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12 August 2010

The Final Report has been reviewed and accepted.

Phil Boggan 8/30/2010
Phil Boggan — Date
[Deputy] State Historic Preservation Officer

Mr. Phil Boggan
Deputy State Historic Preservation Officer
Attention: Division of Archaeology
1051 N. 3rd Street, Room 319
Baton Rouge, Louisiana 70802

Re: ***Grand Liard Submerged Cultural Resources Survey, East of Scofield Bayou, Plaquemine Parish, Louisiana***

Dear Mr. Boggan:

Two final reports that address comments received by our firm on 6 July 2010 are enclosed for your department's archives. A compact disk with MS Word and PDF versions is affixed to the back inner cover of each final deliverable. If you have any questions or concerns, please contact our office number or email above for assistance.

Best regards,

Robin C. Arnold

Robin C. Arnold

Enclosures-2

Copy: Coastal Planning & Engineering [Boca Raton FL]

Grand Liard Submerged Cultural Resources Survey,
East of Scofield Bayou, Plaquemines Parish, Louisiana

Coastal Planning & Engineering, Inc.
2481 N.W. Boca Raton Boulevard
Boca Raton, Florida 33431

12 August 2010

Grand Liard Submerged Cultural Resources Survey,
East of Scofield Bayou, Plaquemines Parish, Louisiana

Submitted to:
Coastal Planning & Engineering, Inc.
2481 N.W. Boca Raton Boulevard
Boca Raton, Florida 33431

Submitted by:

Tidewater Atlantic Research, Inc.
P. O. Box 2494
Washington, North Carolina 27889

Gordon P. Watts, Jr.
Principal Investigator

12 August 2010

Abstract

American Vibracore Services (AVS) is contracted by the State of Louisiana's Office of Coastal Protection and Restoration and the National Marine Fisheries Service for the Grand Liard Marsh and Ridge Restoration Project. The goal of the project is to nourish approximately 140 acres of existing marsh and create approximately 34 acres of maritime ridge habitat along the eastern bank of Bayou Grand Liard. These features will be constructed using hydraulically dredged and pumped sediment from two potential offshore sediment sources, composing a total area of 347 acres. In order to carry out reconnaissance and design level geophysical and geotechnical surveys, AVS contracted with Coastal Planning & Engineering, Inc. (CPE) of Boca Raton, Florida. As part of that study, CPE contracted with Tidewater Atlantic Research, Inc. (TAR) of Washington, North Carolina to supervise the conduct of a submerged cultural resource and geophysical survey of two offshore borrow sites. Analysis of the magnetic and acoustic data identified a total of 122 magnetic and 7 acoustic anomalies within two borrow areas. The primary borrow area, Grand Liard East, contains 70 individual magnetic and 6 acoustic targets. Six magnetic targets, grouped into 4 target areas, contain signature characteristics suggestive of potentially significant submerged cultural resources. Three target areas contain associated sonar images. These images are suggestive of potentially significant cultural material. Avoidance or additional investigation of these four target areas is recommended. The remaining 64 individual magnetic anomalies contain signature characteristics suggestive of modern debris and are not recommended for buffering or further investigation. The secondary borrow area, Grand Liard West, contains 52 individual magnetic anomalies and 1 acoustic anomaly. Sixteen individual magnetic anomalies, grouped into 7 target areas, exhibit signature characteristics suggestive of potentially significant submerged cultural resources. Avoidance or additional investigation of these target areas is recommended. The remaining 36 individual anomalies, 2 of which have an associated sonar target suggestive of dredge pipe, contain signature characteristics suggestive of modern debris. No additional investigation of these 36 individual anomalies is recommended in conjunction with proposed project activities. A review of the seismic record failed to locate buried channels, middens or other relict landforms associated with prehistoric habitation.

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Preface

The Grand Liard submerged cultural resource remote-sensing survey off Scofield Bayou was carried out by Coastal Planning & Engineering, Inc. (CPE), of Boca Raton, Florida and Tidewater Atlantic Research Inc. (TAR), of Washington, North Carolina. Coastal Planning & Engineering, Inc., is the consulting geotechnical engineering firm for the Grand Liard Marsh and Ridge Restoration Project and as such is under contract to American Vibracore Services for the State of Louisiana's Office of Coastal Protection and Restoration (OCPR) and the National Marine Fisheries Service (NMFS) project sponsors. In order to determine the project's effect on potentially significant submerged cultural resources, CPE contracted with TAR to supervise the conduct of an archaeological and geophysical remote-sensing investigation of the proposed borrow site. Gordon P. Watts, Jr., served as the project Principal Investigator and field research associated with remote-sensing was carried out under the supervision of Joshua Daniel. In conjunction with previous projects in the survey area, Allen R. Saltus provided prehistoric and historical background data and Dr. Charles Finkl developed the geological background included in this document. This report was prepared by Gordon Watts, Joshua Daniel and Robin Arnold.

Introduction

American Vibracore Services (AVS) is contracted by the State of Louisiana's Office of Coastal Protection and Restoration (OCPR) and the National Marine Fisheries Service (NMFS) for the Grand Liard Marsh and Ridge Restoration Project. The goal of the project is to nourish approximately 140 acres of existing marsh and create approximately 34 acres of maritime ridge habitat along the eastern bank of Bayou Grand Liard. These features will be constructed using hydraulically dredged and pumped sediment from two potential offshore sediment sources. In order to carry out reconnaissance and design level geophysical and geotechnical surveys, AVS contracted with Coastal Planning & Engineering, Inc. (CPE) of Boca Raton, Florida. As part of that study, CPE contracted with Tidewater Atlantic Research, Inc. (TAR) of Washington, North Carolina to supervise the conduct of a submerged cultural resource and geotechnical survey of two offshore borrow sites.

The survey was carried out between 2 and 15 February 2010. To reliably identify anomalies associated with submerged cultural resources, the survey was designed to include both magnetic and acoustic remote-sensing, employing a cesium magnetometer, sidescan sonar, and sub-bottom profiler. Bathymetric data was generated using a survey grade precision depth recorder. Navigation and data collection was accomplished using differential global positioning and computer survey software.

All personnel associated with the conduct of historical and literature research, supervision of survey operations, data analysis and report preparation meet, or exceed, the minimum standards of the U.S. Department of Interior. Personnel included Mike Wenger, captain of the M/V *Thunderforce*. Project field personnel consisted of Mr. Joshua Daniel, TAR archaeological field supervisor and a team of remote-sensing operators from CPE. CPE personnel included geophysicist Chris Dougherty, hydrographer Kitrina Godding and operations manager Matt Andrews. Data analysis and illustrations were prepared by principal investigator Dr. Gordon Watts and Mr. Daniel. Historical, cartographic and geological research was carried out by Dr. Watts, Allen Saltus, Dr. Charles Finkl and historian Ms. Robin Arnold. Dr. Watts, Mr. Daniel and Ms. Arnold prepared this report.

Project Location

The sediment source for the restoration project consists of two borrow areas in State waters in the Gulf of Mexico. The primary survey area, Grand Liard East, is situated approximately 1.5 nautical miles southeast of the mouth of Scofield Bayou and is a polygon measuring 4,333 feet in width, 2,152 feet in length and covers an area of 139.6 acres (Figure 1).

The coordinates for the primary survey area are identified in Louisiana State Plane, South Zone, NAD 83, U.S. Survey Foot coordinates (Table 1).

Point	Easting (X)	Northing (Y)
A	3852613	268708
B	3854690	268011
C	3856475	267212
D	3857034	266360
E	3852705	266557

Table 1. Coordinates of the primary survey area.

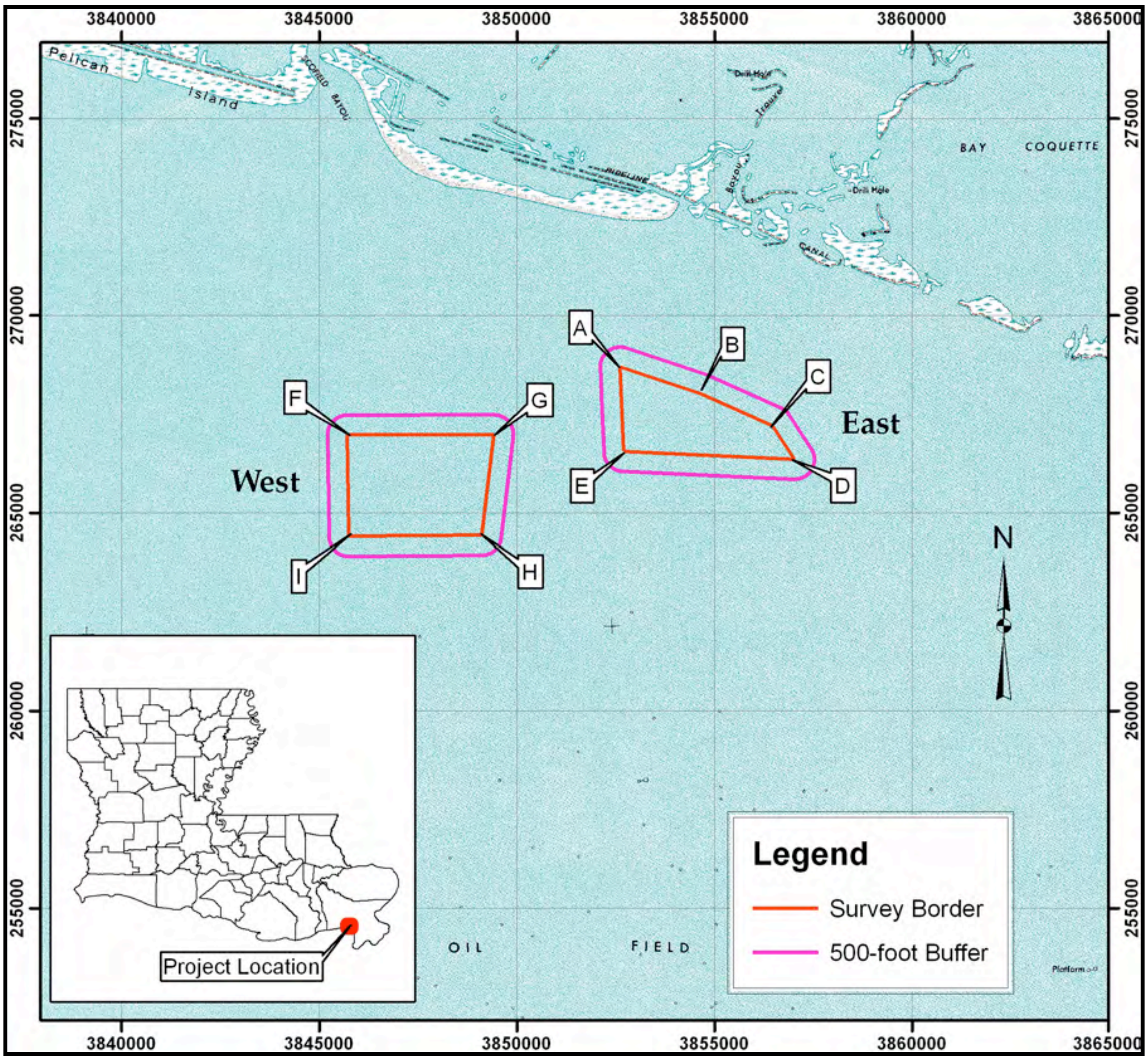

Figure 1. Project area locations (USGS. "Bay Coquette quadrangle, Louisiana" 1:24,000).

The secondary survey area, Grand Liard West, is situated approximately 1.2 nautical miles south of the mouth of Scofield Bayou and is a polygon measuring 3,706 feet in width, 2,566 feet in length and covers an area of 207.4 acres (Figure 1).

The coordinates for the secondary survey area are identified in Louisiana State Plane, South Zone, NAD 83, U.S. Survey Foot coordinates (Table 2).

Point	Easting (X)	Northing (Y)
F	3845709	266983
G	384941	266990
H	3849111	264442
I	3845752	264414

Table 2. Coordinates of the secondary survey area.

The area surveyed also included a 500-foot perimeter buffer so that any targets located along the periphery of the borrow area could be identified and the impact of dredge related sloughing assessed.

Geological Setting

The geological environment in the project vicinity, northern Gulf of Mexico, is dominated by the sedimentary geology and geomorphology of the Mississippi River Delta Plain. Since the Late Jurassic, Mississippi River alluvium has been forming coastal Louisiana. A sedimentary pile over 15 km in thickness accumulated during the Mesozoic and Cenozoic (Coleman et al. 1991). Along the northern margin of the Gulf of Mexico Basin, Tertiary and Quaternary sedimentation prograded the shelf edge by 300 km. The rate of progradation was approximately 5 to 6 km per ka (thousand years).

Quaternary glacio-eustatic fluctuations were accompanied by marine regressions and transgressions. The last glacial advance (Last Glacial Maximum, LGM) occurred during late Wisconsin time about 18,000 to 20,000 years ago. Sea level during the LGM was about 394 to 426 ft (120 to 130 m) lower than present sea level (Saucier 1994).

As the shoreline regressed seaward across the continental shelf, Pleistocene sediments were exposed to subaerial weathering and erosion. During Quaternary lowstands, rivers flowed seaward across the shelf to lowered base levels (as determined by a falling sea level). Shelf gradients induced intricate channel networks that cut into Pleistocene sediments (Figure 2). Late Pleistocene and Holocene marine transgressions, resulting from deglaciation (glacial retreat) caused a landward shift in deltaic sedimentation and shoreface erosion (Berryhill 1986). During sea-level rise, estuaries were infilled, subaerial landforms were submerged and eroded, and exposed sediments were reworked (Saltus et al. 2003).

Although Quaternary marine transgressions and regressions impacted near-surface (shallow) geology in the project area, the primary influence on local sedimentation was avulsion and shifting of Mississippi River delta lobes. The Barataria area lies within the Mississippi River Deltaic Plain, a constructional

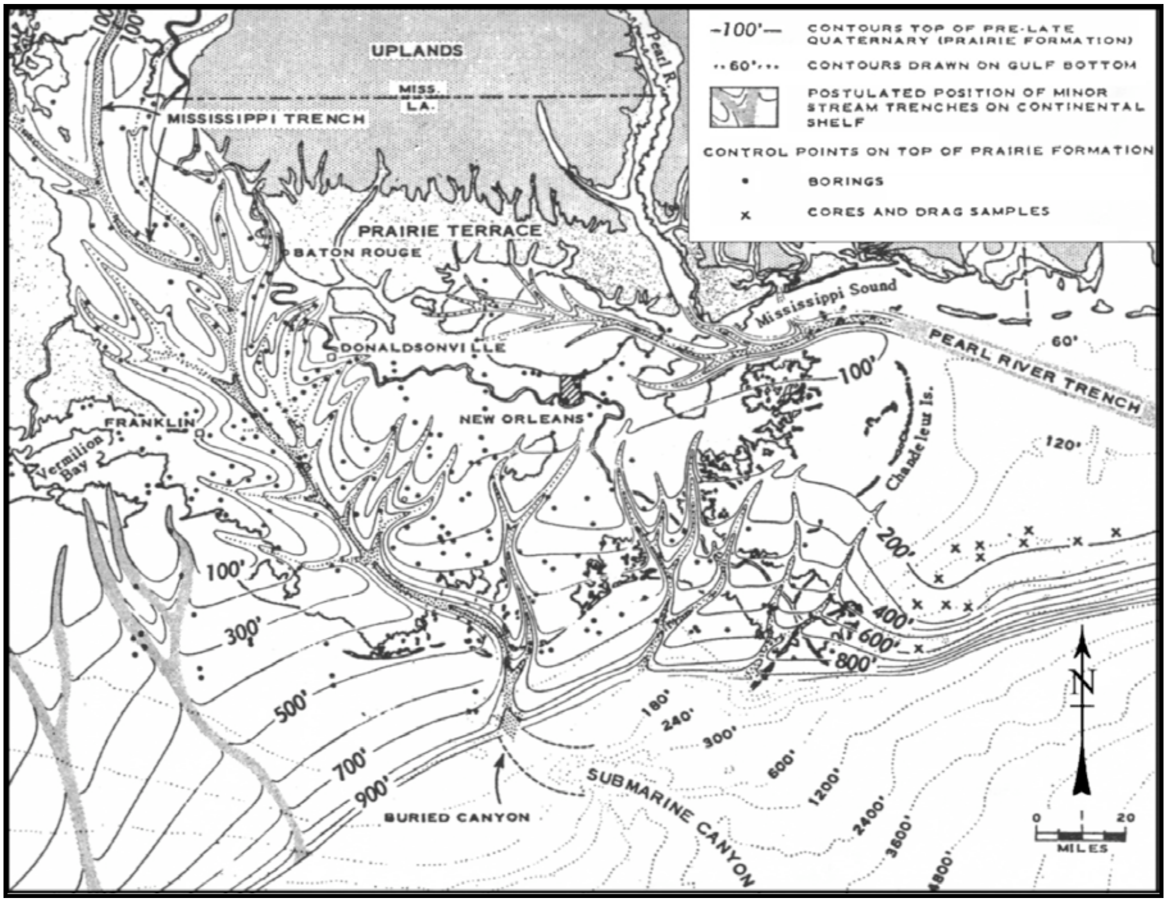

Figure 2. Pleistocene channels (adapted from Fisk and McFarlan 1955).

landform assemblage comprised by numerous lakes, channels and swamps. These features formed by Mississippi River delta building, abandonment and associated land erosion and subsidence to form the present landscape.

In an active deltaic environment, net deposition (sedimentary accumulation) exceeds net subsidence (compaction and loss of volume). Thus, when sedimentary build-up exceeds the rate of subsidence, land is created. When sedimentary accumulation decreases, subsidence dominates and there is land loss (by drowning) over time. The rate of subsidence ranges from 3.6 ft (1.1 m) to 4.8 ft (1.46 m) per century in the project area. Faulting, sea-level rise, geosynclinal down-warping and displacement from fluid withdrawal are other factors that contribute to subsidence (Penland et al. 1989; Saucier 1994).

Seven different delta complexes were built and abandoned by the Mississippi River over the last 9,000 years. For the last 600 years, the Mississippi River has occupied the Balize (modern) Delta (Figure 3). In the study area, delta formation began approximately 4800 B.P. as the Mississippi River began to shift its course eastward, forming the St. Bernard Delta Complex.

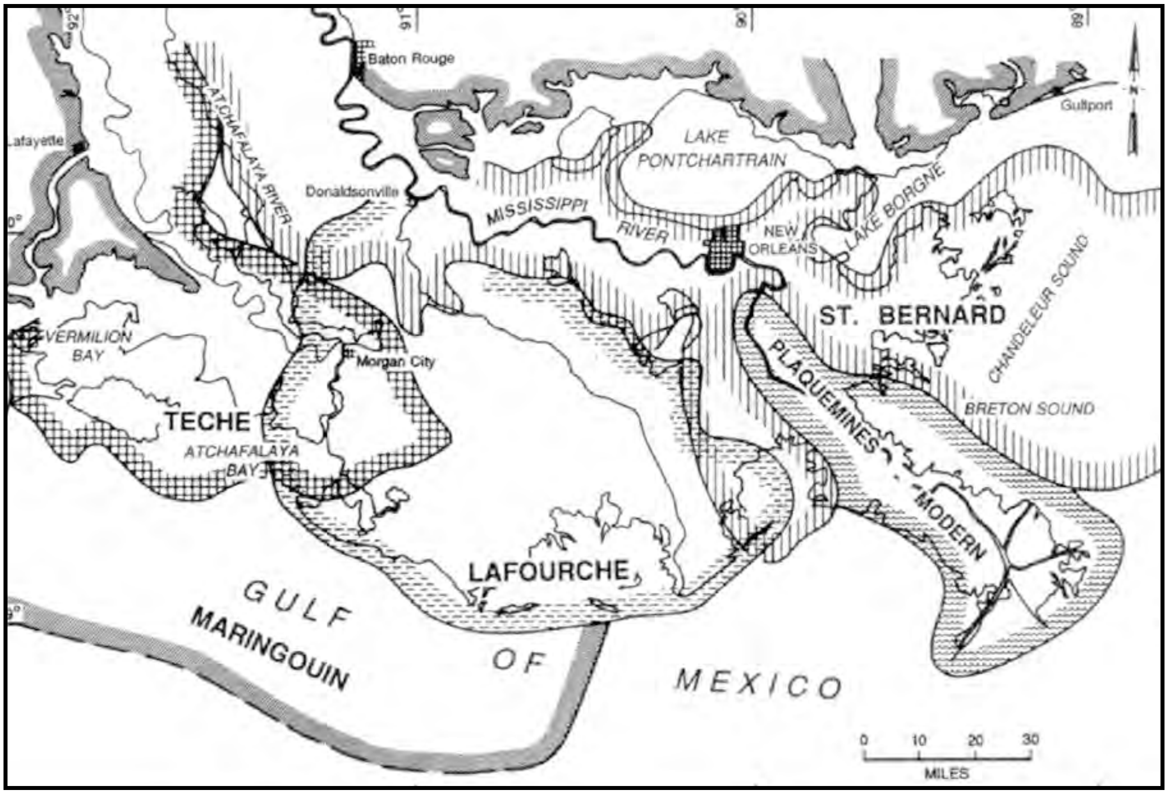

Figure 3. Map showing project area in relation to deltaic lobes (after Frazier 1967).

According to Saucier (1994), approximately 150 to 400 ft (46 to 122 m) of deltaic silts and clays accumulated in this area during the Holocene. These thick deltaic units form a wide delta front. These deltaic deposits contain very fine-grained sediments (*i.e.* silt and clay).

The Barataria Basin "is an interdistributary wetland system located between the abandoned Lafourche and Plaquemines delta complexes" (Penland et al. 1989:36). The Barataria Basin is located between two distributary ridges formed by channels of the Mississippi River. The basin, about 115 miles (185 km) long by 24 to 64 miles (38 and 103 km) wide, contains about 1.54 million acres and includes portions of nine parishes. To the north and east, the basin is bounded by the Mississippi River and on the west by Bayou Lafourche. A series of barrier islands separate the basin from the Gulf of Mexico to the south. Reworked sands from distributary sediments, formed on the perimeter of delta lobes, are deposited on beaches (Figure 4). Grand Isle and Grand Terre Islands are barrier islands that formed during the retreat of the Lafourche Delta Complex approximately 3,300 years ago (Gagliano et al. 1979).

The present delta, a system of distributaries that form a distinct pattern (in plan view), is referred to as a birds-foot delta. It includes subdelta formations that are created when trunk channels silt up and new channels follow hydrodynamic paths of least resistance. This type of delta growth depends on sediment supply being greater than dispersal by current and wave action (Krumbein and Sloss 1953). Delta growth may be slow or fast, depending on various factors. Lobeck (1939), for example, notes an average Mississippi River deltaic growth rate at seaward passes (in 1908) as 250 ft (76 m) per year. He also states that a levee break at Garden Island Bay (in 1912) advanced a crevasse splay by 2,000 ft (610 m) in only a few months.

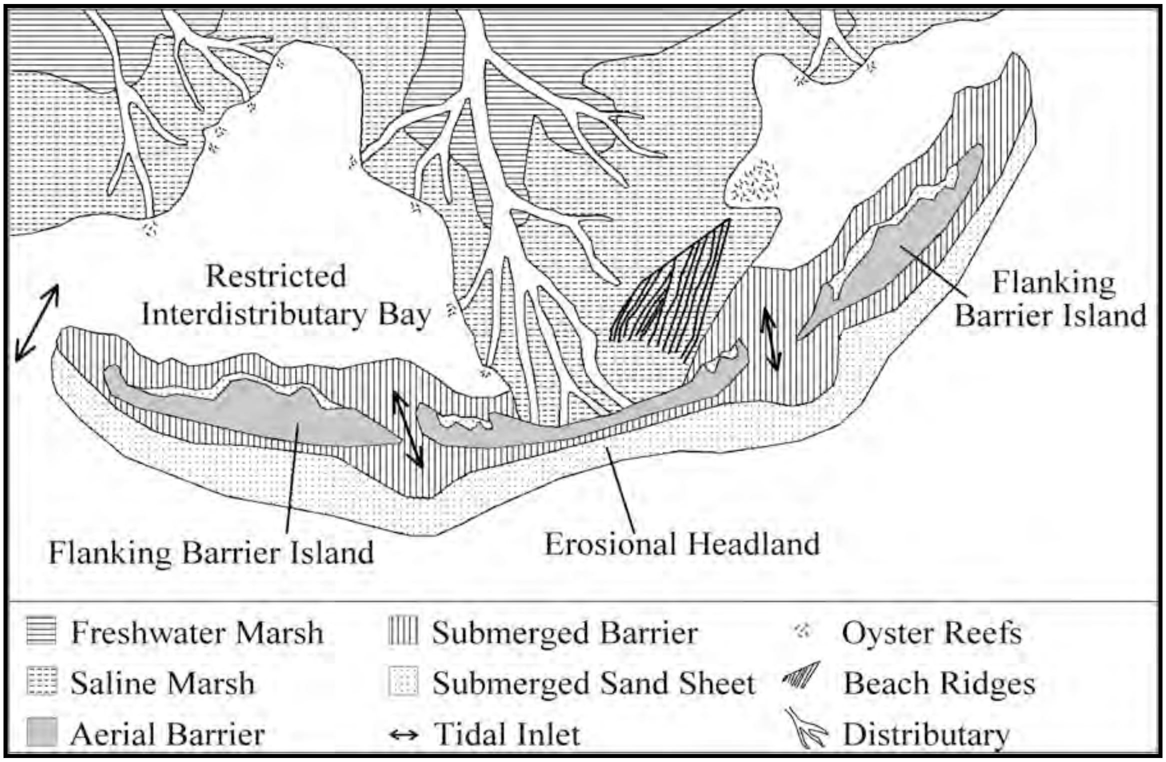

Figure 4. Barrier island formation at delta mouth (adapted from Penland et al. 1988).

In floods, coarser sediments drop out of suspension, as water velocity decreases, along trunk and distributary channels (Saucier 1994) to form natural levees. During delta construction, intervening areas between sublobes are enclosed by natural levees to form broad basins and lakes. Marshes form in these basins.

Natural levees provide elevated dry locations for human settlement. Many prehistoric and historic sites are located on active and relict natural levees in the coastal zone (Hunter et al. 1988). The natural levees created by the deltaic channels eventually subside over time. Sediment deposition from low velocity interdistributary streams and/or subsequent deltaic episodes buries these landforms and their identification becomes problematic. Archaeological testing and core-hole data have identified several buried natural levees, but most remain hidden beneath more recent sediments (Hunter et al. 1988).

Barataria Region Prehistoric Overview

The prehistory of Louisiana is divided into five stages based on archaeologically recognized cultural aspects. These five stages, Paleo-Indian (ca. 12,000 to 8000 B.P.), Archaic (ca. 8000 to 3500 B.P.), Gulf Formational (ca. 4500 to 2000 B.P.), Woodland (ca. 2000 to 800 B.P.) and Mississippian (ca. 800 to 300 B.P.), conform to general developmental trends that have been documented archaeologically across the southeastern United States. Each of these stages is further sub-divided by distinct subsistence and settlement patterns and/or artifact assemblages prevalent during certain time periods and usually representing regional preferences.

Few archaeological sites have been located that pre-date the Tchula period (ca. 2500 to 2000 B.P.) in the coastal zone south of New Orleans. Those sites are on salt dome structures and remnant natural levees of the Teche complex. The natural levees associated with the eastern portion of this complex possibly were habitable between about 4500 and 3500 B.P. (Saucier 1994). The oldest identified natural levee structures in the Barataria Basin suitable for prehistoric settlement are those of the Lafourche complex dating to around 2000 B.P. and the Bayou des Familles-Barataria lobe of the St. Bernard complex dating between 4600 and 3400 B.P. (Saucier 1994). Beavers (1977) used the term "linear" to describe the settlement pattern associated with the natural levees along the channels of these complexes. Kniffen (1936) outlined four types of sites that were found in the coastal zone of southeast Louisiana: earthen mounds, shell mounds, shell middens and wave-washed shoreline deposits. Beavers (1977) and Gagliano et al. (1979) noted that most sites are located at the junction of two bodies of water; be they bayou and bayou, bayou and bay or bayou and lake.

In the southern portion of Barataria Bay these older natural levees either are lacking or are deeply buried. Subbottom profiles along the offshore portion of the proposed survey area indicate approximately 5 to 20 feet of reworked sandy sediments overlying truncated channels. The oldest landforms in or near the current study area consist of barrier islands and cheniers, which are estimated to be less than 1,000 years old, but more likely are less than 700 years old (Conaster 1971; Kniffen 1988; Spearing 1995).

For the purpose of this report the discussion of prehistoric sequences will start with the Tchula period in Louisiana, which is the earliest culture likely to be encountered in the current project area. Earlier occupations of the area unquestionably occurred, but any sites would be so deeply buried by Holocene deposits that the chances of encountering them during dredging would be remote.

Late Gulf Formational Stage (ca. 3000 to 2000 B.P.)

The Late Gulf Formational stage (ca. 3000 to 2000 B.P.) contrasts significantly with the preceding Poverty Point period (ca. 4000 to 2600 B.P.). During this period, small, low earthen mounds were favored over the monumental earthworks of the past. The extensive trade networks developed during the Late Archaic and Poverty Point stages declined and local resources were emphasized. Gibson (1974) originally proposed that the decline of the Poverty Point culture was caused by a breakdown in the hierarchy. His reasoning stemmed from observations that exotic goods increased at the Poverty Point Site (16WC5), while decreasing at regional centers and their peripheral hamlets. This was viewed as the result of the elite taking more and giving less. At approximately the same time that the Poverty Point Site was abandoned, the Tchefuncte culture arose in the Lower Mississippi Valley and along the coast.

Tchula Period (ca. 2500 to 2000 B.P.)

Ford and Quimby (1945) defined the Tchefuncte culture from investigations at the Tchefuncte Site (16ST1) on the north shore of Lake Pontchartrain. The cultural period is referred to as the Tchula period (ca. 2500 to 2000 B.P.), named for a town near the Jaketown Site (22HU505), where a substantial number of Tchefuncte ceramics were recovered (Ford et al. 1955). Subsequent excavations at Bayou Jasmine (16SJB2), Beau Mire (16AN17), Morton Shell Mound (16IB3), Big Oak Island (16OR6), Little Oak Island (16OR7) and other sites contributed in establishing attributes of the culture and defining regional phases (Byrd 1994; Shenkel 1974, 1982; Neuman 1984; Weinstein and Rivet 1978). The artifact assemblage of the Tchefuncte culture was very similar to that of the preceding period. First, baked clay Poverty Point objects, while still manufactured, were less abundant and restricted to a few forms during the Tchula period (Ford and Quimby 1945). Next, while exotic lithic materials are not as common on Tchefuncte sites, worked shell and bone artifacts appear in relatively high frequencies (Ford and Quimby 1945; Kidder and Barondess 1982; Shenkel 1974). Last, the Tchefuncte people are identified as the first culture in Louisiana to manufacture ceramic in quantities indicative of everyday usage (Ford and Quimby 1945; Neuman 1984).

Throughout the southeast fiber-tempered ceramics were being replaced by sand, grit and clay-tempered ceramics (Walthall 1980). Weinstein (1995) states that the present evidence suggests that the untempered Tchefuncte ceramic tradition and its northern equivalent, Tchula ceramics, developed out of the Wheeler fiber-tempered ceramic tradition. This reasoning stems from the fact that early Tchefuncte ceramics at Beau Rivage (16LY5) and early Tchula ceramics in the Yazoo Basin contain decorations identical to those found on Wheeler ceramics in the same deposits.

One of the most widespread "cultures" during this period of development in the Southeast was the Alexander culture (ca. 2600/2500 to 2100 B.P.). Plain and decorated Alexander sand-tempered ceramics, as well as fiber-tempered ceramics, have been recovered from Tchefuncte sites throughout the Lower Mississippi Valley, thus illustrating some form of interaction between these cultures (Ford and Quimby 1945; Shenkel 1974; Weinstein 1995). In the Mobile Bay region the Bayou LaBatre culture, utilizing coarse quartz grit as temper, arose at approximately the same time as the Alexander and Tchefuncte cultures (Blitz and Mann 1993; Stowe 1991). One site of importance in understanding the relationship between these concurrent cultures is Apple Street (22JA530) on the coast of Mississippi. Blitz and Mann (1993) found Alexander, Tchefuncte and Bayou LaBatre ceramics occurring in the same cultural deposits at Apple Street. This supports Weinstein's (1995) proposal that later Tchefuncte ceramic decorations were borrowed from coeval cultures that interacted along the Gulf Coast.

Subsistence during the Tchula period combined the utilization of shellfish, fish, turtle, alligator, large and small mammals and native cultigens (Byrd 1994; Shenkel 1982). One of the more notable features of the Tchula period along the coast is their large *Rangia* shell middens. Most of these middens are several meters thick, attesting to their heavy consumption of shellfish. At the Morton Shell Mound (16IB3) in southern Louisiana Byrd (1994) found evidence of squash and gourd, suggesting that small-scale agriculture also was practiced during this period.

As originally defined by Ford and Quimby (1945), Tchula period sites contain Tchefuncte Incised, Tchefuncte Stamped, Tammany Punctated, Lake Borgne Incised and Orleans Punctated ceramics, along with Pontchartrain and Macon projectile points. Socketed bone points also were produced and are more common at coastal sites than at inland sites. Tchefuncte Stamped and Tchefuncte Incised ceramic types occur in higher frequencies than the other decorated ceramic types. In the Pontchartrain Basin Tchefuncte sites generally are restricted to the shores of Lakes Pontchartrain, Borgne and Maurepas, and the lower portions of the bayous and rivers that drain into these lakes (Ford and Quimby 1945; Smith et al. 1983). Along natural levees and adjacent terraces of the Mississippi River and its tributaries from approximately Baton Rouge to the head of Bayou Lafourche late Tchula sites exhibit thinner ceramics. In this region Tammany Punctated sherds occur more frequently than the other types, while Tchefuncte Stamped sherds are a minority (Weinstein and Rivet 1978).

Hays and Weinstein (1999), after a reexamination of ceramic sherds recovered from the Bayou Jasmine site (16SJB2), have designated a new ceramic type for the Tchula period. Chene Blanc Plain is described as "relatively thick, well-made sherds with nonlaminated [sic] pastes that contain specks of hematite, bone, possibly shell and sometimes grog" (Hays and Weinstein 1999). Chene Blanc Plain, *var. Chene Blanc* was identified in the upper portion of the Bayou Jasmine midden, thus a late Tchula type. Chene Blanc Plain, *var. Fountain* was found to occur in the very top portion of the midden, indicating a very late Tchula or very early Marksville association.

Carbon samples from the Bayou Jasmine site (16SJB2) recently submitted by Hays (1995) for assay yielded uncalibrated dates from ca. 140 B.C. (2140 B.P.) to ca. 980 B.C. (2980 B.P.). Most of these uncalibrated radiocarbon dates ranged between ca. 630 B.C. (2630 B.P.) and ca. 880 B.C. (2880 B.P.). If these dates are upheld, the currently recognized temporal span of the Tchefuncte culture will need readjusting. These radiocarbon dates also could substantiate Gibson's (1974) original theory that the Tchefuncte people actually were the Poverty Point people that had migrated into the Mississippi River floodplain during the waning decades prior to the abandonment of the Poverty Point site ca. 700 B.C. (2700 B.P.). In fact, Hays and Weinstein (1999) agree that the Tchefuncte culture has ties to the Poverty Point culture, but the relationship is not wholly understood. Gibson (1995) notes that the occurrence of Tchefuncte-like ceramics in Poverty Point cultural contexts at the type site (16WC5) could mark the appearance of ceramics in the Lower Mississippi Valley, but widespread manufacture of ceramic vessels did not occur until the Tchula period.

An unnamed phase of the late Tchula period occurs in Assumption and Terrebonne Parishes (Weinstein 1995). Coastal Environments, Inc. identified two sites (16TR211 and 16TR212) of this phase located on subsided natural levees that were assumed to have been dated post-Tchula in age (Weinstein and Kelley 1992). Ceramics recovered from these sites included Lake Borgne Incised, *vars. Cross Bayou* and *Lake Borgne*, Orleans Punctated, *var. Boothe*, Tammany Punctated, *vars. Brittany* and *Tammany*, Tchefuncte Incised, *var. Bayou Braud* and Tchefuncte Plain, *var. Tchefuncte*.

North of the current study area Tchula period shell midden sites (16JE91 and 16JE93) have been recorded along Bayou Dupont (Gagliano et al. 1979). These sites yielded Orleans Punctated, *var. Boothe* and Tchefuncte Plain, *var. Tchefuncte* ceramic sherds. Like the sites in lower Assumption and Terrebonne Parishes, no phase has been assigned to Tchula sites in this area.

Tchula period sites in or near the current project area include Bayou Dupont-Dupre Cut (16JE91), Dupre Cut-Off I (16JE8), Dupre Cut-Off II (16JE9), Tom Smith (16JE93) and Crown Point (16JE37). Coastal Environments, Inc., at Bayou Cutler I (16JE3), tentatively identified a transitional late Tchula/early Marksville component based on crude ceramic sherds recovered from the site (Gagliano et al. 1979).

Woodland Stage (ca. 2000 - 800 B.P.)

Typically, the Woodland stage (ca. 2500 to 800 B.P.) in the Southeast is seen as a time when ceramics composed a significant portion of the artifact assemblage, native inhabitants practiced ceremonial burials and plant husbandry or agriculture was practiced to some degree (Walthall 1980). While several criteria have been used to define the Woodland stage in the Southeast, it is generally considered that those three traits together define the period.

The Early Woodland period does not occur in southern Louisiana, as it does in other parts of the Southeast. Instead, a transitional Late Archaic-Early Woodland or Late Gulf Formational culture, the Tchefuncte (ca. 2500 to 2000 B.P.), flourished (Green 1999). The Tchefuncte were the first peoples in Louisiana to produce pottery in quantity, however monumental earthen mound construction, ritual interments and agriculture were not common (Ford and Quimby 1945; Neuman 1984).

Marksville Period (ca. 2000 to 1600 B.P.)

The first true Woodland culture in Louisiana was the Marksville culture (ca. 2000 to 1600 B.P.). The Marksville culture, named for the Marksville site (16AV1) in Avoyelles Parish, originally was described as the southern expression of the Hopewell culture, which was located primarily in Illinois and Ohio (Ford 1936; Toth 1988). Toth (1988) argues that the origins of the Marksville culture appeared during the Tchula period. This argument primarily stems from the presence of rocker-stamping, and other ceramic traits, that occur on late Tchefuncte ceramics and are present on early Marksville period ceramic wares. Accordingly, the transformation of the Tchefuncte culture into the Marksville culture was initiated by the Hopewellian intrusion into the Lower Mississippi Valley (Toth 1988). While there has been little doubt as to the similarity of Marksville decorative motifs and vessel forms to those of the Hopewell, influences in ceramic decorations also can be correlated with coeval cultures to the east (Neuman 1984; Walthall 1980). Walthall (1980) notes that these ceramic traditions, Swift Creek, Porter and Santa Rosa cultures in southern Alabama and Georgia, and northwest Florida, were also the result of Hopewell interaction. The most compelling evidence of the ties that these cultures had to the Hopewell culture manifest itself in exotic trade goods and ceremonial objects. Copper and mica artifacts identical to those recovered from Hopewell sites have been found at the numerous sites of the same time period with similar ceramic decorations and forms (Neuman 1984). Zoomorphic pipes, typically associated with the Hopewell, also appeared at sites in the Southeast during this same period (Walthall 1980).

The Marksville culture is seen as having a highly organized social structure demonstrated by the presence of burial mounds for the elite containing special items apparently manufactured expressly for internment with the burials. Several Marksville sites also exhibit log tomb burial chambers similar in construction to those found on Hopewell sites (Toth 1988).

Subsistence during the Marksville period was similar to prior periods. In southeast Louisiana, Marksville sites generally were located on natural levees and terraces along the lakes, rivers and bayous. Gagliano (1964) suggests that the Marksville practiced a cyclical seasonal pattern. During the summer, sites on or adjacent to lakes and streams were occupied to take advantage of shellfish, turtles, alligators, fish and mammals. Permanent or semi-permanent camps were occupied in the uplands and on the Prairie terrace during the fall and winter in order to exploit available nuts and acorns, as well as local fauna.

No phases have been designated for the Marksville period in the present study area. Ceramics recovered from Bayou Cutler and other sites in the area indicate that both the early and late Marksville period are represented. Early Marksville ceramics found on these sites consist of Baytown Plain, *var. Marksville*, Churupa Punctated, *vars. Boyd*, *Hill Bayou* and *unspecified*, Indian Bay Stamped, *var. Cypress Bayou*, Mabin Stamped, *vars. Mabin*, *Point Lake* and *unspecified*, Marksville Incised, *var. Sunflower*, Marksville Stamped, *vars. Marksville* and *Old River* and crosshatched rims (Gagliano et al. 1979). Late Marksville ceramics include Baytown Plain, *var. Satartia* and Marksville Incised, *var. Yokena* (Gagliano et al. 1979). Phillips (1970) notes that Marksville period sites immediately to the north and west of the Barataria Basin have far more Marksville Incised sherds than they do Marksville Stamped sherds.

Coles Creek Period (1200 to 800 B.P.)

By ca. 1300 B.P., the cultural traits that define the Coles Creek culture had taken shape. Coles Creek sites appear to be larger, more numerous and more complex than earlier Troyville sites. The emergence of a chiefdom-like society could be implied from the complexity of the Coles Creek mound system. A sizable labor force must have been necessary to build, maintain and utilize these mounds and it could be assumed that a central authority figure controlled the labor force (Muller 1983). Evidence for the elite residential or mortuary structures often said to be associated with Coles Creek mounds remains elusive prior to ca. 1000 B.P. (Fritz and Kidder 1993; Smith 1975; Steponaitis 1983). Nevertheless, both the form of the platform mounds and their arrangement around plazas are possibly indicative of Meso-American influence (Willey 1958; Williams and Brain 1983). The general population occupied the region surrounding the large ceremonial centers (Neuman 1984).

The Coles Creek ceramic complex consisted primarily of simple rectilinear designs usually present on the upper half of the vessel. French Fork Incised, a ceramic type originating during the Troyville period, was an exception (Phillips 1970; Springer 1977). Interestingly, Coles Creek designs suggest that the culture had contact with the Weeden Island culture along the Northwest Florida Gulf Coast (Willey 1949). French Fork Incised motifs are identical to those found on Weeden Island Incised vessels. Other parallels can include Evansville Punctated and Carabelle Punctated; Hollyknowe Ridged Pinched and Tucker Ridged Pinched; Mazique Incised and Carabelle Incised and Pontchartrain Check Stamped and Wakulla Check Stamped. These ceramic decorative parallels were not temporal, suggesting the infusion of these decorative motifs into the Coles Creek culture as their popularity was waning with the Weeden Island culture. Another less common decoration along the coast during the Coles Creek period, with parallels in the Swift Creek and Weeden Island cultures of Florida, was complicated stamping (Brown 1980, 1982, 1984; Neuman 1981). Brown (1984) assigned the sherds recovered from the Morgan site (16VM9) to the Gainesville Complicated Stamped ceramic type, typically found in the Gainesville Lake area of Mississippi and Alabama (Jenkins 1981). Saunders and Stoltman (1999) decided that a new ceramic type, Cameron Complicated Stamped, was warranted after petrographic studies of the ceramic pastes indicated that they were of local manufacture during the Coles Creek period. Cameron Complicated Stamped has been recovered from the Bayou Cutler I site (16JE3) north of the current study area.

Only limited archaeological evidence has been found to support the theory of subsistence based on maize agriculture during the Coles Creek period (Kidder 1992a). Archaeological efforts have resulted in the recovery of only the smallest amounts of maize from Coles Creek midden deposits. Tooth enamel decay indicative of the consumption of maize was thought to be attributed to the consumption of starchy foods other than maize (Kidder 1992b; Steponaitis 1986). Evidence now available suggests that the growth and consumption of maize was not widespread in the Lower Mississippi Valley until after the Coles Creek period, ca. 800 B.P. (Kidder 1992b; Fritz and Kidder 1993). A better example of subsistence in the Lower Mississippi Valley during this time period can be demonstrated by the faunal remains recovered from the St. Gabriel Site (16IV128), a late Coles Creek/early Plaquemine site in Iberville Parish. These remains included both large and small game such as bear, deer, opossum, rabbit, squirrel, raccoon and alligator. Evidence of several native species of waterfowl, fish and turtle were also recovered. Botanical remains recovered included maize, honey locust, persimmon and grape (Woodiel 1993). Ramenofsky (1989) found evidence of intensive usage of acorns during the Coles Creek period and also notes that the use of acorns increased over time.

A large majority of inland Coles Creek sites have been found to occur along stream systems and particularly on the natural levees of old cutoffs and inactive channels. Soils in these locations would provide nutrients for agriculture (Neuman 1984). Small Coles Creek sites consisted mostly of hamlets with no mounds, while the larger Coles Creek sites contain one or more mounds. Coles Creek mounds typically are larger, and exhibit more building phases than the earlier Marksville burial mounds. Plazas are associated with multiple mound sites (Gibson 1985). Shell middens are the most common forms of Coles Creek period sites in the coastal zone. These middens are commonly on higher portions of natural levees (Springer 1974) along bayous and streams, and along lake shorelines.

The Coles Creek period in southeast Louisiana is divided into three phases: Bayou Cutler, Bayou Ramos and St. Gabriel. Kniffen (1936) designated the Bayou Cutler phase (ca. 1300 to 1150 B.P.) of the early Coles Creek period based on his examination of materials from the Bayou Cutler I site (16JE3) in Jefferson Parish. Phillips (1970), relying on information supplied by McIntire (1958), interpreted the ceramics described by Kniffen as endemic of this phase to include Coles Creek Incised, *vars. Coles Creek* and *Chase*, Beldeau Incised, Chevalier

Stamped, Pontchartrain Check Stamped, *var. Ponchartrain*, Evansville Punctated, *var. Rhinehart*, Mazique Incised, *var. Mazique* and several varieties of French Fork Incised.

The Bayou Ramos phase (ca. 1150 to 1000 B.P.) was described by Weinstein from information obtained during excavations at the Bayou Ramos I site (16SMY133) in St. Mary Parish. The ceramic assemblage of the Bayou Ramos phase consists of Avoyelles Punctated, *var. Avoyelles*, Beldeau Incised, *var. Beldeau*, Coles Creek Incised, *var. Mott*, Mazique Incised, *var. Mazique* and Pontchartrain Check Stamped, *var. Tiger Island* (Weinstein et al. 1978). Bayou Ramos phase sites primarily occur west of the Barataria Basin.

St. Gabriel (ca. 1000 to 800 B.P.) was established by Brown (1985) based on Woodiel's (1980, 1993) excavation of the St. Gabriel site (16IV128) in Iberville Parish. Woodiel concluded that the St. Gabriel site (16IV128) contained a very late Coles Creek occupation just prior to changes that would define the Plaquemine period. Ceramics typical of the St. Gabriel phase include Addis Plain, *var. Addis*, Coles Creek Incised, *var. Hardy*, Evansville Punctated, *var. Wilkinson*, Harrison Bayou Incised, *var. Harrison Bayou*, Mazique Incised, *var. Manchac* and small amounts of Plaquemine Brushed, *var. Plaquemine* (Brown 1985; Weinstein 1987; Woodiel 1980, 1993). The best site investigated in the vicinity of the current project area that contains a St. Gabriel component is the Bayou L'Ours site (16LF54) east of Galliano, Louisiana (Goodwin et al. 1991).

Archaeological findings suggest that by the end of the Coles Creek period the population had increased and became more socially and politically complex. Large-scale mound construction occurs. The implication of the reemergence of a chiefdom-like society is evidenced by the return of long-distance trade of a scale not seen since the Poverty Point period (Muller 1983). The introduction of sociopolitical and material concepts into the Lower Mississippi Valley from the established Mississippian traits associated with Cahokia in southeastern Missouri (Kelly 1990) possibly initiated the transformation of Coles Creek cultural traits into what is now recognized as the Plaquemine culture about 800 B.P.

Mississippian Stage

During the late prehistoric period Mississippian influence radiated from the middle Mississippi River Valley across the Southeast (Haag 1971). Mississippian sites in Louisiana typically are located along the Mississippi River and the southeastern coast (Neuman 1984). Mississippian culture continued to influence the lifeways of indigenous southern Louisiana populations until contact with European cultures.

The consistent variation of Mississippian sites suggests that the Mississippian culture was a complex, non-egalitarian, stratified society. Larger sites contain flat-topped, truncated pyramidal mounds facing onto a central plaza which probably served, at least in part, as platforms for the residences of high-status families. Low-status families occupied single room, rectangular wattle-and-daub buildings (Walthall 1980).

The cultivation of maize, beans, squash and pumpkins; gathering of local plants, nuts and seeds; and fishing and hunting of local faunal species served as the basis of Mississippian subsistence. Terrestrial faunal remains from Mississippian sites indicate that approximately 70 percent of the animals consumed were deer, raccoon, squirrel or turkey. These animals utilized both maize and mast for their own dietary needs and were the hunted game (Neumann 1989). Increased consumption of opossum is evident (Neumann 1984). A byproduct of the swidden horticulture practiced during this time was the growth of persimmon groves on the abandoned fields; persimmons were exploited heavily by both human and animal populations.

The inclusion of shell tempering in the Mississippian pottery enabled potters to create larger vessels. Typical Mississippian ceramic vessels include globular jars, plates and bottles, and loop- and strap-handled pots. These vessels were decorated by engraving, negative painting and incising. Modeled animal heads and anthropomorphic images were also used to decorate ceramics. Chipped and ground stone tools; shell items such as hairpins, beads and gorgets and mica and copper artifacts are a few of the items recovered from Mississippian sites (Neuman 1984; Steponaitis 1983; Walthall 1980).

Plaquemine Culture (ca. 800 - 300 B.P.)

Previously thought to be a transitional phase from the Coles Creek culture to a pure Mississippian culture (Neuman 1984) recent investigations categorize the Plaquemine culture (ca. 800 to 300 B.P.) as Mississippian (Kidder 1988, 1990). The intensification of agriculture, sociopolitical structure and religious ceremonialism suggests the development of a complex social hierarchy.

Plaquemine subsistence was probably based mainly on agriculture and supplemented by native plants and animals. Kidder (1992a) notes that the Emerson Site (16TE104), a late Plaquemine site in the Tensas Basin yielded a large volume of maize, but the quantity of acorn remains from the site indicate that this resource was intensely utilized. In the coastal zone, Williams (1999) identified substantial amounts of *zea maize* associated with late Plaquemine cultural deposits at the Discovery Site (16LF66).

Settlement patterns, economic organization and religious practices of the Plaquemine peoples continued in the tradition of the earlier Coles Creek period. Sites are typically characterized as ceremonial sites with multiple mounds surrounding a central plaza, with dispersed villages and small hamlets (Neuman 1984; Smith et al. 1983). According to Gregory (1969), Plaquemine sites are generally found in lowland areas, including swamps and marshes. Numerous *Rangia cuneata* shell midden sites in the coastal zone contain Plaquemine components, not unlike the preceding Coles Creek period. Identified Plaquemine sites in the region include 16JE2, 16JE45, 16LF29, 16LF31 and 16LF37 (Neuman 1977).

Plaquemine ceramic decorations demonstrate their Coles Creek tradition, while late Plaquemine ceramics reflect an interaction with cultures to the north and east (Kidder 1999; Phillips 1970). Typical early Plaquemine ceramic types included Leland Incised, Coles Creek Incised, *var. Hardy*, L'Eau Noire Incised, Anna Incised and Plaquemine Brushed (Quimby 1951). The inland Plaquemine culture apparently had evolved into a true Mississippian culture by ca. 550 B.P. (Kidder 1988). In the coastal zone of Louisiana, the Plaquemine culture adopted fewer Mississippian cultural traits. Kidder (1990, 1999) notes that Mississippian ceramics represent a minority of the ceramics found on Plaquemine sites in this region dating to the same time period. The Plaquemine culture also did not adopt shell tempering to the same degree as other indigenous cultures in the Southeast. Instead, the Plaquemine people continued utilizing grog as a tempering agent.

Two phases have been established for the Plaquemine culture in the Barataria Basin of Louisiana. The early Plaquemine culture is represented by the Barataria phase. The Barataria phase (ca. 800 to 500 B.P.) was created based on excavations at the Fleming site (16JE36) in Jefferson Parish (Holley and DeMarcay 1977). Ceramics defining the Barataria phase include Anna Incised, *vars. Anna* and *Evangeline*, Carter Engraved, L'Eau Noire Incised, *vars. L'Eau Noire* and *Bayou Bourbe*, Mazique Incised, *var. Manchac*, Maddox Engraved and minor amounts of Plaquemine Brushed (Weinstein 1987). Ceramic decorations also include Southern Cult motifs, particularly on L'Eau Noire Incised vessels. The Delta-Natchezan phase (ca. 500 to 300 B.P.) represents the late Plaquemine culture in the region (Phillips 1970). Ceramics during this phase include early Plaquemine types, along with Addis Plain, *vars. Addis* and *Greenville*, Fatherland Incised, *vars. Bayou Goula* and *Fatherland*, Maddox Engraved, *var. Emerald*, Mazique Incised, *var. Manchac* and Plaquemine Brushed (Brain 1988; Phillips 1970; Weinstein 1987). The latter two types generally occur in minor frequencies. Another trait of the late Plaquemine culture is the occasional presence of Moundville Incised and Pensacola Incised, indicating some form of contact with Mississippian societies to the east (Kidder 1999).

Historic Contact

The great social disruption suffered by aboriginal groups after the De Soto entrada between 1539 to 1543 has caused difficulty in understanding historic Indian cultures of the southeastern United States. Severe population depletions, a result of epidemics caused from a lack of immunity to normal European illnesses (Ramenofsky 1982; Smith 1986) created extreme circumstances that necessitated major social reorganization. The breakdown of the complex Mississippian societies during the terminal prehistoric period, the social and demographic reorganizations during the Protohistoric period (ca. A.D. 1539 to

1673), and even the better documented, but little studied, colonial period yield little information concerning the cultural continuity of most historic aboriginal groups in the region (Peebles and Kus 1977; Peebles and Mann 1981; Welch 1991). This lack of information has lead to difficulty delineating the ancestral archaeological cultures from which the historic groups were derived. Historic Native Americans continued with many practices of the Late Mississippian and Plaquemine peoples. Maize, beans, squash and pumpkin were the principle agricultural crops. The gathering of wild plants along with hunting and fishing remained important components of the aboriginal subsistence system.

Villages remained similar to those observed at Plaquemine and Mississippian sites. The larger villages featured one or more truncated pyramidal mounds surmounted by elite houses and temples; the remaining villagers lived in the area surrounding the mounds and in satellite hamlets. Houses apparently were rectangular in shape and were constructed of poles placed in the ground with wattle and daub walls and thatched roofs (Swanton 1946).

Initial European contact with the Houma tribe occurred at the tribe's primary village near the confluence of the Mississippi and Red Rivers, at the present site of Angola, when La Salle visited there in 1682. The Houma houses were rectangular, and were arranged in a large circle surrounding a central plaza. By the early 18th century, the tribe had been driven from the region by the Tunica. They settled briefly along Bayou St. Jean (Bayou St. John), near New Orleans, and eventually moved to the Great Houmas Village (16AN35) and Little Houmas, both located near the Mississippi River approximately 8 km (5 mi.) down river from Donaldsonville. These lands were sold in 1776. The tribal remnants moved into the coastal swamps and marshes near present-day Houma (Kniffen et al. 1987).

Numerous tribes resident in southeastern Louisiana at various times likely utilized the hunting and fishing resources of Barataria Bay and its margins. In the period of initial contact between the French and the Native Americans, Barataria Bay was at the border of the areas occupied by Muskogean-speaking Indians to the east and Chitimachan-speaking Indians to the west. In 1682, the Quinipisa-Mugulasha were resident on the west bank of Jefferson Parish, but by the turn of the 18th century, they had moved further up the Mississippi River. In 1700, the Chawasha (or Chaouacha) were centered on Bayou Lafourche in the vicinity of modern Lockport and the Washa (or Ouacha) were resident above modern Thibodaux. Both tribes moved closer to New Orleans in the early 18th century. However, several 18th-century maps (e.g., *Carte de Louisiane* by D'Anville, 1732; *Luigiana Inglese, colla Parte Occidentale della Florida, della Giorgia, e Carolina Meridonale* by Zatta 1778) designate Barataria Bay as *Lac des Ouachas* and Cheniere Caminada as *Isle des Chitimachas*, suggesting that these Native Americans visited the region for hunting and fishing during the early historic period (Goins and Caldwell 1995:17, 18, 21; Maygarden et al. 2002).

The late 17th century Chitimacha tribe apparently controlled much of the upper Barataria Basin along both Bayou Lafourche and the Mississippi River. Their population was decimated during the 18th century by disease, war and cultural pressures applied by the French settlers. In response to increasing pressure from the European settlers, the tribe moved into the largely unpopulated areas of southeastern Louisiana, enabling it to survive as an entity into the 20th century (Swanton 1946; Kniffen et al. 1987). Prehistoric Plaquemine period pottery designs identified at the Discovery Site (16LF66) in Lafourche Parish share several similarities with traditional designs used by the Chitimacha tribe. This suggests that the Chitimacha possibly are the descendants of the coastal Plaquemine people (Miller et al. 1999).

Several other tribes, including the Bayou goula, the Quinapisa, the Acolapissa, the Mugulasha, the Okelousa and the Tangipahoa, frequented the lower Mississippi River during the early 18th century. As French and Spanish settlement expanded during the 18th century, these tribes died out, moved westward or were assimilated into remnant tribes scattered throughout the unpopulated portions of southern Louisiana (Kniffen et al. 1987). By the early 19th century, no Indian tribes remained in the vicinity of the project area.

Potential for Prehistoric Resources

Wisconsin Period glacial advances produced world wide lower sea levels. From 60,000 to 50,000 and 24,000 to 20,000 years ago the bottom lands of the Gulf of Mexico were exposed almost to the edge of the Continental Shelf. During this period sea level was some 90 to 300 feet lower than present. The development of vegetation and adaptation of natural resources would have made the exposed continental shelf attractive to human populations (Fisk and McFarlan 1955).

The Gulf Continental Shelf region was drier than today and was characterized by xeric scrub vegetation (Borremans 1990). Areas where rivers, streams or springs provided additional moisture supported forests of oak and pine. These wetter environments also sustained a host of animal life and would have attracted Paleo-Indian groups arriving from the north. By 10,000 B.P., the Continental Shelf environment began to change. Additional rainfall allowed forests to expand farther south. These environmental changes coincide with the introduction of Archaic cultures. Sea level was still low during this period; the present coastlines were not established until around 2000 and 4000 B.P. As a consequence, many Early Archaic sites lie inundated like their Paleo predecessors.

The fluctuation of sea level during and following the Wisconsin Glaciation is an important factor for reconstructing paleoenvironment and determining the potential for Native American sites on drowned continental shelf surfaces. Sea level fluctuation and its role in archaeological interpretation was postulated by Goggin in 1948 (Murphy 1990). The bands of Paleo-Indian groups that moved onto the exposed Continental Shelf as early as 12,000 B.P. occupied areas adjacent to streams and rivers (Fisk and McFarlan 1955). Confluences of streams and rivers, river levees and river and coastal terraces have proven to be high probability areas for terrestrial Paleo-Indian sites (Coastal Environments, Inc.

1986). On the Continental Shelf, those inundated geomorphological features are considered prime indicators for submerged prehistoric archaeological sites. In 1966, Emery and Edwards established a relative sea level curve and noted its implications for archaeological sites: Paleoindian and Archaic sites were most likely submerged offshore and sites of particular periods could be located at specific depths (Murphy 1990). Those authors also speculated "that little might remain offshore beyond some tools, because of the advancing seas and the scattering of materials produced by the passage of the surf zone over the sites" (Murphy 1990:17-18). Others postulate that deltaic and esturine sediment deposition associated with rising sea level possibly protected sites from erosion associated with the Holocene transgression (Belknap 1983).

The survival of prehistoric cultural material associated with human occupation of the Gulf Continental Shelf has been documented from Florida to Texas (Aten and Good 1985; Stright 1990; Johnson and Stright 1992). Research along the west coast of Florida suggests that the rise of sea level in low energy environments served to preserve sites during the inundation process. Coastal Environments, Inc., documented submerged prehistoric material in association with relic features of the Sabine River. Those remains included subaerial shell middens and associated pollen deposits that reflect features associated with terrestrial archaeological sites. The relic Sabine River deposits were identified approximately 55 to 60 feet below present sea level and 15 to 20 feet below the bottom surface. Material recovered from the deposit was dated approximately 8,100 years B.P. using radiocarbon analysis (Coastal Environments, Inc. 1986). Lithic material suggestive of tools or the tool making process and dating to the period from 13,000 to 10,000 years B.P. was recovered from dredge spoil from Galveston Bay (Aten 1983). The coastal marshes of Avery Island, Louisiana contain well preserved Paleo-Indian sites (Gagliano 1967). Investigation of those sites produced both artifacts and associated faunal remains that date from 12,000 to 10,950 years B.P. (Coastal Environments, Inc. 1977).

In the Sandy Point study areas under consideration, the potential for prehistoric material in association with relict channels appears to be limited. The depth of Pleistocene surfaces in the Gulf off Barataria Bay ranges from 350 to 400 feet below the present bottom surface (Saucier 1994). Those depths are well below the potential impact of proposed dredging. While relict channels were identified in three of the four Sandy Point survey areas, all of those channels appear to be relatively modern geological features. They were probably formed during the Late Wisconsin Period when sea level was more than 30 to 35 feet below present (Curray 1960).

Because the confluences of streams and rivers, river levees and river and coastal terraces have proven to be high probability areas for terrestrial Paleo-Indian sites, relict channels and other submerged geological features have been identified as potential markers for submerged cultural resources. While those features suggest a high potential association with prehistoric human activity, the inundation process associated with marine transgression could have destroyed much of the archaeological record (Murphy 1990). There is little in the sub-bottom records to suggest that the land forms that might have attracted early man to this area of the Continental Shelf have survived. As a consequence, none of the relict channel features that are within the area of proposed dredging are recommended for avoidance or additional investigation.

Historic Overview of the Barataria Region

European Exploration and the Colonial Period to 1803

René-Robert Cavelier de La Salle explored the Mississippi River from Canada to the Gulf of Mexico, and claimed the whole Mississippi Valley for France in 1682. He did not, however, explore the Barataria Bay area. Precisely when Europeans first made landfall on Grand Isle or Grand Terre is not documented. However, several explorers sailed the Gulf in the 16th, 17th and early 18th centuries without describing Grand Isle or Grand Terre in their writings. According to an early 18th century French map, the route from New Orleans along Bayou Barataria, through Barataria Bay and out Grand Pass (or Barataria Pass) to the Gulf was discovered in August 1722. On d'Anville's *Carte de La Louisiane* of 1732 the area of the Gulf of Mexico adjacent to Grand Isle and Grand Terre is named *Ensenada de Palo*, meaning the inlet of the stick, club or mast. This probably refers to driftwood accumulated on the beaches in this vicinity. The *Carte* notes that this is the name of the inlet "on Spanish charts," and other names for the cove were Woods Bay, the Bay of Logs or *Anse au Bois* (Evans et al. 1979:14-16; Maygarden et al. 2002).

At an early date, the French settlers gave the name "Barataria" to a swampy area of interlaced bayous and lakes stretching from the natural levee of the Mississippi River's west bank south to Grand Isle and Grand Terre (correctly Grande Terre). Le Page du Pratz (1975) applied the name to an area west of the mouth of the Mississippi River, between the Gulf of Mexico and the River, where alluvial land exists surrounded by lakes and other waterways, "to form almost an island on dry land" (Le Page du Pratz 1975). This is a reference to the "Island" of Barataria of which Sancho Panza was made governor in de Cervantes' *Don Quixote*. Some writers have tried to connect the origin of the Louisiana name with the early 19th century smuggling "Baratarians," or even earlier smugglers, but the Barataria region was evidently named prior to its becoming a smuggler's haven. Several 18th century maps applied the name "Isle [de] Barataria" to an inland area in the vicinity of modern Lafitte, or the area bounded by Bayou Perot, Bayou Rigolettes, Bayou Barataria and Lake Salvador. French reconnaissance of the Barataria region made evident the area's potential for the extraction of timber, game, fish, furs and shell. The earliest French place-name inland in the Barataria area was *L'Hermitage*, appearing on a number of 18th century maps in the area to the east of Lake Salvador. However, along Bayou

Barataria land grants were made as early as 1726 to settlers who farmed their Barataria tracts, raised livestock or engaged in extractive industries such as timbering or harvesting furs (Evans et al. 1979; Maygarden et al. 2002).

With huge amounts of excellent alluvial land available in the Louisiana colony, the Gulf Coast of Barataria remained sparsely populated during the French and Spanish colonial period. The first grant along the Gulf was at Cheniere Caminada, granted to Monsieur du Roullin in 1763. The Spanish, in control of Louisiana after 1763, sought to restrict both access to and information about the Gulf Coast. Grand Isle and Grand Terre are depicted with some measure of accuracy on European maps beginning about 1770. In 1771, Englishman George Gauld (1771) published a *Plan of the Coast of West Florida and Louisiana Including the River Mississippi*, the first relatively accurate survey of the Louisiana Gulf coast. Circa 1785, Spanish pilot José de Evia conducted a reconnaissance of the Louisiana Coast, and produced the first extensive description of Grand Terre (*Gran Tierra*) and Grand Isle (*Isla Larga*). De Evia mentioned the large amounts of driftwood along this coast caused by the outflow of the Mississippi, and the presence of hunting and fishing camps in the area (Evans et al. 1979; Maygarden et al. 2002).

The Spanish government began to grant tracts on Grand Isle in 1781, when Jacques Rigaud received the eastern portion of the island. Joseph Caillet received a grant for a tract on Grand Isle in 1782, François Anfrey obtained a tract in 1785 and Charles Dufrene was granted the western portion of Grand Isle in 1787. Charles Mayronne was granted a tract on Grand Terre in 1794. Some of these grantees, such as Jacque Rigaud and Charles Dufrene, resided on their tracts and raised crops and cattle, while others, such as Mayronne and Anfrey, were absentee owners. One advantage of Grand Terre over its neighbor Grand Isle was that the former afforded a better harbor, closer to Grand Pass, where sea-going vessels of moderate draft could anchor in the protected waters of Barataria Bay, close to the shore of the island. However, access to Barataria Bay was limited by the shallowness of the bar, which historical documentation seems to indicate was from nine to fifteen feet in depth. The shallow bar prevented larger vessels from entering Barataria Bay and anchoring behind Grand Terre or Grand Isle if the tide was out (Evans et al. 1979; Swanson 1975; Maygarden et al. 2002).

During the Spanish colonial period (1762 - 1803) smuggling became endemic in Louisiana, as American and other merchants as well as the Creole inhabitants of the colony sought to evade Spanish commercial regulations. Early on, Barataria became an avenue for avoiding the Spanish Customs at New Orleans. The Dubreuil Canal, dug in 1740, connected the Mississippi River to Bayou Barataria, and may have been used as a smuggling route as early as the French colonial period. The Spanish administration of Louisiana tried to patrol the Gulf Coast with the *Armada de Barlovento*, consisting of galleys and a few large sailing ships based at the Balize. However, smuggling was rampant, and Governor Carondelet even suffered a humiliating demotion for failing to enforce commercial regulations. With the transfer of Louisiana from Spain to France, and then from France to the United States, it is probable that the opportunities for smugglers in Louisiana waters became even greater (Maygarden et al. 2002; Swanson 1975).

The Baratarians and the Laffites (1803 - 1814)

Governor Claiborne was aware of the smuggling problem early in his administration of the Louisiana Territory, but within the first decade of the American period in Louisiana, smuggling and worse contraventions of law and order still would attain unprecedented heights. The surge of smuggling activity in this period was strongly related to the prevalence of international privateering, which was carried on with little or no regard for national law and international conventions. That is, the privateers descended into piracy. Furthermore, Grand Terre Island would be the recognized headquarters of the Baratarians, as the principal perpetrators of these nefarious undertakings came to be known. The prominent use of Grand Terre Island (and to a lesser extent, Grand Isle) by privateers of the Gulf of Mexico and Caribbean begins in 1808 and ends with the suppression of the Baratarians by U. S. authorities in 1814. The isolation of Louisiana's southern coast permitted the privateers and smugglers a base for their operations, since Louisiana politicians discouraged suppression of smuggling by the Federal authorities (Maygarden et al. 2002).

The Baratarians, a conglomeration of smugglers, privateers and pirates, and their operations are the most colorful aspects of the history of the Barataria Bay area. Among the prominent characters associated with Barataria in this period are captains Dominique You, Vincent Gambie, René Beluche, Joseph Sauvinet, Louis Chighizola (alias "Nez Coupé"), Franco Tomas, Antonio Angelo, Captain Marqueire, Antoine Sennet, Pierre Cadet, Juan Juanillio (alias Gianni *Barbe en Feu* or Johnny "Flaming Red Whiskers"), Joseph Clement and several others. More famous yet are the brothers Pierre and Jean Laffite. Jean Laffite in particular has attained legendary status and inspired voluminous literature, but, unfortunately, most of the secondary material concerning the Laffite brothers is inaccurate or unreliable. Basic facts about the Laffites remain in some doubt, although recent research (summarized in Maygarden et al. 2002) dispels much of the legendary misrepresentation of the historical figures. Original documents, bearing the Laffites' signatures, indicate that they invariably spelled their surname *Laffite* and not *Lafitte*. Lafitte and its variations is a very common southwestern French name, and documentary sources in France, Louisiana and the West Indies are literally full of dozens of Jean and Pierre Lafittes who are not related to the famous Louisiana figures. The relevant Laffites were born in Bordeaux, Pierre probably in the early 1770s and Jean about 1780. They lived in St. Domingue (now Haiti) prior to immigrating to Louisiana. Jean Laffite is documented to have been in New Orleans by 1801; Pierre Laffite is likely to have arrived at the same time. Some writers have stated that Baratarian captain Dominique You was a brother of the Laffites, but this is erroneous. The Laffite's legitimate occupations are not thoroughly documented, but they were associated with a blacksmith shop established in New Orleans in 1802, and subsequently operated a store. There is no trustworthy evidence that prior to settling in Louisiana the Laffite brothers had any training or significant experience as sailors or seafarers (Maygarden et al. 2002).

The American administration of Louisiana relaxed much of the restrictive commercial regulation that had encouraged smuggling. However, the Jefferson Embargo of 1809 was an obvious stimulation to smuggling, and smugglers again made use of Grand Pass and Barataria Bay as an avenue to the bayous south of the city of New Orleans, as they had during the Spanish regime. In 1808, Pierre Laffite may have set up a small "establishment" in the Barataria region where he acted as an agent or factor for the ships using the Barataria route to avoid customs and revenue inspectors at the mouth of the Mississippi and in New Orleans. Meanwhile, privateers under French West Indies commissions were accustomed to entering New Orleans, despite being legally barred from doing so. In 1809, the Jefferson Embargo was repealed, removing some of the impetus for large-scale smuggling, and causing the contraband trade to diminish (Faye 1940). However, the privateers, yet more in need of a base of refitting and repair, began to return to New Orleans. The vessels and their cargo were embargoed by U. S. gunboats, and several cases concerning privateers with prizes were soon in the District Court in New Orleans (Maygarden et al. 2002).

There was a strong element of popular opinion in New Orleans in favor of tolerating the privateers, and the authorities encountered difficulties in suppressing the activities of the Baratarians. Smuggling in the waterways of the Barataria Basin continued despite Governor Claiborne's actions to suppress it. On 11 November 1811, the province of Cartagena in the Spanish Viceroyalty of New Granada (now Columbia) declared its independence from the Spanish crown. The thriving seaport of Cartagena, comparable in size to New Orleans at that time, and its hinterland, became a republic. Since Cartagena did not have a navy of its own, the issue of commissions for privateers was among its first initiatives to resist the might of Spain. Commissions from Cartagena would soon begin to appear in the hands of Louisiana privateers. The Laffite brothers became agents of these vessels both at Grand Pass and on the bayous of Barataria, probably supplanting a number of early contenders and competitors. Notably, it was Pierre Laffite, and not his younger brother, who was given the sobriquet "Emperor of Barataria" by virtue of his importance to the smugglers' operations and the illicit commerce of the Barataria waterways (Maygarden et al. 2002).

By the autumn of 1811, the Laffite brothers had acquired vessels and outfitted some of them as privateers, captained by professional sailors. By 1812, the level of activity at Barataria accelerated with the availability of privateer commissions from Cartagena. The United States did not recognize the government of the Republic of Cartagena for some years, and during the time the Baratarians were active, any commissions from Cartagena were illegitimate under American laws. For his part, Governor Claiborne sought to maintain a semblance of law and order, in the face of frequent complicity on the part of many Louisianans with the privateers and smugglers. On 15 March 1813, Claiborne issued a proclamation against the smugglers, and on 7 April 1813, both Jean and Pierre Laffite were indicted for violation of the revenue and neutrality laws of the United States. Writs were issued against them, but the brothers could not be found. Despite indictment of the Laffites, the Baratarians grew yet bolder, committing acts of blatant piracy and scuffling with U. S. Customs agents and other authorities. Governor Claiborne issued a second proclamation proscribing the smugglers and privateers on 24 December 1813. It was apparent to the Laffites that the authorities were becoming less tolerant of their open activities. Meanwhile, some U. S. troops that had been stationed at Grand Terre were withdrawn, allowing the Baratarians to make use of the island once more. A Customs officer was killed by the Baratarians in January 1814, and Claiborne appealed to the state legislature for men and funds to "disperse these desperate men on Lake Barataria, whose piracies have rendered our shores a terror to neutral flags" (quoted in Fortier 1914:468). The legislature did nothing. On 23 March, Claiborne issued a third proclamation against the Baratarians (Maygarden et al. 2002).

Throughout the spring and early summer of 1814, Baratarian privateers returned to Grand Terre with prizes, aggravating Spanish representatives in the United States and embarrassing federal and state authorities. Federal authorities, with decreasing patience, were nearing successful action against the Baratarians. In July 1814, a grand jury indicted two Baratarian captains on charges of piracy on the high seas and Pierre Laffite was named as an accessory. On 8 July 1814, Pierre Laffite was arrested on the street in New Orleans, placed in the jail at the Cabildo and held without bail. Jean Laffite publicly expressed disdain for the authorities' actions, but the arrest of Pierre Laffite signaled a change in an important element of public opinion (Maygarden et al. 2002).

Meanwhile, Grand Terre was flourishing as a market for goods taken by the Baratarians, and hundreds of people might have been on the island at any one time, buying or selling goods. Numerous writers seem to have assumed that everyone on Grand Terre was part of Laffite's "organization," but several contemporary witnesses make clear that a substantial portion of the people on the island were not privateer crewmen or otherwise regular members of some Baratarian organization. It seems likely that the degree of order and organization imposed by Jean Laffite on the activities of the Baratarians has been inflated by writers and historians. Contemporary witnesses concurred that he had the greatest authority on Grand Terre, but the fact is that the specifics of Laffite's power are undocumented. The Laffites probably had little or no real authority over privateer captains that owned their own ships, and their capacity as "fences" for goods taken by the privateers was most likely a relationship of convenience. Jean Laffite was more likely a "first among equals" at Barataria and not an autocrat. Besides mundane materials like pig iron or consumer goods such as cloth, glassware and ceramics, a major item in the Laffite's trade were enslaved Africans taken from captured Spanish vessels. Slaves were highly in demand in Louisiana's rapidly developing agricultural economy, while the importation of slaves into the United States had been made illegal in 1809. It does the romantic image of the Laffites little good that they were engaged in such a ruthlessly brutal business. It is difficult to estimate the total value of shipping seized by the Baratarian privateers, but throughout this period, a large number of vessels were captured and taken to Cheniere Caminada, Belle Isle, Last Isle, Cat Island, Grand Isle or Grand Terre or plundered at sea and destroyed. However, the wheels of government turned slowly in 1814. The executive branch finally determined on military action to suppress the

Baratarians' brazen flouting of law and order. In the summer of 1814, the Secretary of the Navy ordered Daniel T. Patterson, commander of the New Orleans naval station, to destroy or disperse the illicit establishment of Barataria (Maygarden et al. 2002).

In May 1814, the British had established a base at the Apalachicola River in Florida to coordinate military activity with the Creek and Seminole Indians. The British command decided to try to recruit the Baratarians to the British forces, and on 30 August, Captain Nicholas Lockyer of the sloop *Sophie* was ordered to convey Captain M'Williams to Barataria to confer with Laffite. Lockyer and M'Williams were instructed to offer Laffite a pardon for piracy and lands in the American colonies at the end of the war in return for his services and the restitution of any plundered Spanish property. In most secondary accounts of the famous meeting of Laffite with the British in early September 1814, Laffite is characterized as a clever, unshakable American patriot, and the British appear as bumblers, but the details of the British offers to Laffite have frequently been misinterpreted and sometimes grossly exaggerated. In fact, the British concluded from their meeting with Laffite on Grand Terre that the Baratarians could not be relied upon for any purpose and lost all interest in recruiting them. Laffite, for his part, could not provide restitution for captured Spanish shipping even if he wanted to. Since cooperation with the British was not feasible, reconciliation with the Americans was probably Laffite's last option in the increasingly tense and dangerous situation. To that end, Laffite sent documents given him by the British to the American authorities and offered his assistance in the defense of Louisiana (Maygarden et al. 2002).

On 5 September 1814, Pierre Laffite escaped from the civil prison at the Cabildo. Despite Pierre's escape, Claiborne considered Jean Laffite's offer of cooperation serious enough to address it at a war council meeting with Commodore Patterson, Colonel George T. Ross of the United States Army and Major General Jacques Villeré, commander of the Louisiana militia. Preparations for the military expedition against Barataria were actually delayed while Laffite's proposal was being considered. When a vote of the participants was taken, only Villeré was in favor of accepting the Baratarians' offer. With the Council decision against Laffite, on the evening of 15 September, the U.S.S. *Carolina* and five U. S. gunboats under Patterson, plus Colonel Ross and 70 men of the 44th Regiment of U. S. Infantry sailed from Southwest Pass into the Gulf of Mexico and toward Grand Terre (Maygarden et al. 2002).

Jean and Pierre Laffite received information that a U. S. naval force was being outfitted in New Orleans to proceed against Grand Terre, and left the island. The Baratarians continued to have daily sales on Grand Terre, hoping to sell as many of the goods as possible before the arrival of the expedition. Patterson's flotilla arrived off Grand Terre on the morning of 16 September, and the Baratarians and their customers fled without a fight. About 80 persons were captured and seven vessels were seized, and another ship captured the next day. Patterson and Ross burned all of the crude Baratarian buildings on Grand Terre and returned to New Orleans with their prize vessels. Events developed rapidly as the threatened British invasion of Louisiana materialized in the autumn of

1814. The most careful scrutiny of the available documentation indicates that Pierre Laffite served honorably on the field at Chalmette, but the presence (or absence) of Jean Laffite at the Battle of New Orleans cannot be verified. As a result of their military service during the events of December 1814 and January 1815, the Laffites, Dominique You and other Baratarians were pardoned by President Madison. Frustrated in legal efforts to regain the vessels captured at Grand Terre, Jean Laffite subsequently moved his operations to the anarchic coast of Texas (Maygarden et al. 2002). Thus ended the colorful era of pirates and privateers in Barataria.

The Barataria Bay Region (1815 – 1865)

Following the suppression of the Baratarian smugglers and the cessation of hostilities with Great Britain, relative calm descended on the Barataria Bay area. Within the Barataria region, the vast majority of the population resided along the northern portion of Bayou Barataria, where during the antebellum period several sugar plantations were developed. Toward the south and along the margins of Barataria Bay lived full-time and part-time farmers as well as hunters, fishermen and loggers who were all more or less dependent upon the rich natural resources of the region. There was a greater interest in proprietorship of the formerly remote Barataria region, and prominent families, such as the Beauregard and the St. Denis families, gave their names to locations within the area. Another activity in the Barataria region was lime making. Jean Baptiste Degruy, for one, owned extensive Barataria plantation tracts in the early-19th century and established a lime manufactory near an Indian mound, which he mined for *rangia* shells. On Grand Isle, numerous landowners were either descendants of the original grantees or more recent purchasers, such as former Baratarian captain Louis Chighizola, a Genoan who bought a tract on the island in 1818. By 1830, there were 12 households on Grand Isle, consisting of a total of 107 persons, of whom 23 were slaves. None of the residents in the early-19th century had a sufficient number of slaves to pursue large-scale commercial agriculture. François Rigaud, son of Jacques Rigaud, held the largest number of slaves, consisting of nine persons in 1830. Livestock raising continued to dominate the agricultural activity of the island through the early decades of the 19th century (Evans et al. 1979).

In the later antebellum period, larger plantations were attempted on Grand Isle. Manuel Encalda, who had purchased the Caillet concession in 1787, died in 1804. His heirs, Jacques and Valentin Encalda, reputedly were the first to grow sugarcane on the island. They probably grew sugar on a small scale, since commercial cane culture was very labor-intensive. In 1829, Samuel Britton Bennett purchased the 600-superficial arpent tract, and in partnership with Henri Pierre Fauchier of Cheniere Caminada, began larger-scale sugarcane growing. In this venture Bennett and Fauchier were not particularly successful, requiring several mortgages on the property to remain in operation. In 1836, Samuel Bennett sold the tract to Henry Lyle Bennett, who sold it a year later to James Ramage. After Ramage's death in 1840, his estate was inventoried, and at that time his Grand Isle Plantation, plus sugar mill, house, agricultural equipment, livestock and 14 slaves, was valued at $41,000. At the public sale held in 1841, Noel Barthelemy Le Breton purchased the plantation and slaves for only $17,000; LeBreton promptly had the tract subdivided into 43 tracts and sold off the plantation piecemeal. Ten of Le Breton's easternmost lots were purchased by Fernando de Colmenero and Mariano Ribas and added to their Barataria Plantation, which became the largest on Grand Isle (Evans et al. 1979).

Ramon de Colmenero, brother of Fernando, and Mariano Ribas had purchased 26 arpents from Genevieve Encar in 1830, about 20 arpents from Francois Rigaud in 1831, 10 arpents from La Breton after 1841, plus additional acreage, for a total accumulation of about 60 arpents front. In 1840, the Barataria Plantation had 100 slaves housed in 38 quarters cabins, outbuildings, implements and livestock with a total value of $102,100.50. The Barataria Plantation managed some medium-sized sugar crops, producing 431 hogsheads in 1844. In 1848, Juan Ignacio de Egana purchased the interests of de Colmenero and Ribas in two separate sales. De Egana, with the backing of silent partner Manuel Julian de Lizardi, had a particularly successful crop in 1849, producing 626 hogsheads of sugar on the Barataria Plantation. However, after 1854, de Egana shifted to growing sea-island cotton because of a decline in the quantity and quality of sugar that could be produced on Grand Isle. After de Egana's death in 1860, his Barataria Plantation plus 116 slaves was valued at $148,190. De Lizardi subdivided the plantation into 60 one-arpent strips stretching across the island from Gulf to Bay, which were sold in the 1860s to a number of purchasers. The plantation era on Grand Isle ended with de Egana's death (Evans et al. 1979).

On Grand Terre Island, Jean-Baptiste Moussier acquired an undivided half-interest in the island from François Mayronne in 1821, and the other half in 1823. Moussier and his family resided in a townhouse in New Orleans and overseer Louis Wagner managed the "Grande Terre" plantation which was developed as a sugar plantation. Moussier died in 1831, and his Grande Terre plantation (plus 58 slaves) was purchased by the Consolidated Association of the Planters of Louisiana. The Consolidated Association of planters sold the Grand Terre tract, then reacquired it, and in 1835 sold the plantation (plus 40 slaves) to the partnership of Alexander Gordon, Edmond Forstall, Felix Jean Forstall, Placide Forstall and Louis Alexander Forstall. Felix and Louis Forstall remained the principal owners of the Grand Terre Plantation into the post-Civil War period. By 1850, the plantation had 86 slaves (Whitbread 1977; Maygarden et al. 2002).

The United States government maintained a military interest in Grand Terre Island after the war with Great Britain had ended. In 1815, the 44th Regiment of Infantry constructed a stockade fortification on Grand Terre, and the ruins of this fort were later referred to erroneously as "Fort Lafitte." The permanent fortification on Grand Terre, eventually named Fort Livingston was the product of the "Third System" or third period (1821-1861) of United States fortification construction. During this era, a permanent and integrated national system of seacoast defenses was developed by the Board of Engineers for Fortifications of the War Department. The extremely expensive masonry works were decisively proven obsolescent during the Civil War. Fort Livingston was not planned until decades after the War of 1812, and construction was not actually begun in any substantial way until 1840. In 1832, a survey of the western end of Grand Terre Island was performed in preparation for purchase of the property by the U. S. and the following year the Adjutant General of the Army named the proposed fortification on Grand Terre Island "Fort Livingston," after statesman Edward Livingston (1764 to 1836). In 1834, the Louisiana Legislature approved cession of state jurisdiction over the fort site to the United States. Little substantial work was accomplished until 1840, when construction began under the direction of Captain John G. Barnard. The plan of Fort Livingston was a polygonal enceinte without bastions, and with masonry walls that only partially contained casemates. The walls enclosed a parade ground and were surmounted by a terreplein, earthen ramparts and a parapet (Maygarden et al. 2002).

In 1853, the U. S. Coast Survey and the Provisional Light-House Board recommended that a first-class lighthouse be erected at Barataria Pass, and on 3 August 1854, Congress authorized construction of a lighthouse to mark the "Grand Pass to Barataria Bay." The degree of erosion at the western end of Grand Terre and accretion on Grand Isle led the Board to recommend that the light be placed on Grand Isle. However, since the United States already owned the western end of Grand Terre, it was decided to erect the lighthouse there. The Grand Terre lighthouse was completed in 1857 at a cost of $9,990.88. Despite the effort and expense of construction, only two years later, on 1 October 1859, the Barataria Bay lighthouse was deemed unnecessary "by reason of mutation of commerce" and discontinued by the Light-House Board. The outbreak of the Civil War found Fort Livingston still unfinished, subsiding and damaged by storms. Louisiana troops assumed control of Fort Livingston in January 1861, but the fort was abandoned by the Confederates when U. S. Naval vessels appeared offshore in April 1862. Following the capture of Fort Livingston by Union forces in 1864, the lighthouse was renovated and Union troops remained posted at Fort Livingston throughout most of 1866 (Maygarden et al. 2002).

The Barataria Bay Area in the Late-19th Century

The swamp portions of the upper Barataria Basin began to be heavily affected by commercial cypress logging during the 1890s, but the marshlands around the margins of Barataria Bay remained largely undeveloped and unoccupied. The Civil War spared Grand Isle any direct damage from military activity, and the generally salubrious environment of Grand Isle attracted a number of new settlers in the post-war period. As immigration to Grand Isle accelerated, the larger plantation tracts of the antebellum period were subdivided, and much of the central and eastern portion of the island (including the Barataria Plantation and the large Rigaud holdings) became characterized by small farms and the residences of fishermen. The 1880 census enumerated 249 residents on Grand Isle in 42 households. The majority of households on Grand Isle in 1880 were headed by laborers, who mostly worked on farms, but about one in four of the Grand Isle households were headed by a fisherman. Fifi Island, on the bay side of Grand Isle, was rented after the war by Abner Jones, a freedman, who resided there with his family, raising vegetables and oranges. At the end of the 19th century, cucumber farming began to become important on Grand Isle. Carefully nursed through the winter months, the cucumbers were picked in April and shipped rapidly via boat to the Harvey Canal, then rushed to northern markets by rail. By the turn of the 20th century, over 35,000 bushels of Grand Isle cucumbers were shipped to Chicago annually. Citrus trees also were producing valuable crops, and in the mid-1890s, grocer John Ludwig of Grand Isle began a program of breeding terrapins in captivity, releasing them to marshes and then paying trappers to return the grown turtles (Evans et al. 1979).

Exploitation of marine resources had been an important activity in the Barataria Bay region for many years, but commercial fishing began to become more important in the late-19th century, as ice-making machines and railroad networks made it practical to transport fish to markets outside of the immediate region. Particularly notable was the rise of shrimping and shrimp processing. Lim Yim, a Cantonese, is credited with bringing the shrimp-drying process to Louisiana from his homeland, where the process had been used for generations (Kane 1943).

Prior to the development of shrimp trawlers in the 20th century, shrimp were usually caught by seining in shallow waters with hand-thrown nets. The shrimp were taken to the platforms for processing. These platforms were hundreds of feet to a side. The shrimp were first boiled in salt water in large cauldrons, and then spread out on the broad plank platforms to dry. Slight rises and valleys in the platform insured good drainage during rainstorms, during which the shrimp would be raked up to the nearest peak and covered by a tarpaulin (Schoonover 1911). They were raked and turned until dried, and then, in a process called "dancing the shrimp," the hulls and heads were removed by the tread of men, women and children with their feet wrapped in burlap, marching around the platform to the rhythm of a chant or work-song. The most famous, but not necessarily the first, of these platforms was Manila Village.

Historians debate its origins; claims that the village dated to the 18th century are certainly false. Manila Village was probably founded about 1882 by Jacinto Quintin de la Cruz of Albay, the Philippines. Manila Village was perhaps later acquired by the Quong Sun company, which exported dried shrimp from Barataria to China beginning in 1873. The Quong Sun company also owned a platform at Bayou Defond, possibly pre-dating Manila Village. The Barataria shrimp platform workers, who were either Filipinos, Chinese or possibly ethnically Chinese Filipinos, lived in barracks quarters or in small family houses on the platforms. Other shrimp-drying platforms were located at Bassa Bassa Bay, Leon Rojas, Bayou Cholas and Bayou Bruleau. In total, there were at least a dozen such settlements over time, in an area stretching from Wilkinson Bay to Cheniere Caminada (Swanson 1975; Churchill 1999; Evans et al. 1979). In addition to the platform, docks, residences and store (Kane 1943), Manila Village also had a post office referred to as Cabinash. The 1926 United States Coast Pilot for the Gulf Coast from Key West to the Rio Grande notes that a mail boat made deliveries between Grand Isle and Manila three times a week (Patterson 1926). It also mentions that gasoline, oil and provisions could be obtained from Manila Village. Dry dock facilities for boats up to "3 1/2 to 4 feet drafts" also were available at Manila Village.

Another notable development in the Bay region during the late-19th century was the increasing use of Grand Isle as a resort destination, a trend that had been long in developing. Despite resentment toward vacationers and tourists on the part of some residents, Joseph Hale Harvey promoted his plantation-converted-to-resort, where former slave cabins were used by houseguests from 1866 on. In 1868, Robert L. Preston built a bathhouse near the Harvey hotel. The Harvey hotel was purchased in 1878 by John F. Krantz and renamed the Krantz Place. Also on Grand Isle were the "pension" of George Willoz, established in 1872, which became the hotel of P. F. Herwig in 1888. By 1890, the Fort Jackson and Grand Isle railroad had been completed to Myrtle Grove in Plaquemines Parish, from whence vacationers took a steamer to Grand Isle, reducing the New Orleans-Grand Isle trip time to four hours. The railroad encouraged the most grandiose of the Grand Isle hotel ventures, the 160-suite Ocean Club Hotel, constructed in 1891-1892 for James H. Wilkinson. Herwig was also planning to build a new hotel, but Mother Nature had something else in store for the Grand Isle resorts. The severe 1893 hurricane wrecked the Krantz Place, the Herwig Hotel and the Ocean Club. Grand Isle recovered slowly as a tourist destination, but vacation homes rather than resort hotels were more characteristic of the Island in the 20th century (Evans et al. 1979).

After the Civil War, the War Department made plans to perform further work on Fort Livingston, but these were ultimately shelved. Through the 1870s, the Fort was neglected and decayed, but in 1875, a petition of local vessel owners and masters requested that the Grand Terre light be shown 360 degrees. This modification to the lighthouse was accomplished by the end of July 1875. General W. T. Sherman recommended in 1882 that Fort Livingston be abandoned. Instead, maintenance and minor repairs continued until the southern corner of Fort Livingston was breached by storm action and erosion in 1886. Custody of Fort Livingston was transferred from the Quartermaster Department to the Light House Board of the Treasury Department in March 1889. The hurricane of 1893 did great damage to the southern corner of the fort, expanding damage that had already begun. Another major hurricane more fully exposed the parade grounds of the fort on the southern side in 1915. In 1923, Fort Livingston and its reservation were turned over to the State of Louisiana (Maygarden et al. 2002).

Louis E. Forstall and Felix J. Forstall were unable to meet mortgage terms on their Grand Terre plantation after the War and in 1870, the plantation was sold to the Consolidated Association of Planters of Louisiana. At the end of 1878, the Grand Terre plantation was sold to Joseph [José] "Pepe" Llulla, the most celebrated duelist of antebellum New Orleans. Llulla was born in the Balearic Islands, in 1815. Legend, whether true or not, says that Llulla retired to Grand Terre at least partly to avoid the attentions of aggressive young men. In 1888, Llulla also purchased a large tract on Cheniere Caminada, but evidently resided on Grand Terre. In 1888, Llulla died and the Grande Terre plantation was inherited by his daughter, Louisa Suarez Meranda. On 13 June 1893, Mrs. Suarez sold Grand Terre (minus the U. S. military reservation) to 25 New Orleans businessmen, each of whom obtained an undivided 1/25 interest in the island. Considerable resort development had occurred on Grand Isle by the time of Llulla's death, and these businessmen purchased Grand Terre expecting the extension of a rail line to the island. The rail line never materialized and the island slipped into obscurity. After Pepe Llulla departed, the only regular residents of Grand Terre were the single keeper of Fort Livingston (who left in 1889) and the lighthouse operator. The severe 1893 hurricane did extensive damage to the light and keeper's buildings. However, the brick light tower was still standing after the 1893 storm, and it is undocumented as to when it was demolished or fell down. Following the 1893 storm, the Lighthouse Board decided to move the lighthouse to the northeastern glacis of Fort Livingston. A square wooden tower on concrete foundations, nearly identical to a lighthouse built on Ship Island, was built in 1897 (Maygarden et al. 2002).

The Barataria Bay Region in the 20th Century

During the first decades of the 20th century, Grand Isle remained a relatively quiet locale. Most of the year-round residents remained active in truck farming, fishing, shrimping, turtle raising and other activities that had become traditional on the island. Interest in developing the island for tourism remained, but various proposals to extend railway lines to the island never came to fruition. In 1931, LA Hwy. 620 (now LA Hwy. 1) was extended across Caminada Bay to Grand Isle, greatly increasing both access to the island for visitors and opportunities for shipping island products. During the years of the Great Depression, Alfred Danziger and his Grand Isle Development Corporation bought many properties and became the largest landowner on the island. Danziger's belief in Grand Isle's potential for development had not fully paid off by the time of his death in 1948, although his investments and promotional activities had a significant impact on 20th-century Grand Isle (Evans et al. 1979).

Ownership of Grand Terre Island was never reconsolidated after the 1893 sale by Pepe Llulla's daughter, which perhaps explains why development has not occurred in the 20th century. Unfortunately, the total acreage of the island is rapidly eroding; thus, the individual interests in Grand Terre are corresponding to ever-smaller portions of land. Maps show Grand Terre to have been larger in the late 19th century than it had been in the middle of the century. However, dramatic erosion of the eastern end of Grand Terre was probably initiated by the 1893 and 1915 hurricanes, which resulted in the Grand Terre Island breaking into multiple parts. The areas of ground formerly attached to Grand Terre have been referred to as the Grand Terre Islands since their separation (or re-separation), and are now only a fraction of their size earlier in the 20th century. In 1944, the Barataria Bay lighthouse was automated. The wooden tower remained in use until 1957, when it was replaced by a steel tower (Maygarden et al. 2002).

During the early decades of the 20th century, exploitation of natural resources such as fish, shellfish, oysters and fur-bearing mammals accelerated strongly. Further dramatic growth in fisheries and trapping was partly a result of the development of the internal combustion engine, which by improving both marine and terrestrial transportation lowered production and marketing costs. By the World War I era, Louisiana shrimpers were harvesting over 20 million pounds of shrimp annually, accounting for 85% of all U. S. Gulf of Mexico production. Much of this catch was canned or dried, since shipping the raw product on ice was expensive. The picturesque shrimp drying platforms began to decline after the introduction of shrimp-hulling machinery after World War I, and by 1940, only about a dozen fishermen and their families lived at Manila Village, the most famous of the platforms. Manila Village was finally abandoned after Hurricane Betsy in 1965. Closer to Grand Isle, the Bayou Bruleau shrimp platform and village probably suffered the same fate from Betsy's wrath. In the early 20th century, several shrimp canning plants were established in Jefferson Parish as the market for the product grew. By the mid-1920s, over 35 million pounds of shrimp were harvested annually in Louisiana waters, with a market value of over $2 million. By the second half of the 1930s, shrimp harvests in Louisiana waters reached over 75 million pounds per year, with a value of $2.7 million, but the greater part of the processing had followed the shrimp concentrations to other parts of the Gulf. Canned shrimp were virtually superceded by frozen shrimp from the 1940s, although dried shrimp remained an export item. Coastal Jefferson Parish was also an early center of the Louisiana oyster industry, which had an annual value of $1.5 million on the eve of World War I. In the late 1920s, Louisiana production of oysters surpassed 2.5 million bushels annually, with a total value of $1.5 million. Jefferson Parish at that time had about 28,000 acres of oyster bottoms, about 6% of the Louisiana total. By the late 1930s, over 3.2 million bushels of oysters were harvested in Louisiana waters annually; Jefferson Parish production in 1937 was over 63,000 barrels. Saltwater fish were another growth business in the early decades of the 20th century. The value of Louisiana saltwater fish production, mainly trout, redfish, sheepshead, flounder and "common saltwater" species, plus crabs and sea turtles, was over $2 million annually by the late-1930s. Grand Isle was the center of the Louisiana diamondback terrapin industry, worth $200,000 a year by the World War I period. By the late 1920s, "King" John Ludwig's terrapin farms held up to 25,000 turtles at one time, and produced the majority of Louisiana's terrapin production. Grand Isle terrapin production eventually reached 60,000 turtles per year (Louisiana Department of Agriculture and Immigration [LDAI] 1920, 1924, 1926, 1928, 1938; Laney 1938; Churchill 1999).

Of all the Louisiana animal resource industries in the first decades of the 20th century, the most valuable was fur trapping. The national fashion craze for fur coats led to an annual Louisiana production of 6 million muskrat pelts by the late 1920s, valued at $5 million, more than the annual value of the saltwater and freshwater fishing industries combined. As the value of muskrat pelts increased, trapping lands that had formerly been unregulated were posted by owners, who instituted a sharecropping arrangement with the trappers. Where muskrats were plentiful, owners levied a 50-50 share on the trappers, and where muskrats were scarce, a 35-65 share, the larger percentage going to the trapper. The landowners or their agents collected the furs from the trappers and sold them to the highest-bidding buyer. The owner then distributed the proceeds among the trappers. In places, the south Louisiana marshes became criss-crossed by "trapper's canals," small artificial channels only wide enough to allow the passage of the trapper's pirogue, while "muskrat farms" were established to increase the natural population. By the late 1930s, Louisiana had some 20,000 trappers harvesting muskrat, mink, otter, raccoon and opossum; 1,000 fur buyers; and 100 fur dealers. Most of the trappers spent the spring and summer trawling for shrimp or seining for commercial fish. The fur trade was strong through the 1930s; 6 million muskrat pelts were taken in Louisiana in 1937, valued at $6.5 million, and representing almost three-quarters of total U. S. muskrat pelt production (LDAI 1920, 1924, 1926, 1928, 1938; Laney 1938).

The greatest economic development in the Barataria region in the middle decades of the 20th century was the rise of the petroleum extraction industry. The Humble Oil & Refining Co. began to investigate the potential for offshore oil reserves on the Continental Shelf of the Gulf of Mexico as early as 1930. However, onshore petroleum production in Jefferson Parish began before offshore fields were discovered. In 1934, the Texas Co. sent geophysical crews into the Barataria region, where they found evidence of a dome near Lafitte. In November 1934, a test well was drilled in a Louisiana Land & Exploration Co. lease in Section 19 of Township 17S, Range 24E. In January 1935 drilling began on a well which bottomed out at a depth of 9,572 feet in the "St. Denis Sands," making it one of the world's deepest producing petroleum wells up to that time. The Texas Co. also at this time developed the system of cutting canals through marsh and swamp, allowing barges to be sunk at the well location to provide a foundation for the derrick. By 1940, 42 producing wells had been drilled in the Lafitte field, the third largest producing field in the state, and by 1949, there were 66 wells in the Lafitte field with an annual production of 3.5 million barrels. The successes of the Texas Co. venture at Lafitte ensured that further development in the Barataria region would occur. The second field in the region, the Barataria oil field, was opened by the California Oil Co. in November 1939, and in less than six months, produced over 83,000 barrels of oil. The depth of the first Lafitte well was quickly surpassed, and in 1949, the Texas Co. drilled a well at Queen Bess Island to 16,068 feet, the deepest petroleum well ever drilled to that time. During this developmental period, oilfield workers lived in quarters-boats or oilfield camps, and subsequently the towns of Lafitte, Barataria and Crown Point grew as residential communities for oilfield workers (Stewart 1939; Dabney 1940; Kleck 1950; Black 1949; Holmes 1986).

However, by the late 1940s, oil analysts were predicting a decline in future onshore production and some attention was shifted to potential offshore sources. The Humble Oil Co., a leader in Gulf exploration, conducted gravity and seismograph work off Grand Isle beginning in 1946, but drilling was complicated and delayed by litigation concerning offshore leases. Humble began construction of the first stationary drilling platform in the Gulf of Mexico in November 1947; a non-stationary platform out of sight of land had been brought in off Morgan City the same month. The Humble stationary platform and well were considered a remarkable technological achievement in their time, and were completed on 17 March 1948 at a total cost of $1.2 million. Dubbed "Grand Isle No. 1," the platform had a working crew of 54 men and two decks, one at 34 feet above mean Gulf level and one at 48 feet. During 1948, Humble also built 11 smaller platforms near Grand Isle, with only the wells themselves on pilings and utilizing a fleet of 19 former military surplus landing-ships (LSTs) as tenders. The base of Humble's operations was established on a 65-acre tract on Grand Isle, which included warehouses, boat pens and employee community facilities. Humble also dredged some two miles of Bayou Rigaud and a mile of Grand Pass to improve access for their vessels. Humble's wells in Grand Isle Block 16 and 18 produced a modest 150,000 barrels in 1949 (Police Jury of Jefferson Parish 1949; Kleck 1950).

Humble's investment in offshore production stimulated further exploration and drilling in the northern Gulf. The California Oil Co. began construction of their first Gulf platform in March 1948. With no success at first, California struck in the Bastian Bay field off Plaquemines Parish and then the Bay Marchand field off Bayou Lafourche. The Tidewater Associated Oil Co. also opened the Manila Village field in 1949 (Police Jury of Jefferson Parish 1949; Kleck 1950).

The 20th century brought growing concerns over the condition and quality of natural resources in the Louisiana Gulf coast region. Louisiana State University established the Elinor Behre Field Laboratory for marine research on Grand Isle in the 1930s, and the Louisiana Wildlife and Fisheries Commission began planning a Marine Research laboratory on Grand Terre in 1957. Construction of the Grand Terre facilities was completed in 1960. In recent decades, the erosion of Louisiana's coastal areas has reached critical dimensions, and has been blamed partly on the effects of onshore petroleum extraction activities (Works Progress Administration [WPA] 1940; Maygarden et al. 2002).

Navigational History of the Grand Isle Vicinity

Navigation in the Barataria/Plaquemines vicinity has been reasonably well documented back to the French period. As the demographics and economic needs of the population changed, so did the types, numbers and use of watercraft. The earliest inland watercraft types of the area would have been the dugout canoe or *pirogue,* a vessel type said to have been adopted from the area's aboriginal inhabitants. The word *Pirogue* originated as "an American Indian term" according to Webster's Collegiate Dictionary (1909). The French have made dugouts and called them a pirogue for many centuries. The La pirogue du lac de Paladru is 4.17 meters (13.7 feet) long by 0.70 meters (2.3 feet) wide and 0.45 meters (1.5 feet) deep and carbon dates from 1291 years to 1422 years B.P or 664 to 528 AD (La Sfargues 1990). It resembles a historic dugout found in the Red River, the Carolina Bluff Dugout (Site 16BO174 and LA-DC-86-9) having the same diagnostic swim or spoonbill bow. Two dugouts have been found in the Grand Isle area. One on Grand Isle, the historic Grand Isle Dugout is stored at the Center for Traditional Boatbuilding, Nicholls State University, Thibodaux, Louisiana. The other dugout, prehistoric, was photographed and recorded when found on Elmer's Island after a storm and lost to a subsequent storm. Elmer's Island is immediately west of Grand Isle.

Other small craft used on inland waters during the 18th century would have been skiffs, yawls, launches, keelboats, keeled barges and *chalands* (small scow-like flatboats). The offshore craft during this time included feluccas, *biscaiennes,* barks, brigantines, sloops, schooners, frigates, *pincres, bilandre* and full ships (La Harpe 1971; Pearson et al. 1988). In many instances, because of variations in terminology over space and time, it is difficult to associate a particular vessel type with a specific term.

Early shipping routes from west to east hugged the coast of Louisiana until they reached Timbalier Island/Ship Shoal area where they headed easterly to the mouth of the Mississippi River as the coast swings northward with Barataria Pass well north of the coastal sailing route (Coastal Environments, Inc. 1977). Barataria Pass being out of the shipping lanes was a destination in itself for various reasons. Its bay anchorage and potential inland route was used by shallow draft vessels affording smuggling and privateering activity as early as the 1740s with the Spanish attempting to patrol the coast with sailing galleys and a few larger sailing ships. Jean Lafitte used this anchorage and inland route for his illicit trade in the early 18th century. During this period vessels used in the Gulf of Mexico could have made their way to Barataria Bay; otherwise ocean going craft would not have readily been lost in this area.

The New Orleans Custom House Enrollment of Vessels records (1804-1870) provide rather detailed information on the larger watercraft used in this area during a greater part of the 19th century (WPA 1942). In these records, 42 vessels were identified as associated with the Lafourche and/or Barataria areas (Table 3) and 38 vessels were identified with the owners of Grand Terre Island (Table 4). The types of vessels, places of construction, size ranges of vessel types (length, width and depth) and the dimensional averages where appropriate are given in Tables 3 and 4.

The watercrafts on these two lists differ. The vessels in Table 3, the Lafourche and Barataria areas, seem to be mainly shallow-draft watercraft intended primarily for inland use. On the other hand, the vessels in Table 4, associated with the owners of Grand Terre Island, are predominantly deep-draft offshore watercraft types with only about a third being types that could be for either inland or coastal use. The majority of the watercraft associated with the inland waters were constructed locally, or in the western river region, whereas the majority of the vessels associated with Grand Terre were built in the North Atlantic region, with the exception of half of the smaller steamboats which were built on the western rivers. This dichotomy of types is reflective of function and environmental differences. The anchorage in Barataria Bay on the western end of Grand Terre Island just inside Barataria Pass would allow the use of the deeper draft vessels. This anchorage was augmented by two canals, dug from the high ground through the marsh before 1841 (Goodwin et al. 1985), essentially

Table 3
Watercraft in the Grand Isle and Barataria Bay Region (1804 – 1870)

Vessel Type	Number	Construction	Characteristics (in Feet)	
Boat	1	Local	Length	60.3
			Width	13.3
			Depth	4.7
Skiff	1	Local	Length	48.2
			Width	13.3
			Depth	3.6
Barge	5	Local	Length	55.3 to 77.5
				Av. 69.2
			Width	9.6 to 16.7
				Av. 11.5
			Depth	3.3 to 4.0
				Av. 3.6
Barge/flat	1	Local	Length	76.8
			Width	17.5
			Depth	3.2
Barge/steam	2	Local	Length	51.7 to 74.0
			Width	14.6 to 17.0
			Depth	3.2 to 3.8
Flat boat	2	Western River	Length	80.3 to 86.7
			Width	16.0 to 16.4
			Depth	3.6 to 6.5
Flat/steamboat	1	Western River	Length	93
			Width	18
			Depth	3.4
Sloop	3	Local	Length	39.1 to 47.7
				Av. 42.4
			Width	9.8 to 14.8
				Av. 13.1
			Depth	4.1 to 5.3
				Av. 4.9
Schooner	2	North Atlantic	Length	59.75 to 82.0
			Width	21.14 to 22.75
			Depth	5.7 to 9.5
Schooner	1	South Atlantic	Length	38.9
			Width	15.6
			Depth	4.1
Schooner	15	Gulf Coast	Length	38.9 to 72.0
				Av. 56.07
			Width	10.8 to 21.1
				Av. 15.6
			Depth	.8 to 7.3
				Av. 4.5
Steamboat	23	Western River	Length	80.0 to 173
				Av. 112.4
			Width	13.5 to 36.0
				Av. 15.0
			Depth	3.3 to 6.2
				Av. 4.5

Table 4
Watercraft Associated with Grand Terre Island (1804-1870)

Vessel Type	Number	Construction	Characteristics (in Feet)	
Sloop	2	North Atlantic	Length	50.4 to 57.0
			Width	16.3 to 20.0
			Depth	5.0 to 5.3
Schooner	1	Western River	Length	32.0
			Width	18.0
			Depth	4.0
Schooner	6	North Atlantic	Length	45.0 to 71.0 Av. 60.3
			Width	15.1 to 22.5 Av. 17.2
			Depth	4.3 to 7.6 Av. 6.4
Bark	2	North Atlantic	Length	94.5 to 98.0
			Width	23.0 to 26.3
			Depth	12.0 to 13.0
Brig	7	North Atlantic	Length	70.4 to 117.1 Av. 85.4
			Width	21.0 to 26.1 Av. 20.7
			Depth	8.7 to 12.4 Av. 10.0
Ship	4	North Atlantic	Length	81.3 to 110.0 Av. 93.2
			Width	23.3 to 30.0 Av. 26.5
			Depth	9.4 to 13.3 Av. 12.6
Steamboat	8	Eastern River	Length	96.5 to 177.5 Av. 123.7
		(after 1832)	Width	11.3 to 25.3 Av. 20.9
			Depth	3.9 to 13.0 Av. 8.1
Steamboat	8	Western River	Length	76.4 to 172.0 Av. 123.5
		(after 1832)	Width	18.3 to 28.0 Av. 19.9
			Depth	4.1 to 8.0 Av. 5.9

allowing direct access from oceangoing vessels to the plantation. Additionally, the owners of the Forstall Plantation on Grand Terre Island seemed to have had more complex and elaborate plantation facilities than did the planters on Grand Isle, and the need for overseas commodity shipments may have been greater. Grand Isle did not offer similar deep-water landing sites, thus the planters there relied mainly on inland watercraft types for transportation.

Vessel types associated with this area during the 19th century then included ships, barks, brigs, schooners, sloops and steamboats, used in the coastal trade; plus "boats," skiffs, flats, barges, sloops, schooners and steamboats used on the inland waters. It should be noted that this division reflects dominant usage. Some vessel types, as well as individual vessels, obviously were used for multiple purposes on both inland waters and offshore. The sloops and schooners used on inland waters were smaller and made locally. These same types, when associated with Grand Terre Island, are larger and made predominantly in the North Atlantic region (see Tables 3 and 4). Steamboats recorded for these two areas also follow this pattern.

These documented vessels probably made up only a small portion of the watercraft used in this area, because commercial vessels of less than about 15 tons burden and non-commercial vessels were not normally enrolled. One vessel type commonly mentioned in the historical accounts but not listed in the New Orleans enrollment records is the "lugger." The lugger is a shallow-draft sailing vessel ranging from 5 to 7 tons in burden, 32 to 38 ft. in length, 10 to 12 ft. in width and having a depth of hold a little over 3 ft. (Chapelle 1951). The name, while referring to a general boat type, is derived from the type of sail used on the vessel. The derivation of this watercraft type has been attributed to the Italians and French from either a felucca, sloop or yawl watercraft form. However, Chapelle is probably correct in stating it came from northern Europe, being introduced into the region by the early French colonists (Chapelle 1951). The hull form of the lugger, with its yawl stem, is very similar to the small sloops used in Louisiana's inland and coastal waters during the 19th century. Common in the 19th and the early 20th centuries, the sailing lugger has essentially disappeared from use in recent years.

In 1881, the Annual Report of the Chief of Engineers (USACE 1881) report provided information on shipping activity in the Barataria region. The report noted that a large fleet of luggers operated in the area, plus a small steamer carrying mail, passengers and commodities serviced Grand Isle and Fort Livingston tri-weekly, and a larger packet steamer carrying freight and passengers made occasional trips to the plantations on Grand Isle. Additionally, another steamer was in service during the tourist season, carrying passengers from New Orleans to Grand Isle.

One of the steamers serving the island was the sidewheel packet *Grand Isle*, built in 1882 in Cincinnati, Ohio, and commanded by Captain John F. Krantz (Way 1994). In 1883, in her first year of operation, the *Grand Isle* was chartered to replace a packet, which had been running on the Black River. There she caught fire, burned and sank about 12 miles below Jonesville, Louisiana (Way 1994). A later steamer, also named *Grand Isle,* apparently a sternwheeler, was sailing between New Orleans and Grand Isle between 1904 and 1911 (Way 1994).

The Harvey family owned and operated several steamers serving the Barataria region, including Grand Isle. These included the *San Nicholas,* purchased by Joseph H. Harvey in 1867. The *San Nicholas* was a sternwheel packet built in Louisville, Kentucky in 1865 (Way 1994). Typical of the steamers operating in the shallow waters of the Barataria Basin, the *San Nicholas* was small, having a burden of only 74 tons and originally measuring 86.5 ft. in length, 19 ft. in breadth and 5 ft. in depth (Way 1994). Joseph Harvey, however, had the vessel rebuilt in 1869, increasing her length to 119.5 ft. Harvey's purchase of the *San Nicholas* in 1867 corresponded with the start of his recreation and tourist interests on Grand Isle. Other Harvey boats were the sternwheeler *Louise Harvey,* a 62.2-foot-long packet built at New Orleans in 1894, and the *Mary F. Golden,* an 86.2-foot-long sternwheeler built at Millwood, West Virginia in 1896 (Way 1994).

The *City of Hartford,* commanded by Captain H. A. Harvey, was another of the Harvey steamers. A 1904 New Orleans newspaper advertisement reports that the *City of Hartford* served Bayou Lafourche and that it:

> "Leaves Harvey's Canal EVERY TUESDAY at 11 a.m., taking freight for all points on the Bayou between Harang's Canal and Lockport; also attending to Barataria business on Tuesday and Friday, as usual. Freight

> received at Harvey on Monday until 6 p.m. and Tuesday until 11 a.m." (Huber 1959).

By 1915, a large number of gasoline-powered sternwheelers were reportedly involved in the New Orleans to Grand Isle trade (USACE 1915). These vessels included the *Tulane, Hazel, Nevada* and *JS&B,* and they were making one or two trips per week. The *Hazel* is probably the same boat that was renamed the *Port Allen* in the 1920s and placed in service as a Mississippi River ferry at Baton Rouge (Way 1994). By this time, the economy of Grand Isle consisted of truck farming, terrapin fishing, shrimping, oystering and a large number of small fishing vessels were operating in the waters around the island. The 1915 survey report indicated that Bayou Rigaud was an important navigation channel, used by almost all traffic to the island.

Barataria Pass was an important and active waterway throughout the historic period. Initially, it served as a safe haven from gulf storms or to bring colonists to the area and service their needs. After 1740, it was the gulf outlet of a navigational route to New Orleans. As the population of the region expanded, larger watercraft types supplemented the fishing boats and other small watercraft. Almost all of the coastal craft types associated with Barataria Bay would have used the pass whether they were engaged in island commerce or fishing.

Bayou Rigaud would have been used as a route by almost all of the inland watercraft servicing Grand Isle and Chenier Caminada from New Orleans and other inland landings of the Barataria Bay region. The eastern end of Grand Isle was utilized primarily for cattle, and watercraft servicing Grand Isle passed through Bayou Rigaud to the central portion of the island. Navigational access to Chenier Caminada also required use of Bayou Rigaud. Canals were dug on the north side of Grand Isle to bring the visitors to the hotels. Guests were taken off steamboats and carried up the canal to the island aboard chaland-like craft (Evans et al. 1979). As noted above, early in this century, most of the boats calling at Grand Isle used Bayou Rigaud (USACE 1915).

The 1936, United States Coast Pilot: Gulf Coast Key West to the Rio Grand, describes the Barataria Basin as:

> Barataria Bay (chart 196) is a large, marsh-fringed, shallow lake, separated from the Gulf by a low, narrow sand island known as Grand Terre Island. The bay has general depths of 4 to 6 feet (1.2 to 1.8 m) and is frequented chiefly by fishermen and oystermen, who take their catch to New Orleans in launches of 3 to 4 feet draft, going by way of one of the various inside routes. With the exception of fishing camps, Grand Isle and Manila Village are the only settlements on the bay.
>
> Barataria Pass, also known as Grand Pass, is the main entrance to Barataria Bay. It is marked on the easterly side by *Barataria Bay Lighthouse,* on the corner of Fort Livingston. Barataria Pass Buoy (black and white vertical striped) lies 2.5 miles 147° true from the lighthouse. The only other objects which can be made out at a distance are some tall

> trees at Grand ls1e to the westward of the pass. In 1934 there was a straight, deep channel leading out of the pass to the southeastward. This channel was 700 yards wide, and there was a controlling depth of 8 to 9 .feet (2.4 to 2.7 m) on the bar, 2 miles off Barataria Bay Lighthouse. Hard sand bars with from 2 to 5 feet (0.6 to 1.5 m) over them extend for about a mile offshore on either side of the channel. The bar off the entrance channel only breaks during bad storms. Two beacons mark submerged wreckage northwestward of the lighthouse. Inside the bar, depths up to 12 feet (3.6 m) extend northward as far as Independence Island.
>
> Strangers should not attempt to enter Barataria Bay without a pilot, as the bar shifts frequently and, with the exception of the lighthouse, there are no aids which would be of any assistance (Cotton 1936).

Many of the areas discussed in the Coastal Pilot no longer have terrestrial expressions (e.g., Shell Island and Independence Island). Through traffic from The Gulf of Mexico via these historic waterways was vastly diminished by the mid-1900s with the opening of the Intercoastal Waterway and the Barataria Waterway. The latter provided an avenue for fisherman, shrimpers and oil field workers from the Lafayette and Barataria area to the lower bay and open Gulf of Mexico.

Nature of the Archaeological Record (Re: Watercraft)

There are only few well-documented watercraft which have been investigated in Louisiana. Although watercraft terms are frequently mentioned in the historic literature knowledge of what they refer to is dubious. E. W. White (1957) wrote with regards to inshore fishing boats. "When consideration is given to the inshore fishing-boats, the earlier history of these craft is even more obscure than that to their larger relations for such familiar objects offered little or no attraction to artists either of the middle Ages or of a much later period." For this reason archaeological mention or investigation of watercraft within the Lower Achafalaya as well as the Barataria Basin have been included in an attempt to understand the nature and depth of this knowledge. These watercraft include the Elmer's Island Dugout, the Lake Salvador Canoe, the Bois Chactas Canoe, the Little Lake Canoe, the McBoat-Morgan City, the 10 watercraft at Adams Camp (Site 16SMY55/56), the School Boat Stop (Site 16SMY58), the three watercraft at Oyster Camp (Site 16SMY61), the lugger *Champion,* the lugger *Denver*, the Mellon wreck, the M/V *Fox* and the steamer *Joe Webre.*

The four dugout watercraft including the Elmer's Island Dugout (LA-DC-85-6), the Lake Salvador Canoe (Site 16SC49 and LA-DC-85-1), the Bois Chactas Canoe (LA-DC-85-3) and the Little Lake Canoe (Site 16LF87 and LA-DC-00-3) all represent hollowed out logs with diagnostic platform bows. Radiocarbon samples submitted for the Little Lake Canoe and the Lake Salvador Canoe returned dates of ca. A.D. 1438 to A.D. 1662 and ca. A.D. 1600, respectively. The Bois Chactas Canoe constructed using reduction by fire, was associated with a shell midden (Site 16SC4). All of these partial dugouts appear to be late prehistoric watercraft of the type best represented by the 16th century Swan Lake Canoe, Site 22WS776, discovered in the bank of Steele Bayou, Swan Lake, Mississippi (Fuller 1992).

The Grand Isle Dugout is the only historic dugout documented as found in the area. It represents a type of large, wide pirogue found throughout southeast Louisiana. This dugout style was still being fabricated in the 1950s as a working watercraft. McBoat represents a chaland, a flat bottom boat constructed by two sill timbers, end sills and cross ties with a planked bottom, forming a raft-like structure. This style of watercraft was similar to the simplified construction of a coal flat. The craft was found at Morgan City (Goodwin and Selby 1984). Its floor timbers with holes, sawdust and open ladder-like ramp timbers suggest a boat that delivered ice along the waterfront.

A total of 10 watercraft were documented at Adams Camp (Site 16SMY55/56) along Bayou Shaffer in St. Mary Parish. Abandoned watercraft left at or close to their landings, as in the case of this site, represent a far larger percentage of our maritime resources than shipwrecks (Saltus 1988). These 10 craft consisted of: WC1) Lafitte Skiff, WC2) Flat, WC3) Flat - John Boat, WC4) pirogue (pirogue en plache), WC5) plywood skiff, WC6) skiff, WC7) skiff, WC8) known cypress buried boat, WC9) motorized lugger, mostly buried location recorded, but not investigated, WC10) large dredge fitted wooden scow barge. A site map of a portion of Site16SMY55/56 illustrates the nature of historic landings with multiple resources including land structures, activity areas, landing features and watercraft. These watercraft were the topic of a paper, "Watercraft Assemblages in Inland Waters" (Saltus 2000), given in Gdansk, Poland and published by the Polish Maritime Museum Gdansk 2000 in *Down the River to the Sea)*. Variability in the watercraft of this area appears to be far greater than anticipated. The skiff in Louisiana was reported to have three types; Mississippi skiff, Creole Skiff and Lake Skiff (Comeaux 1985). Skiffs representing four styles were found at Adam's Camp (Site 16SMY55/56). WC4 represents a plank pirogue (pirogue en plache) unlike any of the six plank pirogues commissioned by the Center for Traditional Louisiana Boatbuilding, Nicholls State University in Thibodaux, Louisiana. The ethnographic exercise in the 1990s had six boat builders across southern Louisiana construct a pirogue. No two were alike and several other styles have been noted in the photographic record. This variation could reflect environmental or ethnographic differences. A single example of a watercraft is insufficient to establish a pattern, trend or type.

Just below Adams Camp is the School Boat Stop (Site 16SMY58), a partially submerged watercraft. This craft originally was constructed as a World War II U. S. Mine Sweeper, then was converted to a Menhaden "pogy" boat. Later it was retired and used as a school "bus" stop prior to being totally abandoned in the late 1950s. In this case, the school bus that picked up the children on Bayou Shaffer was a boat. The Adams children waited for the school boat at the site.

Just north of Adams Camp and across the bayou is the Oyster Camp (Site 16SMY61). Here three watercraft were found including WC1) a coal flat, WC2) a possible lugger or sloop and WC3) a flat bottom skiff. The coal flat and the possible lugger or sloop were only sampled to determine basic data including general age, size and relative vessel type. WC1 is a coal flat, sill on sill construction, two 17-inch sill timbered side, 34-inch side, thwart planking. WC2 is a possible lugger or sloop, rudder gudgeon located, longitudinal bulkhead or centerboard compartment and WC3 is a flat bottom skiff with no rocker. Only the skiff was fully documented.

Lugger as a watercraft term is common in the literature. However, only two Louisiana luggers have been discussed at any length (Brassieur 2000), including the luggers *Champion* and *Denver*. Neither of these craft has been documented using Historic American Engineering Record standards. The term lugger has referred to many different watercrafts using or not using a lug sail. Henry Hall (1880) stated "In model the luggers are sharp, and are mostly keel-boats with a yawl stern." Howard Chapelle (1951) in *American Small Sailing Craft* noted of the New Orleans lugger "early luggers were keel yawl-boats in model and the center board developed from these." Stanley Faye (1940) quoting Carl W. Mitman's Catalogue of *Watercraft Collection in the National Museum* (Mitman 1923) discusses the genealogy as "[w]ith the paranzelleo's original triangular sail (sheet to a boom) still represented by a trapezoidal hanging lug, the fellouca persisted into the 20th century as the "New Orleans lugger … of the shrimping fleets" (Faye 1940:122). Ray Brassieur (2000) notes "the ancient French term for these relatively small open boats is "canot" (the final "T" is pronounced). Louisiana Cajuns still use the French term "canot" to refer to luggers. Kanoa was the term that the French used to describe the largest of the sailing dugout canoes used by the Carib Indians.

Brassieur in his *Brief History of the Lugger* (2000) suggests the following lugger subtypes:

a. single masted open sailing lugger (not decked; ca. 1700 to1850)
b. double masted sailing lugger (early 19th Century)
c. Late 19th Century oyster sailing lugger
d. Motorized Louisiana lugger (rounded fantail)
e. Motorized Biloxi lugger (square transom)
f. Motorized oyster dredge boat
g. Motorized trawling lugger (after 1920)
h. Ice boat / fisheries supply lugger (ca. 1930 to 1940)
i. Motorized passenger and crew transport lugger
j. Oil field auxiliary boat/lugger tug

The *Mellon Wreck* (Site 16SM92) is one of the few documented watercraft in the area. The vessel was pulled out of the river by the riparian landowner. He notified the local historical group after seeing that it represented an old watercraft. The craft, containing both cut and wire nails, represents a centenary watercraft. Its form is long and narrow, with a length of 41 ft (12.5 m), a width of 6.58 ft (2.0 m) and a depth of hold of 1.67 ft (.5 m). The long, narrow and shallow form suggests the remains of the keelboat/barge tradition after the advent of steam. The history of the craft has not been ascertained, but the form and construction has been documented. How and where it fits in our maritime history is still unknown and awaits further physical data but at least we now know we have one that needs further research.

The M/V *Fox* is another of the few documented watercraft. The vessel was built at New Orleans in 1875, with Larose, Louisiana listed as its last home port. It was abandoned 1934. The vessel type is similar to a "double ender," not a keelboat as noted by Coastal Environments, Inc. (Pearson et al. 1989). The vessel, as documented by Goodwin and Selby (1984), is 37.83 ft (11.5 m) long by 9.25 ft (2.8 m) wide with a 3.5 ft (1.1 m) depth of hold. Photographic and pictorial data suggests that this vessel form ranged along the Mississippi River from Empire at the mouth of the river to New Orleans and its associated waterways.

The locomotive engine, propeller and shaft of the steamer *Joe Webre* reportedly were recovered off Grand Isle. Little else is known about this vessel other than its sparse history related to its loss. This makeshift maritime motive technology may provide insight into economic responses. Another economic response is provided by C. J. Christ (2001) in his discussion of the loss of the Standard Oil tanker *Benjamin Brewster* off Grand Isle in 1942, where he notes the use of a tiny Coast Guard patrol boat, as a converted fishing vessel with a farm tractor engine. Variability of these types in the local maritime heritage could represent change in response to economic stimuli. Empirical data concerning watercraft is dependent upon the identification and documentation of these cultural resources. The ability to study and understand watercraft evolution, ethnicity, secondary use, variability, association with land based activities and relationship to other watercraft are all lost when their remains are not thoroughly investigated prior to their destruction.

Potential for Historic Resources

A survey of historical and archaeological literature and archival background research confirmed considerable evidence of maritime activity in the northern Gulf of Mexico. The patterns of maritime activity in the vicinity of the proposed project include navigation associated with colonization, development, agriculture, industry, trade, shipbuilding, commerce, warfare, transportation and fishing. Documented navigation covers the entire history of European activity from the earliest exploration in the first decade of the 16th century. As the scope of European settlement increased dramatically in the 18th century the intensity and regularity of maritime activity reflected that development. By the 19th century a complex web of commercial enterprise connected the ports of the Gulf Coast of the United States with the world. Prior to the American Civil War, New Orleans was second only to New York in the volume of maritime commerce. That trend continued throughout the 20th century as trade, transportation and fishing developed to support expanded navigation. Clearly, the historical record confirms that waterborne transportation, communication, trade and fishing has dominated life in the Barataria region of Louisiana (Appendix A).

As a consequence of those international, national and regional maritime activities, the Gulf Coast of Louisiana has been identified as a high probability area for shipwreck resources. Human error, storms and warfare have resulted in the loss of ships in every period of Gulf Coast history. Central Coastal Louisiana and the coast from Grand Isle east to include the Mississippi River Delta has been identified as a high probability area for shipwrecks and shipwreck preservation (Garrison et al. 1989). Statistical probability suggests that most shipwrecks in the project area would date from the post-World War II period and were associated with the coastal trade, fishing or oil and gas industry (Garrison et al. 1989). However, the limitations of earlier historical records cannot preclude the distinct possibility of earlier wrecks in the area. In addition, small coastal and fishing vessels lost in the area might never have been reported.

Because the Grand Liard project area has a high documented potential for shipwreck sites, magnetic and acoustic anomalies identified during the survey should be given careful consideration. The patterns of navigation identified by historical research confirms that the spectrum of vessels employed in the vicinity of the project includes everything from small coastal craft to international merchant and warships. While larger and more modern vessels generate a more readily detectable magnetic and acoustic signature, small coastal craft can be very difficult, if not impossible, to detect. For that reason serious consideration must be given to each anomaly. Signature analysis is further complicated by the fact that in the northern Gulf of Mexico, the bottom is littered with modern debris. It can be difficult, if not impossible, to determine whether an anomaly represents a shipwreck, a coastal vessel or modern debris. While pipelines and wells can frequently be identified using charts and geographic information systems, much of the bottom surface debris is undocumented. The complex nature of signature analysis has been address by Saltus (1982), Gearhart (1998), Garrison et al. (1989) and Anuskiewicz (1992).

Previous Investigations

Six submerged cultural resource surveys have been carried out between Grand Isle and Pelican Island in the vicinity of the Grand Liard project area. Coastal Environments, Inc. (Gagliano et al. 1979) conducted a cultural resources survey of proposed dredging and spoil disposal areas in Barataria Bay and along Bayou Segnette and Bayou Rigaud in Jefferson Parish for the U. S. Army Corps of Engineers, New Orleans District [USACE-NO]. The fieldwork consisted of a bankline survey and limited pedestrian survey, augmented by subsurface probing and auger tests. During this survey, 14 previously recorded sites were visited or discussed, and 34 new sites were recorded. A total of 11 sites were determined to be potentially significant pending further investigation. In addition, 11 other sites were considered eligible for the National Register of Historic Places. Coastal Environments, Inc., also found 29 sites outside, but adjacent to, their project areas. Of these 29 sites, five were deemed eligible for the National Register of Historic Places and two other sites were determined to be potentially significant. Archaeological sites in or adjacent to the current project area that were investigated by Coastal Environments, Inc. during 1979 included Sites 16JE03, 16JE121, 16JE122, 16JE124, 16JE128, 16JE129 and 16JE130. Of note was the extensive and comprehensive geomorphological and ecological study of the Barataria Basin that was published in the report.

In 1984, Michael Stout undertook a remote sensing survey of the Fort Livingston Offshore Borrow Area in Jefferson Parish for the USACE-NO. A total of 28 clusters of anomalies were found during the survey. Three anomaly-free 10 acre areas were identified as available for borrow activities (Stout 1984). Saltus and Pearson utilized remote sensing to survey two proposed borrow areas near Grand Isle for the USACE-NO. A total of 21 magnetic anomalies were identified during the study. None of the anomalies produced historic cultural materials (Saltus and Pearson 1990).

In 1999, R. Christopher Goodwin and Associates, Inc. conducted a remote sensing survey of 1,152.4 acres offshore of the western end of Grand Terre Island in Jefferson Parish for the USACE-NO. The survey used magnetometer, side scan sonar and fathometer instruments to identify and assess the cultural resources within the project area. A total of 163 magnetic anomalies and 17 sidescan sonar anomalies were encountered during the survey. Of these 180 anomalies two were thought to possibly represent shipwrecks and two were thought to be cable or pipeline segments. The remainder of the anomalies were attributed to modern debris. R. Christopher Goodwin and Associates, Inc. recommended additional study of the four anomalies in question (Pelletier et al. 2000).

Earth Search, Inc. investigated several areas on the western portion of Grand Terre Island in 2001. The survey was performed as part of a study to use dredge spoil to restore portions of the island by the USACE-NO and the Louisiana Department of Natural Resources, Coastal 2050. Project objectives consisted of locating previously unknown cultural resources associated with Fort Livingston (16JE49), and to assess and revise site conditions for Lafitte's Settlement (16JE128) and Forstall Plantation (16JE129). The terrestrial portion of the project was comprised of magnetometer survey, pedestrian survey, auger testing, shovel testing, probing and unit excavation. In addition, exposed cultural features were mapped and photographed. The marine portion of the investigation consisted of magnetometer survey, side scan sonar imaging and fathometer readings. Terrestrial investigations identified several previously unknown cultural features associated with Fort Livingston (16JE49), Forstall Plantation (16JE129) and Lafitte's Settlement (16JE128). Marine investigations identified potential cultural resources and extended the boundary of Site 16JE128 into Barataria Bay. One important finding during the fieldwork was that submerged archaeological sites are not necessarily destroyed by wave action associated with inundation. Of the three sites that Earth Search, Inc. investigated, only Fort Livingston (16JE49) is listed on the National Register of Historic Places. Additional work at all three sites was recommended prior to the actual initiation of the proposed project (Maygarden et al. 2002).

R. Christopher Goodwin and Associates, Inc. carried out a Phase I remote sensing survey of a proposed dredge spoil deposit site in Barataria Pass off the west end of Grand Terre Island. The survey was performed with both side scan sonar and a proton precession magnetometer. The survey area was covered by approximately 110 miles of lanes. Analysis of the data identified a total of 163 magnetic anomalies and 17 sonar targets. A total of 25 clusters of targets were isolated. Two of those were determined to have a potential association with shipwreck sites. Those targets were recommended for avoidance or additional investigation designed to identify and assess the nature of material generating the signature. The remaining targets were not recommended for additional research or avoidance (Goodwin 2000).

In 2003, restoration plans for Pelican Island and Chaland Headland required beach nourishment quality sand, and two inshore areas off Quatre Bayou and Pelican Island, totaling 1,161.4 acres, were selected as potential sources. CPE, under contract to Tetra Tech EM, Inc. for the National Oceanic and Atmospheric Administration, was the consulting geotechnical engineering firm for the Barataria shoreline restoration projects. In order to determine the project's effect on potentially significant submerged cultural resources, CPE contracted with TAR and Archaeological Research, Inc. of Prairieville, Louisiana to supervise the conduct of an archaeological and geotechnical remote-sensing investigation of the proposed borrow sites. Analysis of the magnetic and acoustic data identified 23 anomalies in the Quatre Bayou borrow area and 89 anomalies in the Empire borrow area off Pelican Island. While 53 of those anomalies appeared to be associated with modern debris, 25 had signature characteristics that are suggestive of potentially significant submerged cultural resources. Those anomalies were recommended for identification and assessment if avoidance was not an option (Watts 2004).

In 2005, CPE and TAR carried out a remote-sensing survey of two borrow sites off Barataria Pass and Quatre Bayou Pass to identify sources of sand for restoration of Dernieres Island. The Terrebonne Louisiana barrier island complex was identified as a critical area for coastal erosion and Isles Dernieres was selected as a candidate area for the restoration projects under a federal law entitled "Coastal Wetlands Planning, Protection and Restoration Act" passed by Congress in 1990. Restoration plans for Isles Dernieres included consideration of an increase in beach/dune cross-section and improvement of the bayside marsh platform. The enhancement of the beach and dune provided increased protection from storm-related surge and wave attack, through the prevention of island breaching or loss of major portions of the islands. Restoration of the marsh platform behind the barrier islands reinforced the long-term stability of the island system against major storm events. The remote-sensing survey identified 69 anomalies in the New Cut borrow areas. Two of the anomalies appeared to be associated with an abandoned oil well and another 34 were found outside the area of proposed impact. Of the 33 anomalies that lie within the proposed borrow area and a 500-foot buffer, 22 appeared to be associated with modern debris and 11 contained signature characteristics suggestive of potentially significant submerged cultural resources. The aforementioned 11 anomalies were recommended for identification and assessment if avoidance was not an option (Watts 2005).

Remote-Sensing Survey Methodology

Remote-sensing surveys designed to identify submerged cultural resources are perhaps most frequently carried out in response to priorities for protection and management. They are designed to address two primary questions: (1) are there submerged cultural resources in a given area and (2) are those submerged cultural resources eligible for nomination to the National Register of Historic Places (NRHP). While most surveys are generated by such practical issues as are dictated by the 106 Review and Compliance process, the data they collect frequently contributes to the body of knowledge associated with important historical and anthropological questions. One of the more obvious of those issues regards developing and testing models for the spatial and temporal distribution of shipwrecks. A more specific example of research design issues often unspecified for Phase I surveys relates to the identification of shipwrecks that provide both clues to historical events and answers, or raises anthropological questions associated with human activity surrounding the vessel's construction and use.

The remote-sensing survey of the borrow areas for Grand Liard was designed to identify potentially significant submerged cultural resources that could be impacted by proposed dredging. The survey methodology and equipment was based on standard procedures used for submerged cultural resource remote-sensing surveys. A combination of state-of-the-art seismic, magnetic and acoustic remote-sensing equipment was employed to generate sufficient data to reliably identify cultural material such as shipwreck sites. Remote-sensing data collection was controlled by an onboard computer running precision survey software and connected to a differential global positioning system (DGPS). Data was collected on survey lanes spaced 100 feet (30 meters) apart. That lane spacing was designed to provide complete lateral coverage with the sonar system and a representative sampling with the seismic and magnetometer systems.

Magnetometer

An EG&G Geometrics G-882 marine cesium magnetometer capable of plus or minus 0.001 gamma resolution was employed to collect magnetic data in the survey areas (Figure 5). The cesium magnetometer provides a scalar measurement of the earth's magnetic field intensity expressed in gammas. To produce the most comprehensive magnetic record, data were collected at ten samples per second. Due to shallow water, the magnetometer sensor was towed approximately 3 to 7 feet below the water surface at a speed of approximately 3 to 4 knots. Magnetic data were recorded as a data file associated with the computer navigation system. Data from the survey were contour plotted using QUICKSURF computer software to facilitate anomaly location and definition of target signature characteristics.

Figure 5. The EG&G Geometrics G-882 magnetometer used in the survey.

Sidescan Sonar

An EdgeTech 4200-HFL sidescan sonar system was employed to collect acoustic data in the borrow area (Figure 6). The 4200-HFL uses full-spectrum chirp technology to deliver wideband, high-energy pulses coupled with high-resolution and superb signal to noise ratio echo data. The sonar package included a portable laptop configuration running DISCOVER acquisition software and a 300/600 kHz dual frequency towfish running in high definition mode. Dual frequency provided a differential aid to interpretation. Due to shallow water in the survey area the sidescan sonar transducer was deployed and maintained between 8 and 10 feet below the water surface. Acoustic data were collected using a range scale of 150 meters (492 feet) to provide a combination of +300% coverage and high target signature definition. The digital sidescan data were merged with positioning data via the computer navigation system and logged to disk for post-processing.

Sub-Bottom Profiler

An EdgeTech 512i towfish (Figure 7) was employed with a Full Spectrum Sub-Bottom Topside Unit to collect seismic data. The sub-bottom profiler sends an acoustic signal through the ocean bottom to record surface and subsurface geological features. Each distinct layer in the bottom sediment is indicated as a surficial trace, which is recorded in an electronic format onboard the survey vessel. The chart shows the presence of the sediment surface and other distinct

Figure 6. Launching the EdgeTech 4200-HFL sidescan sonar.

Figure 7. Launching the EdgeTech 512i sub-bottom profiler.

layers or features within the sediment, such as buried river channels. The topside unit was utilized to control the 512i towfish and to display and archive the data, which was merged with positioning data via the computer navigation system. The area was surveyed using the 0.7 KHz to 12 KHz 20ms FM pulse setting. The pulse repetition rate was typically twelve pulses per second.

Positioning and Data Collection

A TRIMBLE differential global positioning system (DGPS) was used to control navigation and data collection in the survey area. That system has an accuracy of +/- three feet, and can be used to generate highly accurate coordinates for the computer navigation system. The DGPS was interfaced with HYPACK 2009, a state-of-the-art navigation and hydrographic surveying system. On-line screen graphic displays include the pre-plotted survey lines, the updated boat track across the survey area, adjustable left/right indicator, as well as other positioning information such as boat speed, quality of fix and line bearing (Figure 8). Navigation fixes (shot points) were recorded 10 times a second (approximately one fix every 0.9 feet) along all survey lanes. All data obtained were recorded on the computer's hard disk and transferred to an external hard drive to provide a backup of the raw survey data. Data generated were correlated to remote-sensing records by DGPS to facilitate target location and anomaly analysis. All data were plotted to Louisiana State Plane, South Zone, NAD 83, U.S. Survey Foot.

Figure 8. Computer navigation system located at the research vessel helm.

Data Analysis

To ensure reliable target identification and assessment, analysis of the magnetic and acoustic data was carried out as it was generated. Using QUICKSURF contouring software, magnetic data generated during the survey was contour plotted at 5-gamma intervals for analysis and accurate location of the material generating each magnetic anomaly. Magnetic targets were isolated and analyzed in accordance with intensity, duration, areal extent and other signature characteristics. Sonogram signatures associated with magnetic targets were analyzed on the basis of configuration, areal extent, elevation, target intensity and contrast with background and shadow image.

Data generated by the remote-sensing equipment were developed to support an assessment of each magnetic and acoustic signature. Analysis of each target signature included consideration of magnetic and sonar signature characteristics previously demonstrated to be reliable indicators of historically significant submerged cultural resources. Sub-bottom data were also assessed for relict channels and the potential for prehistoric resources. Assessment of each target included recommendations for additional investigation to determine the exact nature of the cultural material generating the signature and its potential NRHP significance. Magnetic contour maps of the survey areas illustrating the earth's background magnetic field and anomalies created by ferrous material were produced to aid in the analysis of each target.

Signature Analysis and Target Assessment

While no absolute criteria for identification of potentially significant magnetic and/or acoustic target signatures exist, available literature confirm that reliable analysis must be made on the basis of certain characteristics. Magnetic signatures must be assessed on the basis of three basic factors. The first factor is intensity and the second is duration. The third consideration is the nature of the signature; e.g., positive monopolar, negative monopolar, dipolar or multi-component. Unfortunately, shipwreck sites have been demonstrated to produce each signature type under certain circumstances. Some shipwreck signatures are more apparent than others.

Large vessels, whether iron or wood produce signatures that can be reliably identified. Smaller vessels, or disarticulated vessel remains, are more difficult to identify. Their signatures are frequently difficult, if not impossible, to distinguish from single objects and/or modern debris. In fact, some small vessels produce little or no magnetic signature. Unless ordnance, ground tackle or cargo associated with the hull produces a detectable signature, some sites are impossible to identify magnetically. It is also difficult to magnetically distinguish some small wrecks from modern debris. As a consequence, magnetic targets must be subjectively assessed according to intensity, duration and signature characteristics. The final decision concerning potential significance must be made on the basis of anomaly attributes, historical patterns of navigation in the project area and a responsible balance between historical and economic priorities.

Acoustic signatures must also be assessed on the basis of several basic characteristics. Perhaps the most important factor in acoustic analysis is the configuration of the signature. As the acoustic record represents a reflection of specific target features, wreck signatures are often a highly detailed and accurate image of architectural and construction features. On sites with less structural integrity signatures often reflect more of a geometric pattern that can be identified as structural material. Where hull remains are disarticulated the pattern can be little more than a texture on the bottom surface representing structure, ballast or shell hash associated with submerged deposits. Unfortunately, shipwreck sites have been demonstrated to produce a variety of signature characteristics under different circumstances. Like magnetic signatures, some acoustic shipwreck signatures are more apparent than others. Large vessels, whether iron or wood, produce signatures that can be reliably identified.

Smaller vessels, or disarticulated vessel remains are inevitably more difficult. Their signatures are frequently difficult, if not impossible, to distinguish from concentrations of snags and/or modern debris. In fact, some small vessels produce little or no acoustic signature. As a consequence, acoustic targets must be subjectively assessed according to intensity of return over background, elevation above bottom and geometric image characteristics. The final decision concerning potential significance of less readily identifiable targets must be made on the basis of anomaly attributes, historical patterns of navigation in the project area and a responsible balance between historical and economic priorities.

Grand Liard East

Analysis of the remote-sensing data from the Grand Liard East borrow area identified a total of 70 magnetic anomalies and 6 acoustic anomalies (Figure 9 and Figure 10, Appendices B and C). Forty-seven individual magnetic anomalies were identified within the 500-foot buffer. Forty-three produced signature characteristics suggestive of modern debris such as fish and crab traps, pipes, small diameter rods, cable, wire rope, chain, or small boat anchors. No avoidance or additional investigation of these anomalies is recommended. Three potentially significant targets, GLECR-1, GLECR-2 and GLECR-4, composed of four individual magnetic anomalies, exhibit signature characteristics consistent with shipwreck material and/or other potentially significant submerged cultural resources. Two targets, GLECR-2 and GLECR-4, have associated sonar signatures, GLE-5 and GLE-2, respectively, showing debris. Since the survey area has a high potential for historically significant shipwrecks, those three potentially significant targets are recommended for avoidance or additional investigation. In order to protect material generating these signatures, 300-foot radius buffers conforming to the shape these three targets are recommended. Should avoidance prove impossible, additional investigation should be designed to identify material generating the signatures and assess their historical and archaeological significance in terms of NRHP eligibility.

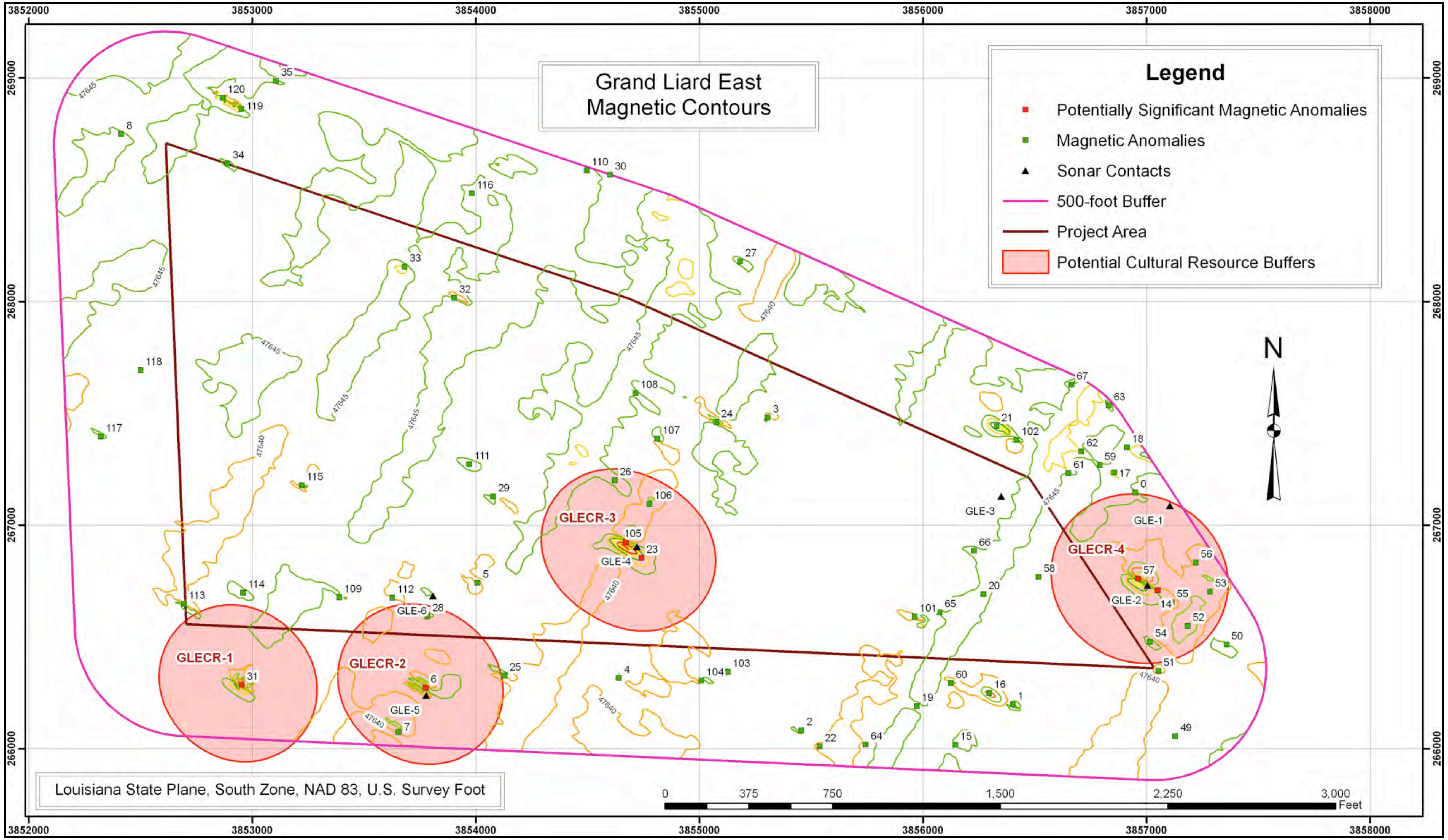

Figure 9. Grand Liard East magnetic contour map.

Figure 10. Grand Liard East sonar coverage mosaic.

Twenty-three individual magnetic anomalies were identified within the borrow area. Twenty-one produced signature characteristics suggestive of modern debris such as fish and crab traps, pipes, small diameter rods, cable, wire rope, chain, or small boat anchors. No avoidance or additional investigation of these anomalies is recommended. One potentially significant target, GLECR-3, composed of 2 individual magnetic anomalies, exhibits signature characteristics consistent with shipwreck material and/or other potentially significant submerged cultural resources. This target has an associated sonar signature, GLE-4 suggestive of debris. As the survey area has a high potential for historically significant shipwrecks, this potentially significant target is recommended for avoidance or additional investigation. In order to protect material generating these signatures, a 300-foot radius buffer conforming to the shape of this target is recommended. Should avoidance prove impossible, additional investigation should be designed to identify material generating these two signatures and assess its historical and archaeological significance in terms of NRHP eligibility.

The remaining three sonar anomalies did not produce a magnetic signature. Their characteristics, including configuration, areal extent, elevation, target intensity and contrast with background are suggestive of modern debris. No avoidance or additional investigation is recommended for these three sonar anomalies. Analysis of the sub-bottom data from the Grand Liard East survey area revealed no buried channels or other relict features indicative of prehistoric habitation within the survey area (Figure 11).

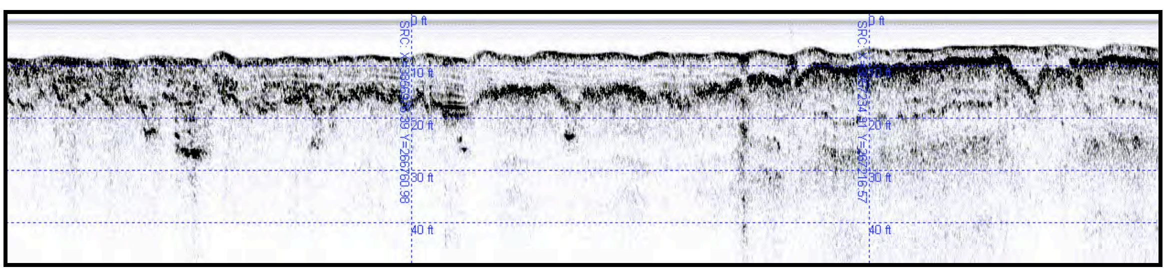

Figure 11. A representative subbottom image from the Grand Liard East survey area.

Grand Liard West

Analysis of the remote-sensing data from the Grand Liard West borrow area identified a total of 52 magnetic anomalies and 1 acoustic anomaly (Figure 12 and Figure 13, Appendices C and D). Thirty individual magnetic anomalies were identified within the 500-foot buffer. Seventeen produced signature characteristics suggestive of modern debris such as fish and crab traps, pipes, small diameter rods, cable, wire rope, chain, or small boat anchors. No avoidance or additional investigation of these anomalies is recommended. Five potentially significant targets, GLWCR-1, GLWCR-3, GLWCR-4, GLWCR-5 and GLWCR-6, composed of 13 individual magnetic anomalies, exhibit signature characteristics consistent with shipwreck material and/or other potentially

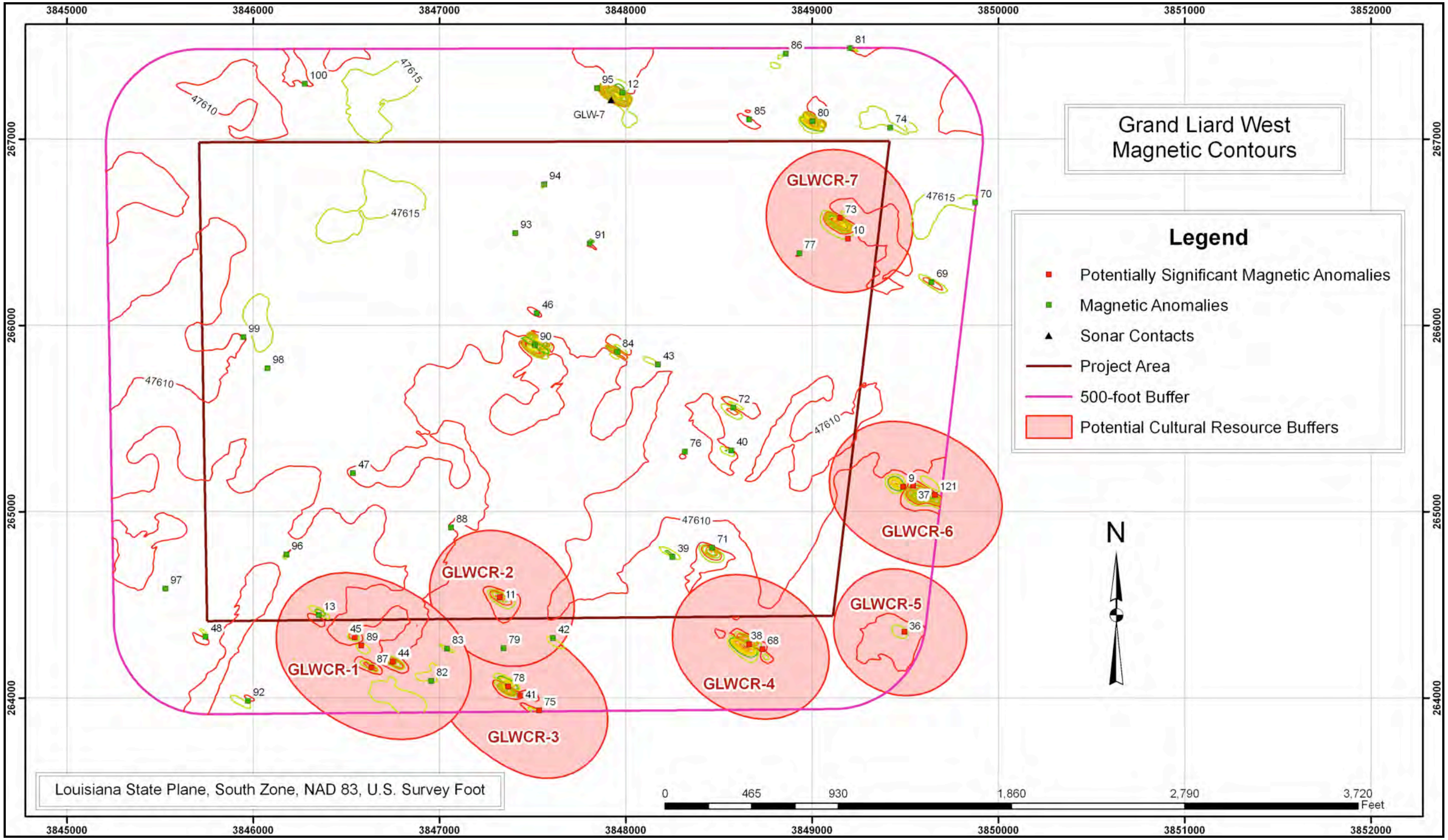

Figure 12. Grand Liard West magnetic contour map.

Figure 13. Grand Liard West sonar coverage mosaic.

significant submerged cultural resources. None of these magnetic targets had associated sonar images. Since the survey area has a high potential for historically significant shipwrecks, those six potentially significant targets are recommended for avoidance or additional investigation. In order to protect material generating these signatures, 300-foot radius buffers conforming to the shape of these six targets are recommended. Should avoidance prove impossible, additional investigation should be designed to identify material generating the signatures and assess their historical and archaeological significance in terms of NRHP eligibility.

Twenty-two individual magnetic anomalies were identified within the west borrow area. Nineteen produced signature characteristics suggestive of modern debris such as fish and crab traps, pipes, small diameter rods, cable, wire rope, chain, or small boat anchors. Of these 19 individual magnetic anomalies, two contained an associated sonar image, GLW-7, showing a section of pipe. No avoidance or additional investigation of these individual anomalies is recommended. Two potentially significant targets, GLWCR-2 and GLWCR-7, composed of 3 individual magnetic anomalies, exhibit signature characteristics consistent with shipwreck material and/or other potentially significant submerged cultural resources. No sonar image was associated with these targets. As the survey area has a high potential for historically significant shipwrecks, this potentially significant target is recommended for avoidance or additional investigation. In order to protect material generating these signatures, a 300-foot radius buffer conforming to the shape of this target is recommended. Should avoidance prove impossible, additional investigation should be designed to identify material generating these two signatures and assess its historical and archaeological significance in terms of NRHP eligibility.

Analysis of the sub-bottom data from the Grand Liard West survey area revealed no buried channels or other relict features indicative of prehistoric habitation within the survey area (Figure 14).

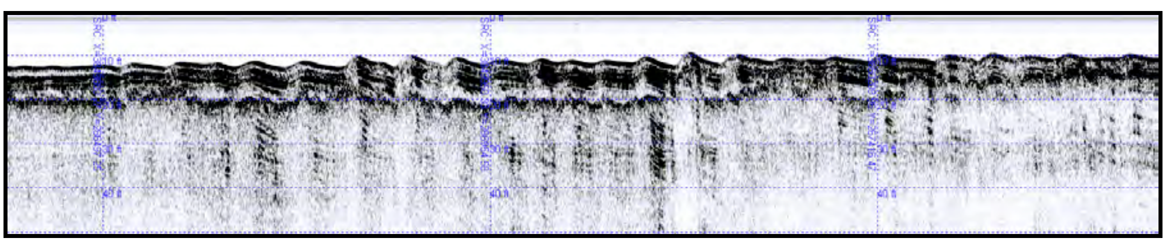

Figure 14. A representative subbottom image from the Grand Liard West survey area.

Conclusions and Recommendations

Literature and historical research has confirmed that the maritime traditions of the Barataria region of the Louisiana Gulf Coast reflect the entire spectrum of navigation in the Gulf of Mexico. Documented shipwrecks in the Gulf of Mexico date from the earliest decades of the 16th century. They reflect the patterns of maritime activity associated with colonization, development, agriculture, industry, trade, shipbuilding, commerce, warfare, transportation and fishing. As the scope of European settlement increased dramatically in the 18th century, the intensity and regularity of maritime activity reflected that development. The historical record confirms that waterborne transportation, communication, trade and fishing has dominated life in the Barataria region of Louisiana.

As a consequence of those international, national and regional maritime activities, the Gulf Coast of Louisiana has been identified as a high probability area for shipwreck resources. Human error, storms and warfare have resulted in the loss of ships in every period of Gulf Coast history. Central Coastal Louisiana and the coast from Grand Isle east to the Mississippi River Delta has been identified by the Minerals Management Service as a high probability area for shipwrecks and shipwreck preservation. Statistical probability suggests that most shipwrecks in the vicinity of the project area, like the *Frances,* date from the post-World War II period and were associated with the coastal trade, fishing or oil and gas industry (Garrison et al. 1989). However, the limitations of earlier historical records cannot preclude the distinct possibility of earlier wrecks in the area. In addition, small coastal and fishing vessels lost in the area might never have been reported.

Because the Grand Liard project area has a high documented potential for shipwreck sites, magnetic and acoustic anomalies identified during the survey should be given careful consideration. The patterns of navigation identified by historical research confirms that the spectrum of vessels employed in the vicinity of the project includes everything from small coastal craft to international merchant and warships. While larger and more modern vessels generate a more readily detectable magnetic and acoustic signature, small coastal craft can be very difficult, if not impossible, to detect. For that reason, serious consideration must be given to each anomaly. Unfortunately, maritime activity and natural resource utilization in the Barataria region has also produced a considerable volume of modern debris. The Grand Liard survey area is a classic example of the nature and scope of that material. It can be difficult, if not impossible, to determine whether an anomaly represents a shipwreck, a coastal vessel or modern debris. While pipelines and wells can frequently be identified using charts and geographic information systems, much of the bottom surface debris is undocumented.

A survey of historical Coast and Geodetic Survey and NOAA charts confirms that at least three vessels have been reported lost in the vicinity of the area surveyed (Figure 15; Appendix A). Two are located at the entrance to Scofield Bayou and one is positioned approximately 1.3 miles south of the Grand Liard East survey area. In addition, one obstruction is charted approximately .4 miles south of the Grand Liard East survey area. This obstruction is first marked on post-1999 NOAA charts. Because AWOIS information is incomplete and positions are not absolute, it is impossible to make a reliable association between the anomalies and the charted wrecks and obstruction.

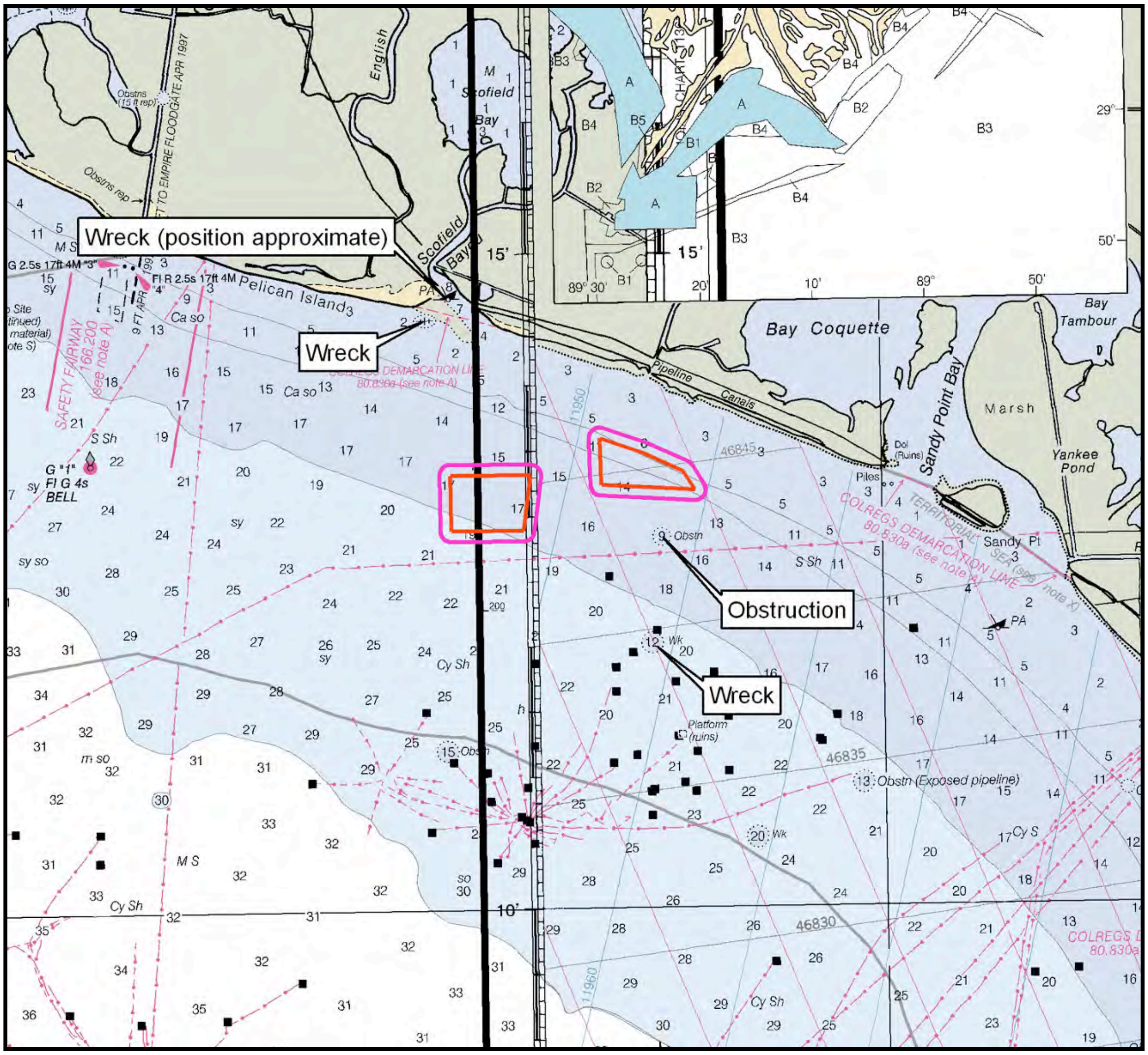

Figure 15. NOAA Chart Numbers 11358 and 11361 with charted wreck and obstruction locations.

Analysis of the magnetic and acoustic data identified a total of 122 magnetic and 7 acoustic anomalies within two borrow areas. The primary borrow area, Grand Liard East, contains 70 individual magnetic and 6 acoustic targets. Forty-seven individual magnetic anomalies were identified within the 500-foot buffer. Forty-three of these produced signature characteristics suggestive of modern debris such as fish and crab traps, pipes, small diameter rods, cable, wire rope, chain, or small boat anchors. No avoidance or additional investigation of these anomalies is recommended. Three potentially significant targets, GLECR-1, GLECR-2 and GLECR-4, composed of four individual magnetic anomalies, exhibit signature characteristics consistent with shipwreck material and/or other potentially significant submerged cultural resources. Two targets, GLECR-2 and GLECR-4, have associated sonar signatures, GLE-5 and GLE-2, respectively, showing debris.

Twenty-three individual magnetic anomalies were identified within the borrow area. Twenty-one produced signature characteristics suggestive of modern debris such as fish and crab traps, pipes, small diameter rods, cable, wire rope, chain, or small boat anchors. No avoidance or additional investigation of these anomalies is recommended. One potentially significant target, GLECR-3, composed of 2 individual magnetic anomalies, exhibits signature characteristics consistent with shipwreck material and/or other potentially significant submerged cultural resources. This target has an associated sonar signature, GLE-4 suggestive of debris. As a consequence, a 300-foot radius buffer conforming to the shape of the anomaly should be established around GLECR-1, GLECR-2, GLECR-3 and GLECR-4 to protect these sites from bottom disturbing activities. Should avoidance of these potentially significant targets prove impossible, additional investigation should be designed to identify material generating these two signatures and assess its historical and archaeological significance in terms of NRHP eligibility.

The secondary borrow area, Grand Liard West, contains 52 individual magnetic anomalies and 1 acoustic anomaly. Thirty individual magnetic anomalies were identified within the 500-foot buffer. Sixteen produced signature characteristics suggestive of modern debris such as fish and crab traps, pipes, small diameter rods, cable, wire rope, chain, or small boat anchors. No avoidance or additional investigation of these anomalies is recommended. Six potentially significant targets, GLWCR-1, GLWCR-3, GLWCR-4, GLWCR-5 and GLWCR-6, composed of 14 individual magnetic anomalies, exhibit signature characteristics consistent with shipwreck material and/or other potentially significant submerged cultural resources. None of these magnetic targets had associated sonar images.

Twenty-two individual magnetic anomalies were identified within the borrow area. Nineteen produced signature characteristics suggestive of modern debris such as fish and crab traps, pipes, small diameter rods, cable, wire rope, chain, or small boat anchors. Of these 19 individual magnetic anomalies, two contained an associated sonar image, GLW-7, showing a section of pipe. No avoidance or additional investigation of these individual anomalies is recommended. Two potentially significant targets, GLWCR-2 and GLWCR-7, composed of 3 individual magnetic anomalies, exhibit signature characteristics consistent with shipwreck material and/or other potentially significant submerged cultural resources. No sonar record was associated with these targets. A 300-foot radius buffer conforming to the shape of each anomaly should be established around GLWCR-1, GLWCR-2, GLWCR-3, GLWCR-4, GLWCR-5, GLWCR-6 and GLWCR-7 to protect these sites from bottom disturbing activities. Should avoidance of these potentially significant targets prove impossible, additional investigation should be designed to identify material generating these two signatures and assess its historical and archaeological significance in terms of NRHP eligibility.

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Appendix A
Shipwrecks in the Vicinity of the Barataria Region

Name	Type	Tons	Built	Lost	Cause	Location	Notes & Reference
Atlantic				1954	Sank	29-20.0N, 92-23.8W	Lonsdale p.94
Barbara Jean	Oil screw fishing vessel (wooden)	57	1947	21/5/1964	Burned	29-15-36N, 89-51-36W	Berman No. 141
Bayard		2,160		6/7/1942	Torpedoed	Reported variously at: 29-19-00N, 88-50-00W 29-35-30N, 88-44-00W	In 150 feet of water; 2,200 tons of cargo; Lonsdale p.93
Belle	Trawler			1953	Wrecked	29-45.2N, 93-07-00W	Lonsdale p.94
Benjamin Brewster	Tanker (steel)	5,950; also as 3,677		9/7/1942	Torpedoed	Reported variously at: 29-05-00N, 90-05-00W, 29-03-00N, 90-09-00W	Demolished. Depth 15'. 26 lives lost (Berman No. 177). Lonsdale p.93
Caribe	Barge			19/12/1954	Sank	29-06.9N, 91-43.3W	Lonsdale p.94
City of Toledo (or *Cities Service Toledo*)	Tanker	8,192		12/6/1942	Torpedoed	29-04-00N, 91-43-00W	Lonsdale p.94
David McKelvy	Stern screw tanker (steel)	6,820	1921	14/5/1942	Torpedoed	28-55-10N, 90-35-00W	17 lives lost (Berman No. 452) Lonsdale p.93
Dr. H.E. White	Trawler			25/7/1954	Sank	29-08.0N, 92-35.0W	Lonsdale p.94
Edgar F. Coney	Steam screw freighter	153	1904	28/1/1930	Foundered	29-22-00N, 93-00-00W	All lives (14) lost (Berman No. 529) Lonsdale p.94
El Vivo	Steam screw (steel)	199	1902	24/4/1945	Foundered	29-10-00N, 90-00-00W	At 9 Mile Point, opposite Westwego, La (Berman No. 550).
Frances	Oil Screw (steel)	178	1947	23/4/1958	Foundered	3 mi SSW of Grand Isle	Berman No. 652
Halo	Steam screw tanker (steel)	6,986	1920	20/5/1942	War loss	28-42-00N, 90-08-00W	Berman No. 777; Lonsdale p.93
Hamlet	Steam screw tanker (steel)	3,994 (net); 6,578 (gross)		27/5/1942	War loss	28-32-00N, 91-30-00W	Norwegian (Berman No. 779); Lonsdale p.94
Heredia	Freighter (steel)	4,740	1908	19/5/1942	War Loss	28-30-25N, 90-59-30W	25-75% lives lost (Berman No. 820). Lonsdale p.93

Kermac XVI	Oil screw	68	1943	2/8/1955	Foundered	29-15-00N, 89-55-00W	Berman No. 1008
Leo Huff	Oil screw	157	1941	5/12/1947	Burned	29-35-00N, 93-14-00W	Berman No. 1042; Lonsdale p.94
Louisiana	Freighter			28/10/1926	Sank	28-59.20N, 89-08.1W	Lonsdale p.93
M/V *Coral Faye*		111		27/11/1959	Burned and sank	On Tiger Shoals	Lonsdale p.94
Nelly Rose	Oil screw	52	1954	24/9/1965	Foundered	Approx. 20 mi. SE of Grand Isle	Berman No. 1311
Obstruction						29-12-50N, 89-31-55W	Approximately .4 miles south of Grand Liard East NOAA Chart 11316. First appears on 2007 navigation charts.
Pearl Harbor	Fishing vessel			1955		29-16.0N, 89-49.4W	Lonsdale p.93
Pioneer	Barge			1954	Sank	29-08.0N, 91-41.9W	Lonsdale p.94
Polaris	Trawler			14/2/1956	Sank	29-21.4N, 91-55.0W	Lonsdale p.94
Ramos III	Trawler			21/11/1955	Sank	29-24.3N, 92-01.0W	Lonsdale p.94
R.M. Parker (or *R.M. Parker, Jr.*)	Steam screw tanker (steel)	6,779		13/8/1942	Torpedoed	28-47-00N, 90-45-00W	Berman No. 1515; Lonsdale p.93
R.W. Gallagher	Steam screw tanker (steel)	7,989		13/7/1942	Torpedoed	28-32.0N, 90-59.3W	8 lives lost (Berman No. 1518); Lonsdale p.93
Rawleigh Warner	Steam screw tanker (steel)	3,663	1912	22/6/1942	Torpedoed	28-53.0N, 89-15.0W	Lonsdale p.93
Shoal Harbor	Oil screw trawler	194	1945	29/9/1955	Burned	29-30-00N, 92-83-00W	Berman No. 1691
Sheherazade	Steam screw tanker (steel)	7,015		11/6/1942	War Loss	28-42-15N, 91-23-00W	Berman No. 1685
Tiger		364	1837	13/11/1844	Exploded	Southwest Pass	Lytle and Holdcamper p.301
U-166	German submarine	740		1/8/1942	Sank	28-47.0N, 90-45.0W	Lonsdale p.93

Unknown						29-12-02N, 89-32-01W	Approximately 1.3 miles south of Grand Liard East NOAA Chart 11361. First appears on 2007 navigation chart.
Unknown				Unknown		29-14-29N, 89-33-57W	Approximately 1.3 Miles North of Grand Liard West; NOAA Chart 11358; AWOIS No. 355.
Unknown						29-14-40N, 89-33-44W	Approximately 1.5 Miles North of Grand Liard West; NOAA Chart 11358. Appears on post-1983 charts.
Virginia	Steam screw tanker (steel)	10,731	1941	12/5/1942	War Loss	28-53-06N, 89-26-42W	27 lives lost (Berman No. 1892)
West Beaufort	Oil screw trawler	119	1938	10/8/1953	Burned	Approx. 5.5 mi SE of Calcasieu Pass, La.	Berman No. 1925
Yuma	Steam screw freighter			17/3/1926	Sank	28-56-35N, 89-26-37W	Berman No. 1984 Lonsdale p.93

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Appendix B
Grand Liard East Magnetic Target Table

Potentially Significant Targets

Target Designation	Map ID	Lane	Anomaly No.	Signature Characteristics	Intensity (gammas)	Duration (feet)	Easting	Northing	Sonar	Recommendation
GLECR-1	31	635	1	multicomponent	41	110	3852953	266285.5	No	Magnetic signature characteristics, intensity, and duration suggest that material generating the anomaly could be associated with the remains of a vessel or potentially significant cultural resource. Avoidance by the creation of a 300-foot radius conforming buffer is recommended.
GLECR-2	6	212	2	multicomponent	25	279	3853774.9	266273	Yes, GLE-5	Magnetic signature characteristics, intensity, and duration suggest that material generating the anomaly could be associated with the remains of a vessel or potentially significant cultural resource. Avoidance by the creation of a 300-foot radius conforming buffer is recommended.
GLECR-3	23	623	1	positive monopolar	13	140	3854740.5	266853.7	Yes, GLE-4	Magnetic signature characteristics, intensity, and duration suggest that material generating the anomaly could be associated with the remains of a vessel or potentially significant cultural resource. Avoidance by the creation of a 300-foot radius conforming buffer is recommended.
	105	624	1	dipolar	45	242	3854670.6	266924.7	Yes, GLE-4	Magnetic signature characteristics, intensity, and duration suggest that material generating the anomaly could be associated with the remains of a vessel or potentially significant cultural resource. Avoidance by the creation of a 300-foot radius conforming buffer is recommended.
GLECR-4	14	605	1	multicomponent	11	488	3857049.5	266708.5	Yes, GLE-2	Magnetic signature characteristics, intensity, and duration suggest that material generating the anomaly could be associated with the remains of a vessel or potentially significant cultural resource. Avoidance by the creation of a 300-foot radius conforming buffer is recommended.
	57	606	1	multicomponent	43	245	3856962.2	266760.2	Yes, GLE-2	Magnetic signature characteristics, intensity, and duration suggest that material generating the anomaly could be associated with the remains of a vessel or potentially significant cultural resource. Avoidance by the creation of a 300-foot radius conforming buffer is recommended.

Individual Targets

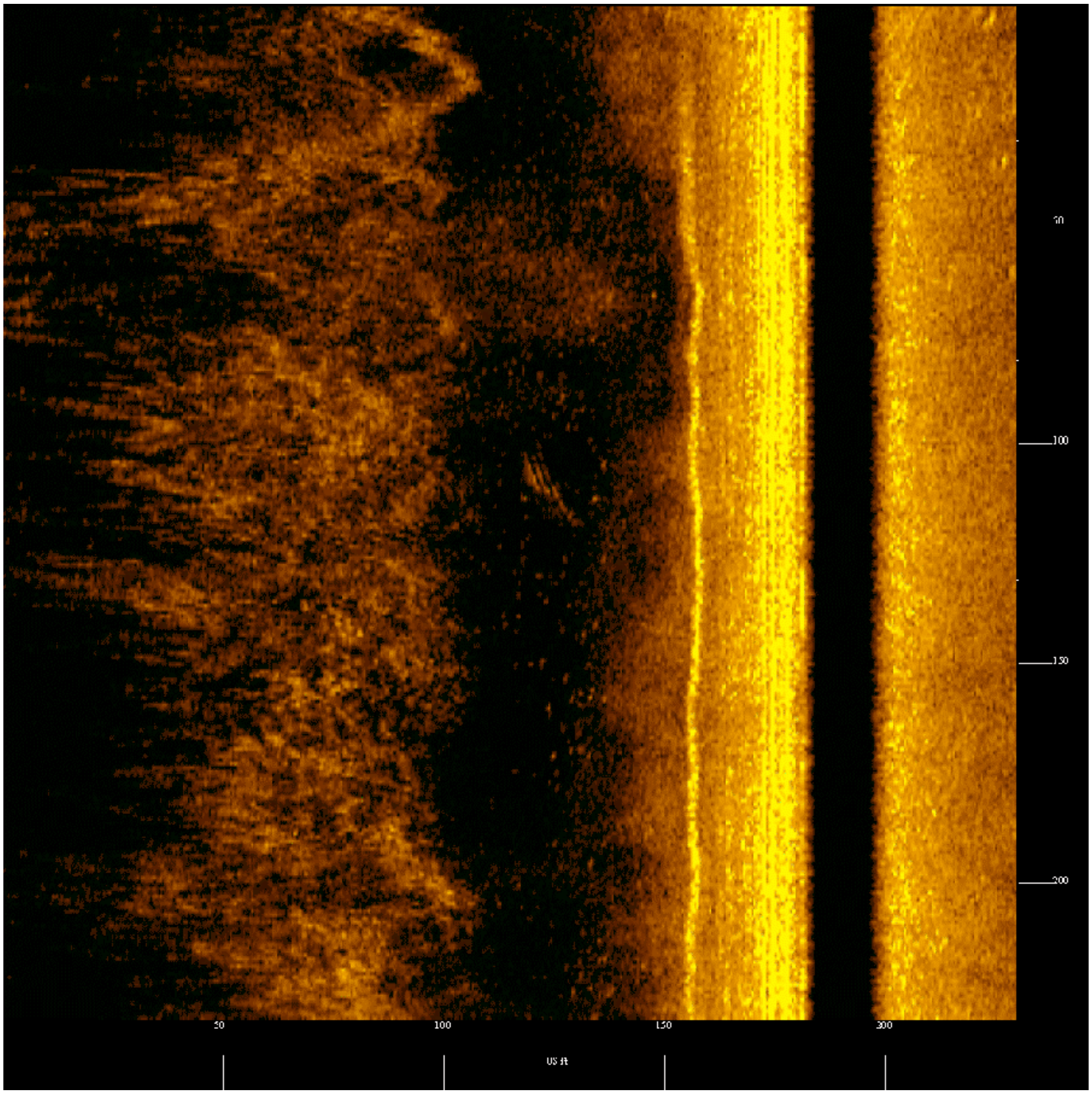
Map ID	Lane	Anomaly No.	Signature Characteristics	Intensity (gammas)	Duration (feet)	Easting	Northing	Sonar	Recommendation
0	209	1	dipolar	5	70	3856948.4	267146.8	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
1	209	2	dipolar	5	75	3856400.2	266197.4	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
2	210	1	dipolar	6	55	3855454.9	266083.2	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
3	211	1	dipolar	8	71	3855304.1	267481.3	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
4	211	2	multicomponent	14	64	3854638.6	266315.6	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
5	212	1	dipolar	5	57	3854007.4	266741.9	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
7	212	3	dipolar	8	113	3853654.7	266074.6	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
8	215	1	positive monopolar	5	31	3852413.1	268749.2	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
15	608	1	dipolar	5	48	3856144.4	266016.7	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
16	608	2	negative monopolar	14	149	3856295	266249.1	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
17	608	3	positive monopolar	4	54	3856854.4	267234.5	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
18	608	4	positive monopolar	5	28	3856912.5	267347.4	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.

19	611	1	negative monopolar	11	60	3855971.3	266190.9	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
20	611	2	positive monopolar	5	111	3856269.6	266690.2	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
21	614	1	negative monopolar	16	48	3855537.3	266010.2	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
22	614	2	positive monopolar	21	106	3856328	267442	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
24	623	2	dipolar	20	78	3855074.1	267460	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
25	626	1	dipolar	16	72	3854128.1	266327.2	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
26	626	2	positive monopolar	6	71	3854620.4	267200.9	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
27	626	3	positive monopolar	6	84	3855181.6	268179.7	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
28	629	1	dipolar	6	53	3853781.7	266591.9	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
29	629	2	dipolar	12	63	3854075.9	267127.9	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
30	632	1	dipolar	4	61	3854599.3	268566.3	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
32	635	2	dipolar	14	101	3853902.5	268017	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
33	638	1	dipolar	9	137	3853680.7	268155.7	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
34	647	1	positive monopolar	6	38	3852889.2	268617.2	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
35	647	2	positive monopolar	4	50	3853105.7	268987.1	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
49	601	1	dipolar	4	52	3857126.8	266056.5	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
50	601	2	multicomponent	7	116	3857356.9	266465.8	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
51	603	1	negative monopolar	5	29	3857051.7	266347.3	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
52	603	2	dipolar	5	39	3857182.5	266548.6	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
53	603	3	multicomponent	7	120	3857282.8	266701.7	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
54	604	1	positive monopolar	9	48	3857014.7	266478.9	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
55	604	2	positive monopolar	5	105	3857111.3	266654.4	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
56	604	3	dipolar	5	48	3857218.6	266832.9	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
58	609	1	dipolar	4	48	3856516.8	266768	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
59	609	2	positive monopolar	6	113	3856789	267267.8	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
60	610	1	dipolar	11	56	3856123	266293.8	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.

61	610	2	dipolar	7	102	3856649.8	267231.7	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
62	610	3	positive monopolar	7	70	3856707.9	267329	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
63	610	4	positive monopolar	5	43	3856830.6	267535.6	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
64	612	1	dipolar	4	49	3855742.4	266019.1	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
65	612	2	positive monopolar	4	70	3856073.4	266610	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
66	612	3	positive monopolar	6	77	3856227.8	266885.8	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
67	612	4	positive monopolar	4	36	3856663.9	267627.7	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
101	613	1	negative monopolar	6	42	3855962.2	266590.9	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
102	613	2	dipolar	10	60	3856417	267380.5	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
103	618	1	dipolar	9	54	3855126.6	266343.4	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
104	619	1	dipolar	6	97	3855007.5	266304.7	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
106	624	2	dipolar	5	112	3854776.7	267094.8	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
107	625	1	dipolar	7	74	3854811.5	267386.7	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
108	627	1	multicomponent	5	285	3854713.7	267590.6	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
109	633	1	dipolar	6	46	3853389.3	266677.5	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
110	633	2	positive monopolar	3	31	3854495.2	268586.1	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
111	631	1	dipolar	4	46	3853627	266675.1	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
112	631	2	positive monopolar	8	115	3853969.3	267272.8	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
113	639	1	dipolar	26	79	3852693.8	266647.3	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
114	637	1	positive monopolar	4	49	3852958.7	266698.3	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
115	637	2	dipolar	11	118	3853220.9	267177.8	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
116	637	3	dipolar	6	61	3853982.1	268483.2	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
117	646	1	dipolar	5	47	3852322.1	267396.4	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
118	646	2	negative monopolar	3	137	3852500.1	267693.2	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
119	648	1	dipolar	27	94	3852951.8	268860.6	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
120	649	1	dipolar	33	86	3852867.2	268911.1	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.

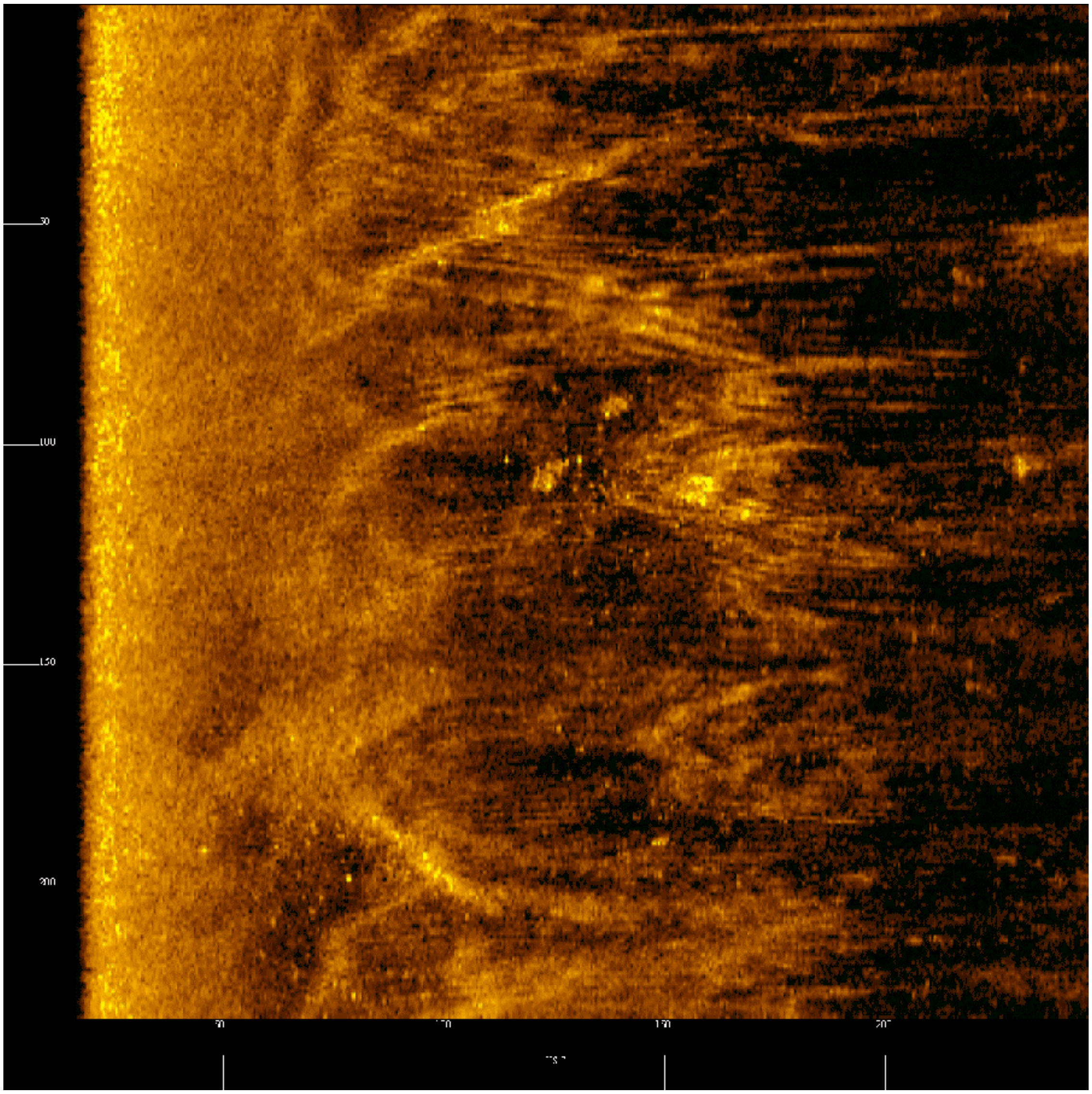
Appendix C
Sonar Contacts

GLE-1



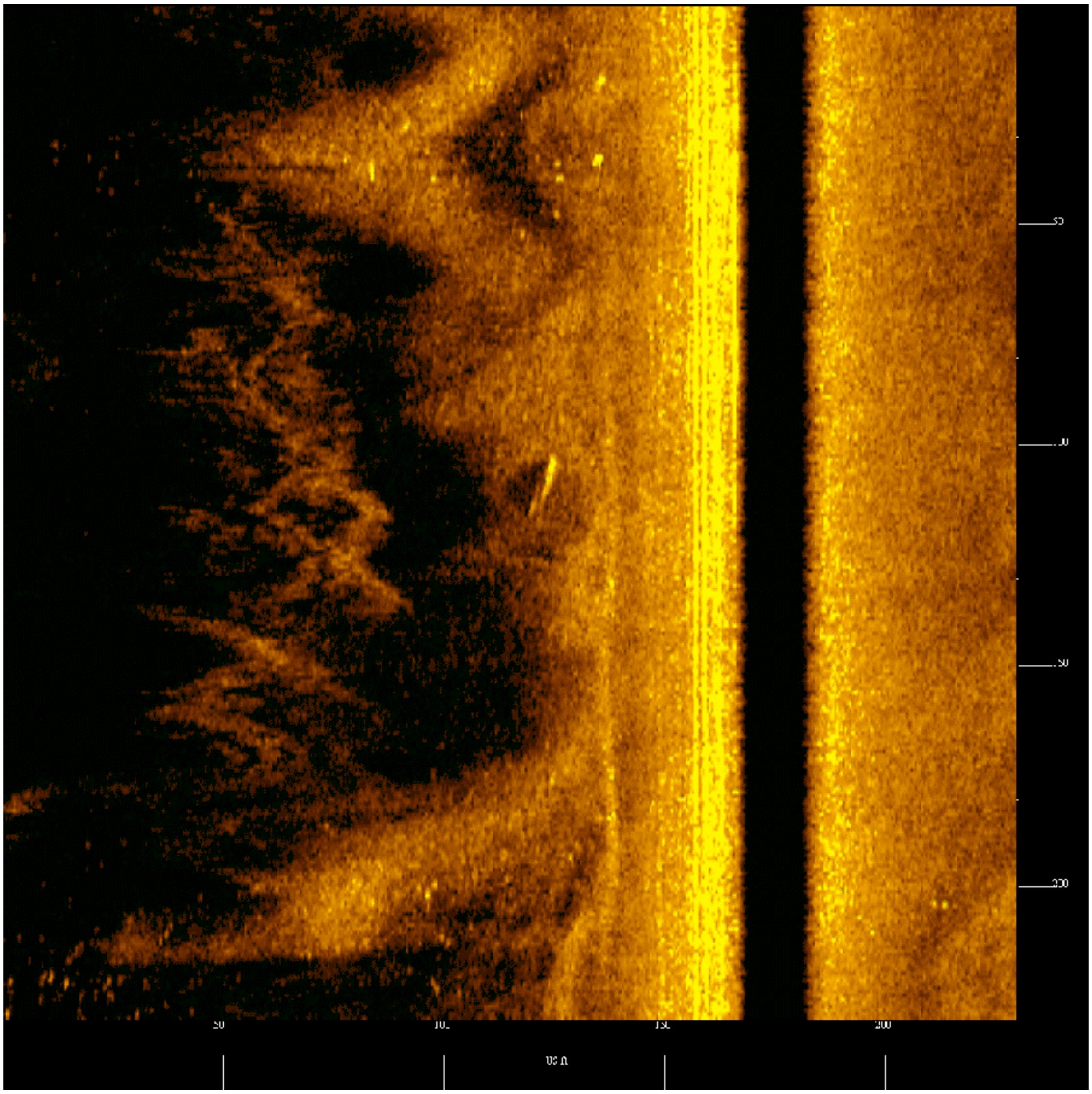
Target Info for GLE-1	User Entered Info
• Sonar Time at Target: 02/14/2010 16:02:03 • Click Position (Lat/Lon Coordinates) 29° 13.31565' N 089° 31.60641' W (WGS84) 29° 13.31565' N 089° 31.60641' W (Local) 29° 13.30218' N 089° 31.60297' W (NAD27) • Click Position (Projected Coordinates) (X) 3,857,104.08 (Y) 267,088.21 • Map Proj: NAD83 Louisiana State Planes, Southern Zone, US Foot • Acoustic Source File: GL_2010_606_NE.jsf • Ping Number: 304311 • Range to Target: 67.73 US Feet • Fish Height: 8.17 US Feet • Heading: 28.00000000 • Event Number: 0 • Line Name: 606	Target Height = N/A Target Length: 18.3 US Feet Target Shadow: N/A Target Width: 6.7 US Feet Mag Anomaly: None Avoidance Area: None Area: Grand Liard East Description: Possible Debris

GLE-2



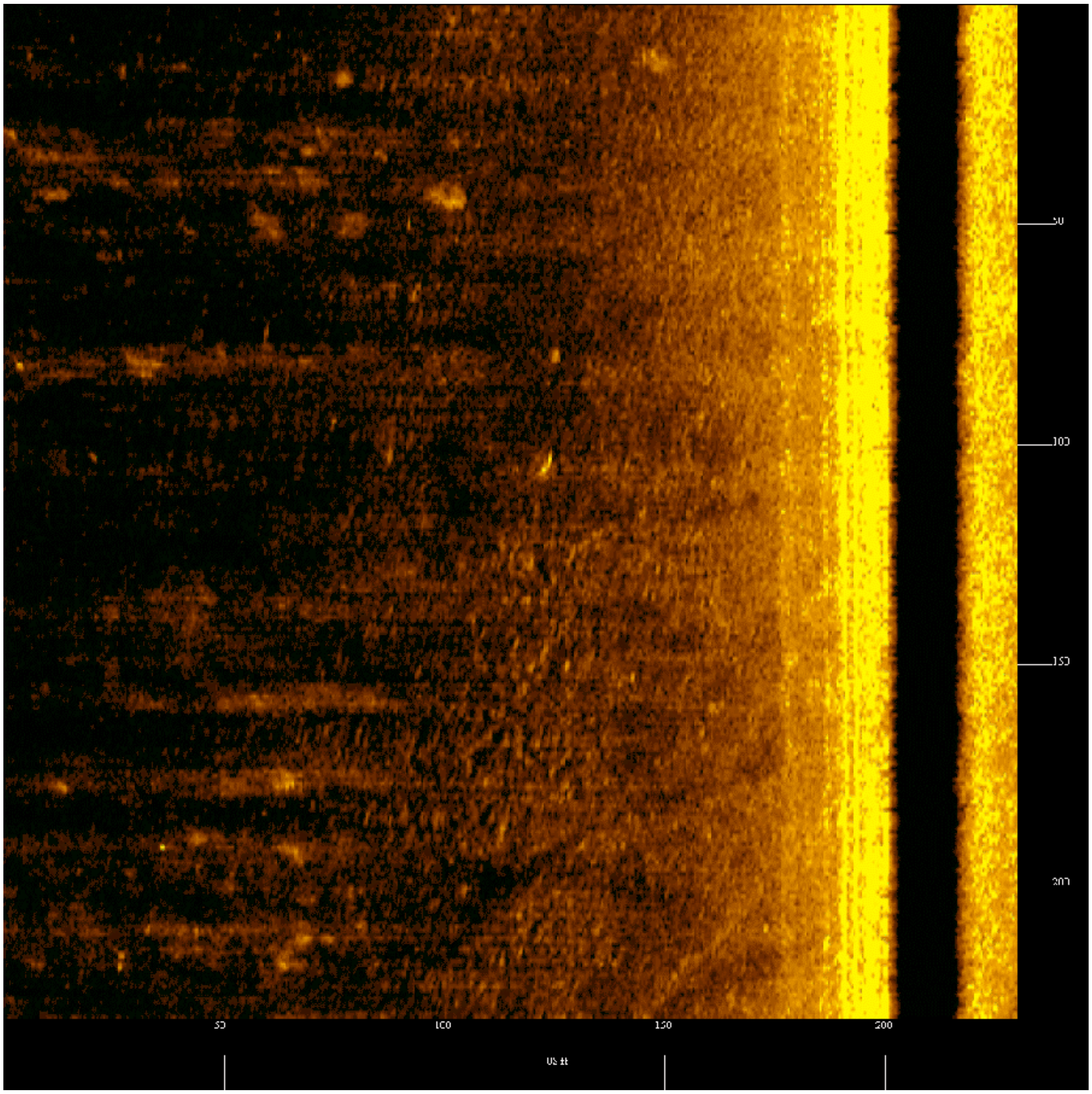
Target Info for GLE-2	User Entered Info
• Sonar Time at Target: 02/14/2010 16:15:39 • Click Position (Lat/Lon Coordinates) 29° 13.25693' N 089° 31.62630' W (WGS84) 29° 13.25693' N 089° 31.62630' W (Local) 29° 13.24345' N 089° 31.62286' W (NAD27) • Click Position (Projected Coordinates) (X) 3,857,003.94 (Y) 266,730.67 • Map Proj: NAD83 Louisiana State Planes, Southern Zone, US Foot • Acoustic Source File: GL_2010_607_NE.jsf • Ping Number: 311929 • Range to Target: 112.88 US Feet • Fish Height: 7.69 US Feet • Heading: 26.00000000 • Event Number: 0 • Line Name: 607	Target Height = N/A Target Length: N/A Target Shadow: N/A Target Width: N/A Mag Anomaly: 14, 57 Target: GLECR-4 Avoidance Area: 300-foot radius conforming buffer Area: Grand Liard East Description: Possible Debris

GLE-3



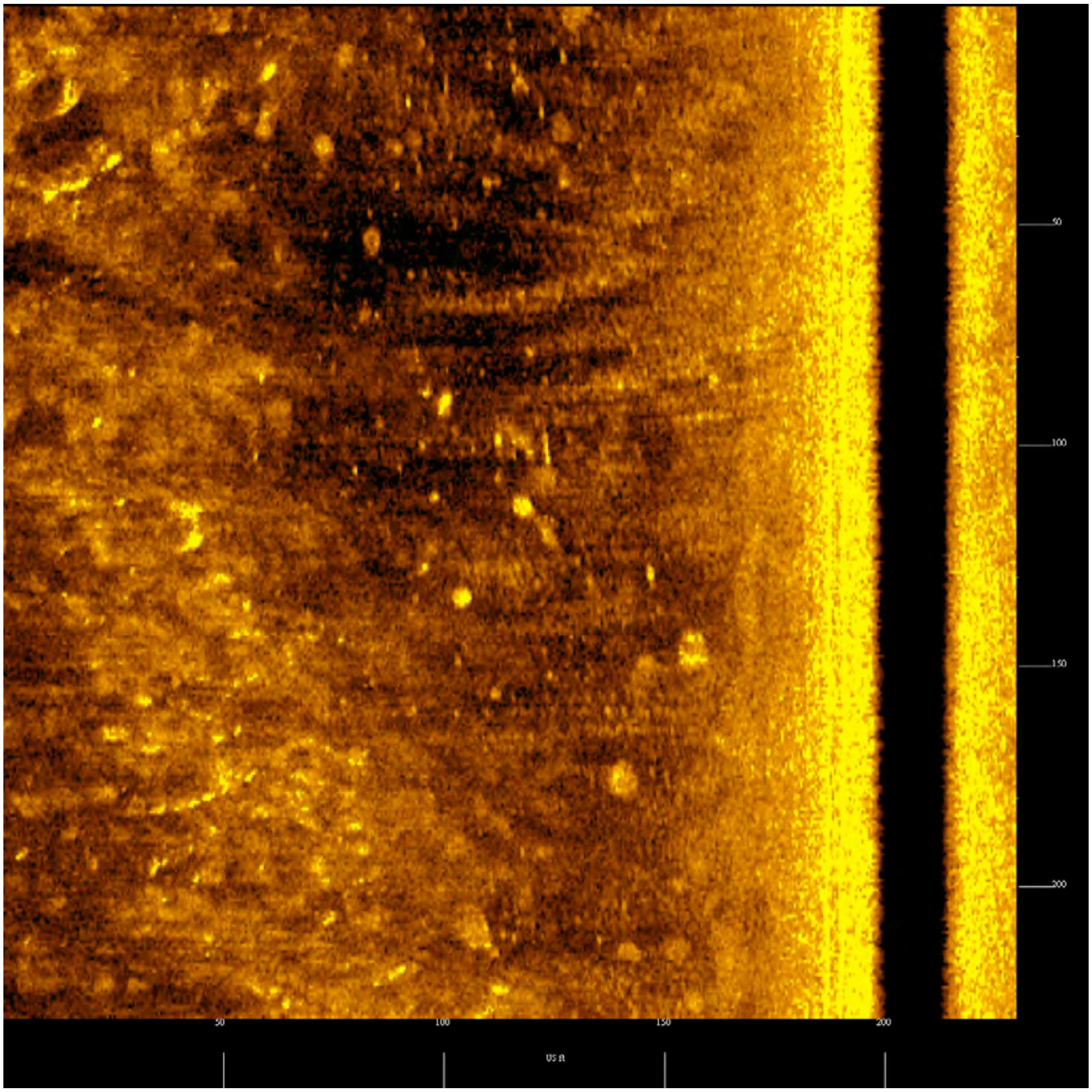
Target Info for GLE-3	User Entered Info
• Sonar Time at Target: 02/14/2010 16:31:11 • Click Position (Lat/Lon Coordinates) 29° 13.32439' N 089° 31.74819' W (WGS84) 29° 13.32439' N 089° 31.74819' W (Local) 29° 13.31091' N 089° 31.74474' W (NAD27) • Click Position (Projected Coordinates) (X) 3,856,349.52 (Y) 267,129.26 • Map Proj: NAD83 Louisiana State Planes, Southern Zone, US Foot • Acoustic Source File: GL_2010_612_NE.jsf • Ping Number: 320635 • Range to Target: 52.36 US Feet • Fish Height: 7.69 US Feet • Heading: 28.00000000 • Event Number: 0 • Line Name: 612	Target Height = 0.7 US Feet Target Length: 15.9 US Feet Target Shadow: 5.0 US Feet Target Width: 3.4 US Feet Mag Anomaly: None Avoidance Area: None Area: Grand Liard East Description: Debris

GLE-4



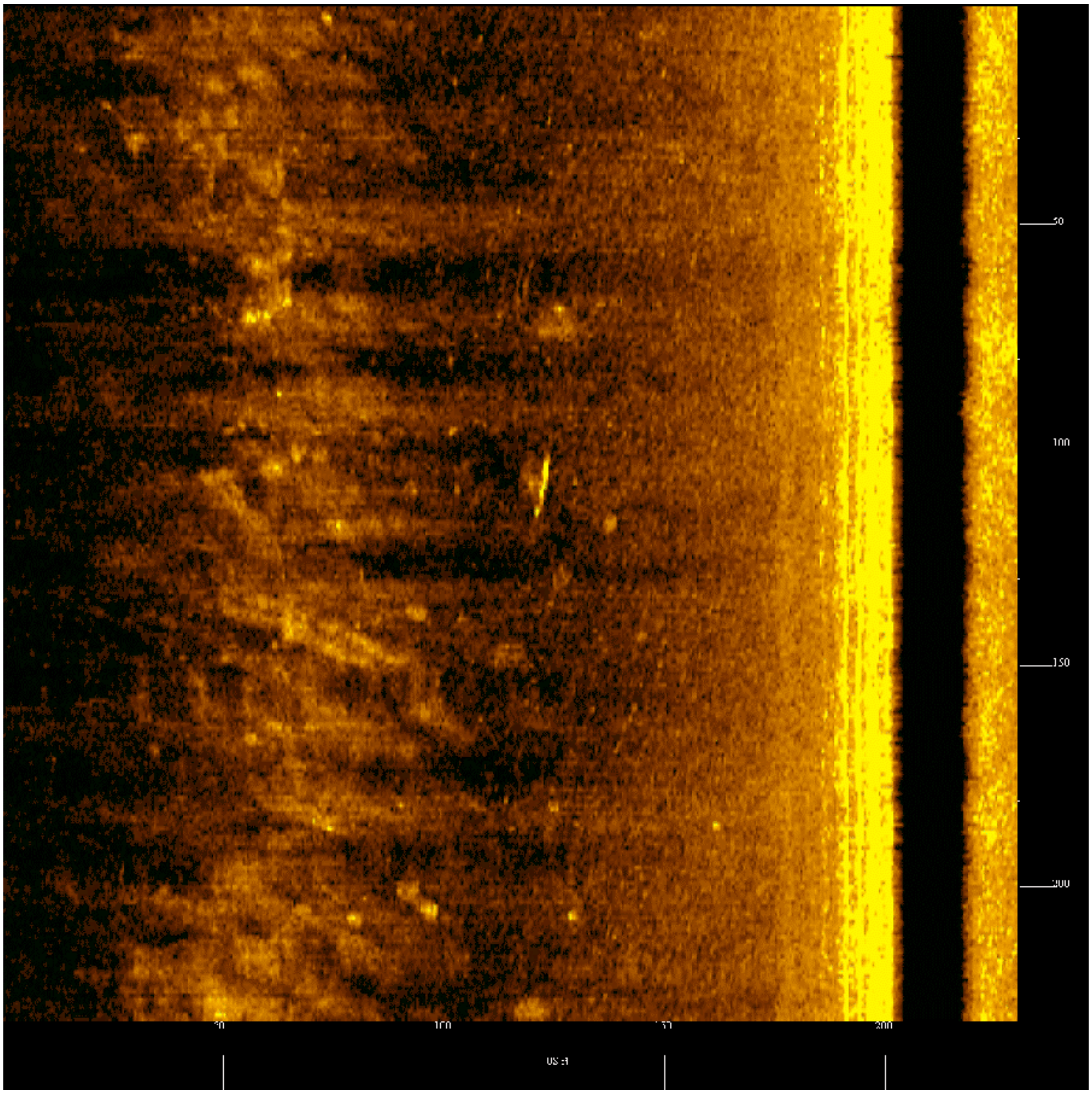
Target Info for GLE-4	User Entered Info
• Sonar Time at Target: 02/15/2010 09:54:05 • Click Position (Lat/Lon Coordinates) 29° 13.29162' N 089° 32.05508' W (WGS84) 29° 13.29162' N 089° 32.05508' W (Local) 29° 13.27814' N 089° 32.05162' W (NAD27) • Click Position (Projected Coordinates) (X) 3,854,721.22 (Y) 266,905.05 • Map Proj: NAD83 Louisiana State Planes, Southern Zone, US Foot • Acoustic Source File: GL_2010_624_SW.jsf • Ping Number: 42572 • Range to Target: 86.46 US Feet • Fish Height: 7.69 US Feet • Heading: 208.00000000 • Event Number: 0 • Line Name: 624	Target Height = N/A Target Length: 8.6 US Feet Target Shadow: N/A Target Width: 2.4 US Feet Mag Anomaly: 23, 105 Target: GLECR-3 Avoidance Area: 300-foot radius conforming buffer Area: Grand Liard East Description: Possible Debris

GLE-5



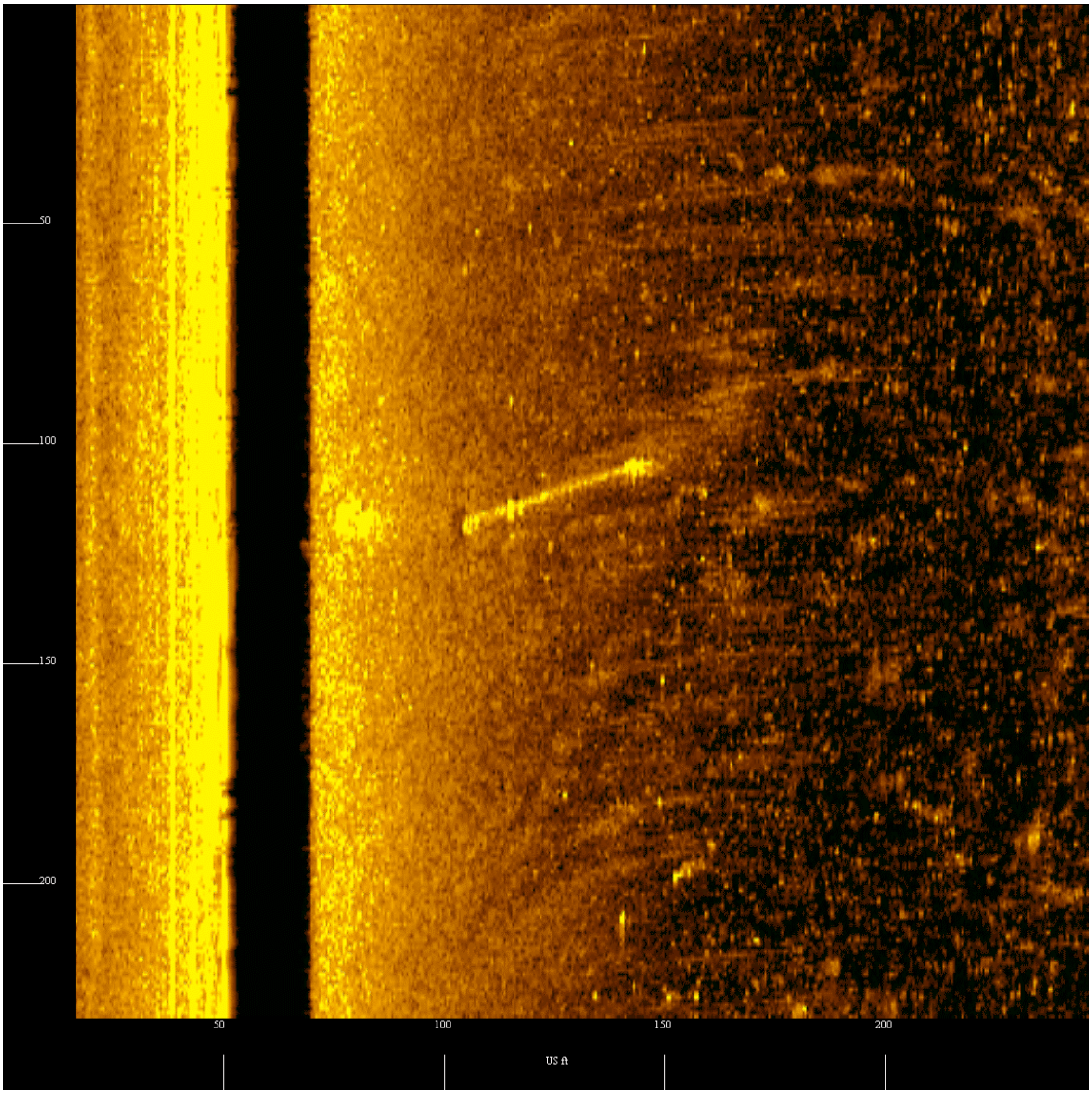
Target Info for GLE-5	User Entered Info
• Sonar Time at Target: 02/15/2010 10:24:43 • Click Position (Lat/Lon Coordinates) 29° 13.18419' N 089° 32.23459' W (WGS84) 29° 13.18419' N 089° 32.23459' W (Local) 29° 13.17070' N 089° 32.23112' W (NAD27) • Click Position (Projected Coordinates) (X) 3,853,777.15 (Y) 266,239.02 • Map Proj: NAD83 Louisiana State Planes, Southern Zone, US Foot • Acoustic Source File: GL_2010_628_NE.jsf • Ping Number: 59742 • Range to Target: 83.58 US Feet • Fish Height: 7.69 US Feet • Heading: 37.00000000 • Event Number: 0 • Line Name: 628	Target Height = N/A Target Length: 9.1 US Feet Target Shadow: N/A Target Width: 2.0 US Feet Mag Anomaly: 6 Avoidance Area: 300-foot radius conforming buffer Area: Grand Liard East Description: Possible Debris

GLE-6



Target Info for GLE-6	User Entered Info
• Sonar Time at Target: 02/15/2010 10:37:58 • Click Position (Lat/Lon Coordinates) 29° 13.25740' N 089° 32.22733' W (WGS84) 29° 13.25740' N 089° 32.22733' W (Local) 29° 13.24392' N 089° 32.22386' W (NAD27) • Click Position (Projected Coordinates) (X) 3,853,808.79 (Y) 266,683.33 • Map Proj: NAD83 Louisiana State Planes, Southern Zone, US Foot • Acoustic Source File: GL_2010_630_SW.001.jsf • Ping Number: 67176 • Range to Target: 87.42 US Feet • Fish Height: 8.17 US Feet • Heading: 208.00000000 • Event Number: 0 • Line Name: 630	Target Height = N/A Target Length: 14.3 US Feet Target Shadow: N/A Target Width: 2.4 US Feet Mag Anomaly: None Avoidance Area: None Area: Grand Liard East Description: Possible Debris

GLW-7



Target Info for GLW-7	User Entered Info
• Sonar Time at Target: 02/14/2010 11:11:41 • Click Position (Lat/Lon Coordinates) 29° 13.35965' N 089° 33.33285' W (WGS84) 29° 13.35965' N 089° 33.33285' W (Local) 29° 13.34617' N 089° 33.32933' W (NAD27) • Click Position (Projected Coordinates) (X) 3,847,922.10 (Y) 267,211.29 • Map Proj: NAD83 Louisiana State Planes, Southern Zone, US Foot • Acoustic Source File: GL_2010_681_NE.002.jsf • Ping Number: 141523 • Range to Target: 64.34 US Feet • Fish Height: 10.57 US Feet • Heading: 27.00000000 • Event Number: 0 • Line Name: 681	Target Height = N/A Target Length: 48.3 US Feet Target Shadow: N/A Target Width: 2.0 US Feet Mag Anomaly: 12, 95 Avoidance Area: None Area: Grand Liard West Description: Section of pipe.

Appendix D
Grand Liard West Magnetic Target Table

Potentially Significant Targets										
Target Designation	**Map ID**	**Lane**	**Anomaly No.**	**Signature Characteristics**	**Intensity (gammas)**	**Duration (feet)**	**Easting**	**Northing**	**Sonar**	**Recommendation**
GLWCR-1	44	676	1	positive monopolar	26	86	3846748.7	264196.1	No	Magnetic signature characteristics, intensity, and duration suggest that material generating the anomaly could be associated with the remains of a vessel or potentially significant cultural resource. Avoidance by the creation of a 300-foot radius conforming buffer is recommended.
	45	679	1	positive monopolar	15	82	3846544.7	264326.3	No	Magnetic signature characteristics, intensity, and duration suggest that material generating the anomaly could be associated with the remains of a vessel or potentially significant cultural resource. Avoidance by the creation of a 300-foot radius conforming buffer is recommended.
	87	677	1	positive monopolar	10	76	3846635.1	264164.3	No	Magnetic signature characteristics, intensity, and duration suggest that material generating the anomaly could be associated with the remains of a vessel or potentially significant cultural resource. Avoidance by the creation of a 300-foot radius conforming buffer is recommended.
	89	678	1	negative monopolar	5	94	3846580.9	264282.1	No	Magnetic signature characteristics, intensity, and duration suggest that material generating the anomaly could be associated with the remains of a vessel or potentially significant cultural resource. Avoidance by the creation of a 300-foot radius conforming buffer is recommended.
GLWCR-2	11	218	1	positive monopolar	26	166	3847323.8	264540.2	No	Magnetic signature characteristics, intensity, and duration suggest that material generating the anomaly could be associated with the remains of a vessel or potentially significant cultural resource. Avoidance by the creation of a 300-foot radius conforming buffer is recommended.
GLWCR-3	41	670	1	positive monopolar	6	96	3847431.3	264014.2	No	Magnetic signature characteristics, intensity, and duration suggest that material generating the anomaly could be associated with the remains of a vessel or potentially significant cultural resource. Avoidance by the creation of a 300-foot radius conforming buffer is recommended.
	75	669	1	dipolar	19	104	3847534.5	263933.5	No	Magnetic signature characteristics, intensity, and duration suggest that material generating the anomaly could be associated with the remains of a vessel or potentially significant cultural resource. Avoidance by the creation of a 300-foot radius conforming buffer is recommended.
	78	671	1	dipolar	85	143	3847368.2	264062.7	No	Magnetic signature characteristics, intensity, and duration suggest that material generating the anomaly could be associated with the remains of a vessel or potentially significant cultural resource. Avoidance by the creation of a 300-foot radius conforming buffer is recommended.
GLWCR-4	38	661	1	dipolar	98	259	3848661.6	264288.5	No	Magnetic signature characteristics, intensity, and duration suggest that material generating the anomaly could be associated with the remains of a vessel or potentially significant cultural resource. Avoidance by the creation of a 300-foot radius conforming buffer is recommended.
	68	660	1	positive monopolar	8	150	3848732.4	264262.9	No	Magnetic signature characteristics, intensity, and duration suggest that material generating the anomaly could be associated with the remains of a vessel or potentially significant cultural resource. Avoidance by the creation of a 300-foot radius conforming buffer is recommended.
GLWCR-5	36	655	1	positive monopolar	9	245	3849493.7	264355.5	No	Magnetic signature characteristics, intensity, and duration suggest that material generating the anomaly could be associated with the remains of a vessel or potentially significant cultural resource. Avoidance by the creation of a 300-foot radius conforming buffer is recommended.
GLWCR-6	9	216	1	negative monopolar	22	83	3849488.6	265133	No	Magnetic signature characteristics, intensity, and duration suggest that material generating the anomaly could be associated with the remains of a vessel or potentially significant cultural resource. Avoidance by the creation of a 300-foot radius conforming buffer is recommended.
	37	658	1	dipolar	32	266	3849541.5	265139.8	No	Magnetic signature characteristics, intensity, and duration suggest that material generating the anomaly could be associated with the remains of a vessel or potentially significant cultural resource. Avoidance by the creation of a 300-foot radius conforming buffer is recommended.
	121	657	1	dipolar	43	218	3849658.2	265090.2	No	Magnetic signature characteristics, intensity, and duration suggest that material generating the anomaly could be associated with the remains of a vessel or potentially significant cultural resource. Avoidance by the creation of a 300-foot radius conforming buffer is recommended.

GLWCR-7	10	217	1	positive monopolar	19	90	3849191.6	266465	No	Magnetic signature characteristics, intensity, and duration suggest that material generating the anomaly could be associated with the remains of a vessel or potentially significant cultural resource. Avoidance by the creation of a 300-foot radius conforming buffer is recommended.
	73	668	2	dipolar	101	270	3849149.4	266576.4	No	Magnetic signature characteristics, intensity, and duration suggest that material generating the anomaly could be associated with the remains of a vessel or potentially significant cultural resource. Avoidance by the creation of a 300-foot radius conforming buffer is recommended.

Individual Targets

Map ID	Lane	Anomaly No.	Signature Characteristics	Intensity (gammas)	Duration (feet)	Easting	Northing	Sonar	Recommendation
12	219	1	dipolar	313	193	3847980.9	267250.6	Yes, GLW-7	Sonar and magnetic signatures suggestive of possible pipe or other modern linear debris. No additional investigation is recommended.
13	219	2	dipolar	21	207	3846351.9	264445.8	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
39	667	1	dipolar	12	106	3848249.8	264756.9	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
40	667	2	dipolar	14	88	3848565.7	265328	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
42	670	2	dipolar	9	116	3847608	264321.4	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
43	673	1	positive monopolar	6	56	3848171.6	265789.7	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
46	679	2	negative monopolar	10	59	3847521.1	266065.2	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
47	682	1	negative monopolar	5	58	3846535.3	265207.1	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
48	685	1	dipolar	6	148	3845744.3	264329.3	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
69	662	1	positive monopolar	18	103	3849639.6	266232.1	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
70	662	2	positive monopolar	3	188	3849874.1	266659.8	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
71	665	1	dipolar	39	279	3848462.7	264807	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
72	668	1	dipolar	22	192	3848576.3	265558.9	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
74	668	3	dipolar	8	64	3849418.7	267061.6	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
76	669	2	dipolar	3	102	3848316.4	265321.3	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
77	669	3	dipolar	4	74	3848930.5	266386.6	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
79	672	1	negative monopolar	6	47	3847343	264267.8	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
80	672	2	dipolar	356	125	3849002	267095.6	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
81	672	3	dipolar	10	56	3849203.2	267487.6	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
82	674	1	dipolar	2	54	3846954.6	264091.6	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.

83	674	2	negative monopolar	3	55	3847039.7	264264.8	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
84	674	3	multicomponent	79	167	3847953.9	265856.7	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
85	674	4	dipolar	3	74	3848661.5	267105.2	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
86	674	5	negative monopolar	3	51	3848858.8	267458.8	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
88	677	2	dipolar	4	47	3847062	264916.2	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
90	678	2	multicomponent	375	188	3847511.5	265894.6	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
91	678	3	dipolar	4	78	3847806.9	266440.5	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
92	681	1	dipolar	9	101	3845972.8	263985.4	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
93	681	2	positive monopolar	3	40	3847407	266494.7	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
94	681	3	dipolar	6	67	3847561.1	266756.4	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
95	681	4	dipolar	3	40	3847845.3	267272.8	Yes, GLW-7	Sonar and magnetic signatures suggestive of possible pipe or other modern linear debris. No additional investigation is recommended.
96	683	1	dipolar	5	146	3846178	264770.1	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
97	688	1	dipolar	5	53	3845529.2	264587.6	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
98	689	1	negative monopolar	3	39	3846077.1	265770.3	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
99	691	1	dipolar	6	40	3845947.4	265937.6	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.
100	695	1	dipolar	4	55	3846276.2	267296	No	Signature suggestive of small diameter pipe, trap, anchor or other small modern debris. No additional investigation is recommended.