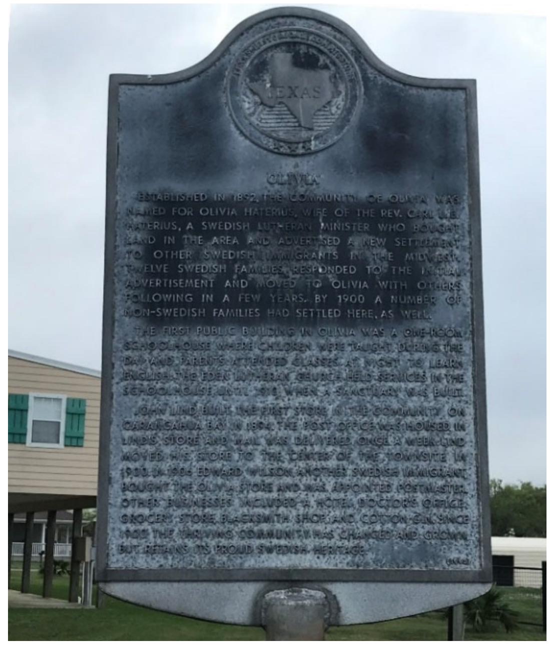

Figure 5-2. Olivia State Historic Landmark.Results of Field Investigations

The Rhodes Point Reef area was surveyed by an intensive marine archaeological survey utilizing both magnetic and acoustic profiling instruments. Depths in the survey area did not exceed 1.8 to 2.1 meters (6 or 7 feet). Due to the shallows, the magnetometer was towed at the surface behind the vessel while the side-scan sonar was towed just below the surface. Magnetometer and side-scan sonar data were recorded in the entirety of the survey area. These data were analyzed to determine any existing hazards/obstructions on or below the seabed and document any magnetic anomalies that could present historic shipwrecks for avoidance during project activities.

5.1.6 Magnetometer

The predetermined grid for the remote sensing survey within the open waters of Keller Bay consisted of a total of 69 track lines (Lines 1–69) at 20-meter (65.6-foot) line spacing. Lines 2–69 were oriented north-south within the survey tract and Line 1 collected data associated with caused from commercial fishing activities. One acoustic target is located outside of the APE and is interpreted as a plugged and abandoned gas well.

The recommended management action for the Rhodes Point APE is avoidance of bottom disturbance activities within the 50-meter (164-foot) avoidance areas, as mandated by Texas Administrative Code, Title 13, Part 2, Chapter 26, for magnetic anomalies RP1, RP2, and RP3. If avoidance is not possible, then Gray & Pape recommends archaeological diver-ground truthing to identify and evaluate the NRHP significance of magnetic anomalies of each. No further archaeological investigations are recommended for anomalies RP4–RP9.

7.0 REFERENCES CITED

Aten, Lawrence E.
1984 Woodland Cultures on the Texas Coast. In Perspective on Gulf Coast History, edited by Dave D. Davis, pp. 72-93. Ripley P. Bullen Monographs in Anthropology and History, No. 5. Florida State Museum, University Presses of Florida, Gainesville.

Borgens, Amy A.
2011 "Maritime Archaeology of the Northern Gulf of Mexico: Archaeology from the Age of Exploration to the Twilight of Sail". Chapter 29 in The Oxford Handbook of Maritime Archaeology, edited by Alexis Catsambis, Ben Ford, and Donny L. Hamilton, pp.660-684. Oxford University Press, New York, New York.

Borgens, Amy, Sara G. Laurence, and Robert L. Gearhart II
2012 Marine Geophysical Survey for Historic Properties, Matagorda Bay Ship Channel and Potential Placement Areas, Matagorda Ship Channel Improvement Project, Matagorda and Lavaca Bays, Texas. Report on file at Texas Historic Commission un Texas Antiquities Permit No. 4080.

Bruseth, James E. and Toni S. Turner
2006 From a Watery Grave: The Discovery and Excavation of La Salle's Shipwreck, La Belle. Texas A&M University Press, College Station.

Campbell, T.N.
1958 "Archaeological Remains from the Live Oak Point Site, Aransas County, Texas". *The Texas Journal of Science* 10:432-442.

Chappelle, Howard
1951 American Small Sailing Craft. W.W. Horton and Company, New York.

Comeaux, Malcolm, L.
1985 "Folk Boats of Louisiana". In *Louisiana Folklife: A Guide to the State*, edited by Nicholus Spitzer, pp. 160-178. Published by the Louisiana Folklife Program, f the Arts and the Center for Gulf South History and Culture.

Corbin, J.E.
1974 A Model for Cultural Succession for the Coastal Bend Area of Texas. Bulletin of the Texas Archaeological Society 45:29-54.

Dolphin Talk
2020 "Representing the Coast Guard", thedolphintalk.com/?p=10537. Accessed March 09, 2020.

Doran, Edwin Jr.
1987 "The Laguna Madre Scow Sloop". *Ships, Seafaring, and Society: Essays in Maritime History*, edited by Timothy J. Runyan, Wayne State University Press, Austin.

Francaviglia, Richard V.
2010 From Sail to Steam: Four Centuries of Texas Maritime History, 1500-1900. University of Texas Press, Austin.

Garrison, E.G., C.P. Giammona, F.J. Kelly, A.R. Tripp, and G.A. Wolff
1989 Historic Shipwrecks and Magnetic Anomalies of the Northern Gulf of Mexico: Reevaluation of archaeological resource management zone 1. Vol. 2: Technical narrative. OCS Study, MMS 89-00024. United States Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region.

Gearhart, Robert L., II
2011 Archaeological Interpretations of Marine Magnetic Data. Chapter 4 in The Oxford Handbook of Maritime Archaeology, edited by Alexis Catsambis, Ben Ford, and Donny L. Hamilton, pp.90-113. Oxford University Press, New York, New York.

2017 Marine Archaeology Survey in Support of Lavaca Bay Reef Project Calhoun County, Texas. Prepared for The Texas Parks and Wildlife Department. Bob Hydrographics, LLC.

Hester, Thomas R.
1976 Hunters and Gatherers of the Rio Grande Plain and Lower Texas Coast of Texas. Center for Archaeological Research. The University of Texas at San Antonio.

Hunter, Louis C.
1949 Steamboats on the Western Rivers: An Economic and Technological History. Harvard University Press, Cambridge, MA.

Johnson, Donald S.
2002 *La Salle: A Perilous Odyssey from Canada to the Gulf of Mexico.* Cooper Square Press, New York.

Jurgens, Christopher J
1989 Additional Archeological Survey of Proposed Wastewater System Construction at Riviera Water Control and Improvement District, Kleberg County, Texas. Construction Grants Division, Texas Water Development Board.

Linden, Sarah and C. E. Pearson, Ph.D.
2014 Phase I Marine Cultural Resources Remote Sensing Survey in Buffalo Bayou for the Proposed Kinder Morgan Export Terminal, Pasadena, Harris County, Texas. Prepared for Environmental Management Resources Southwest, Inc., Houston, Texas by Coastal Environments, Inc., Corpus Christi, Texas.

Malsch, Brownson
2017 "Indianolo, Texas" *Handbook of Texas Online*. Available URL:(http://www.tshaonline.org/handbook/online/articles/hep07) accessed July 2019.

Masey, Gerald
2020 "Olivia, Texas, http://www.texasescapes.com/TexasGulfCoastTowns/OliviaTexas/OliviaTx.htm. Accessed March 09, 2020.

Maywald, Lonnie Ficklen
2010 "Port Lavaca, Texas". *Handbook of Texas Online*. Available URL:(http://www.tshaonline.org/handbook/online/articles/hep07) accessed July 2019.

Mowery, Irvin C., and James E. Bower
1978 Soil Survey of Calhoun County, Texas. United States Department of Agriculture – Soil Conservation Service, Washington, DC.

Morison, Samuel Eliot
1974 he European Discovery of America: Volume 2: The Southern Voyages A.D.1492-1616. Oxford University Press.

Newcomb Jr. W.W.
1961 The Indians of Texas. From Prehistoric Times to Modern Times. The University of Texas, Austin, Texas

National Oceanic and Atmospheric Administration (NOAA)
2020a Navigation Chart 11317 entitled, Matagorda Bay Including Lavaca and Tres Palacios Bays. https://www.charts.noaa.gov/OnLineViewer/11317.shtml. Accessed March 6, 2020.

2020b Port Lavaca, - Station ID: 8773259. https://tidesandcurrents.noaa.gov/stationhome.html?id=8774513#obs. Accessed on March 27, 2020.

National Register of Historic Places
2020 National Register of Historic Places Database. https://npgallery.nps.gov/NRHP, accessed March 12, 2020.

Parry, J. H.
1966 *The Spanish Seaborne Empire*. University of California Press, Berkeley, California.

Pearson, Charles E., George J. Castille, Donald Davis, Thomas E. Redard, and Allen R. Saltus
1989 A History of Waterborne Commerce and Transportation Within the U.S. Army Corps of Engineers New Orleans District and an Inventory of Known Underwater Cultural Resources. Submitted to the New Orleans District, U.S. Army Corps of Engineers, New Orleans.

Pearson, Charles E., and Allen R. Saltus
1993 Underwater Archaeology on the Ouachita River, Arkansas: The Search for the Chieftain, Haydee, and Homer. Coastal Environments, Inc., Baton Rouge. Report submitted to the Vicksburg District, U.S. Army Corps of Engineers, Vicksburg.

Pearson, C.E. and K.G Hudson
1990 Magnetometer Survey of the Matagorda Ship Channel: Matagorda Peninsula to Point Comfort, Calhoun and Matagorda Counties Texas. Prepared for the United States Army Corps of Engineers, Galveston District, by Coastal Environments, Inc., Baton Rouge Louisiana.

Porter, Admiral David D.
1998 Naval History of the Civil War. Dover Publications.

Railroad Commission of Texas Public GIS Viewer
2020 GIS Viewer. https://gis.rrc.texas.gov/GISViewer/. Accessed March 13, 2020.

Ricklis, Robert A., and Richard A. Weinstein
2005 "Sea-Level Rise and the Fluctuation along the Texas Coast: Exploring Cultural-Ecological Correlates" Gulf Coast Archaeology: The Southeastern United States and Mexico. Nancy M. White ed. University Press of Florida, Gainesville, Florida.

Saltus, Allen
1987 Submerged Cultural Resources Investigation of the Western Portion of the Maurepas Basin. Submitted to the Division of Archaeology, Baton Rouge.

1988 Submerged Cultural Resources Investigation of Various Waterways of Lake Pontchartrain's North Shore. Archaeological Research and Survey. Submitted to the State of Louisiana, Department of Culture, Recreation and Tourism, Division of Archaeology, Baton Rouge.

Sharf, Thomas J.
1966 History of the Confederate States Navy. Random House Trade; Reprint edition (1996).

Texas General Land Office (TxGLO)
2020a Coastal Resource Management Map https://cgis.glo.texas.gov/rmc/index.html Accessed March 6, 2020.

2020b Miscellaneous: Definitions and Explanations http://gisweb.glo.texas.gov/RMC/instructions/Revised_RMC_all_20141009.pdf Accessed 12 September 2018.

Texas Historical Commission
1972a Atlas Number 9057004001, Archeological Site Form 41CL40. Texas Archeological Sites Atlas. https://atlas.thc.state.tx.us/. Accessed March 12, 2020.

1972b Atlas Number 9057004101, Archeological Site Form 41CL41. Texas Archeological Sites Atlas. https://atlas.thc.state.tx.us/. Accessed March 12, 2020.

1974 Atlas Number 9057005101, Archeological Site Form 41CL51. Texas Archeological Sites Atlas. https://atlas.thc.state.tx.us/. Accessed March 12, 2020.

1992 Atlas Number 5057003855. Olivia Historic Marker. Texas Archeological Sites Atlas. https://atlas.thc.state.tx.us/. Accessed March 12, 2020.

The Portal to Texas History
2020 "Photograph of a Schooner in the Galveston Bay", https://texashistory.unt.edu/ark:/67531/metapth503/?q=schooner, accessed March 02, 2020.

Turner, E. S., and T. R. Hester
1993 A Field Guide to Stone Artifacts of Texas Indians, 2nd Edition. Texas Monthly Field Guide Series. Gulf Publishing Co., Houston.

Tuttle, Michael C.
2004 Duke Energy Hubline Marine Archaeological Services. Report produced by Panamerican Consultants, Inc., Memphis.

Tuttle, Michael C., Stephen R. James, Jr., Whitney J. Autin, and Amy M. Mitchell
2001 Cultural Resources Remote-Sensing Survey of the Navigation Channel Within Pools 3, 4, and 5 of the Red River Waterway, Louisiana. Panamerican Consultants, Inc., Memphis, TN. Submitted to the USACE, Vicksburg District.

Weddle, Robert S.
2011 Handbook of Texas Online. "La Salle Expedition" http://www.tshaonline.org/handbook/online/articles/RR/pfr1.html. Accessed August 2019.