Remote Sensing Survey of the Borrow Area B-West

East Rockaway Inlet and Jamaica Bay Integrated Hurricane Sandy General Reevaluation Report, New York

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Abstract

This report presents the results of the Remote Sensing Survey of Borrow Area B-West in connection with the East Rockaway Inlet to Rockaway Inlet and Jamaica Bay Integrated Hurricane Sandy General Reevaluation Report, New York. Remote sensing survey of the Area of Potential Effects (APE) for Borrow Area B-West was carried out by a team from Dolan Research, Inc. (Dolan Research) under the direction of Lee Cox on September 24, 2020. The remote sensing survey simultaneously collected magnetic, acoustic, sub bottom, and bathymetric data. The purpose of the survey was to locate, identify, and preliminarily assess the significance of potential submerged cultural resources that might be impacted by offshore sand harvesting activities within Borrow Area B-West. The underwater survey was designed to generate sufficient magnetic and acoustic remote sensing data to identify anomalies suggestive of potential submerged cultural resources. Analysis of the remote sensing data aimed to isolate targets of potential historical significance that might require further investigation or avoidance. The analysis of results was carried out by Dolan Research in conjunction with the Research and Archaeology staff of the Lake Champlain Maritime Museum (LCMM) and First Environment, Inc.

LCMM and Dolan Research have concluded that the research undertaken for the Remote Sensing Survey of Borrow Area B-West has demonstrated that there are no submerged cultural resources located within the APE of the project. The remote sensing data upon which this survey was conducted examined approximately 13.5 hectares (33.26 acres) of sea floor in the underwater study area for the project. Analysis of the survey data revealed 14 distinct targets. All 14 targets were side scan sonar targets with no associated magnetic signature. There was little magnetic variation across the APE and no sustained magnetic anomalies or magnetic targets were identified. None of the 14 sonar targets that were identified are suggestive of submerged cultural resources, such as a shipwreck or other submerged manmade structure, object, artifact, or feature. No archaeological or historical resources that are eligible for listing in the National Register of Historic Places (NHRP) were identified within the APE for the project.

LCMM offers the following conclusions and recommendations for the APE of offshore Borrow Area B-West:

1. Analysis of the side scan sonar, magnetometer, and sub-bottom profiler data indicate that there are no submerged archaeological or historic resources within the APE for the project.
2. No further studies or archaeological investigations are recommended within the APE for the project.
3. Should additional work outside of the B-West APE be proposed during the development of this project, LCMM notes that additional archaeological assessment may be required. Therefore, LCMM recommends that it, or other CRM professionals, review any adjustments to the APE that may fall outside the current underwater study area and review the results of any additional remote sensing or geotechnical studies that may be conducted during the course of the project to ensure that any as yet unidentified shipwrecks or underwater archaeological resources that are revealed can be avoided.

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1.0 Introduction

This report presents the results of the Remote Sensing Survey of Borrow Area B-West in connection with the East Rockaway Inlet to Rockaway Inlet and Jamaica Bay Integrated Hurricane Sandy General Reevaluation Report, New York.

The East Rockaway Inlet to Rockaway Inlet project area consists of the Atlantic Shorefront Component, which includes approximately six miles (9.7km) of shorefront on the Rockaway Peninsula entirely within the Borough of Queens, New York City, and the Jamaica Bay Component, which includes three separate areas where High Frequency Flood Risk Reduction Features (HFFRRFs) are planned. The proposed bayside work features a series of floodwalls, berms, pumps, and nature-based features to prevent flooding to the back-bay areas. The sand used for the Atlantic Shoreline features will come from three borrow areas along the Atlantic shoreline. Borrow Areas A-West and A-East have been previously surveyed, but B-West has not been previously investigated.

1.1 Project Location and Description

The Area of Potential Effect (APE) is offshore Borrow Area B-West, which is in the Atlantic Ocean, 2.5 nautical miles south/southeast of East Rockaway Inlet, Queens Borough, New York, New York (Figure 1). Borrow Area B-West is a square-shaped area that covers an area approximately 13.5 hectares (33.26 acres). The sides of the APE are slightly more than 1,200 feet (366m) in length. Water depth at the APE ranged from 49 to 61 feet (15-18.6m).

1.1.1 Location of Borrow Area B-West

Coordinates for the corners of Offshore Borrow Area B-West in the Atlantic Ocean are expressed in the New York State Plane Coordinate System (Long Island Zone, feet) in Table 1. These coordinates were provided by the U.S. Army Corps of Engineers, New York District.

Table 1: Location of Borrow Area B-West

Corner	Northing	Easting
1	136,950	1,057,900
2	138,100	1,057,600
3	138,400	1,058,750
4	137,250	1,059,100

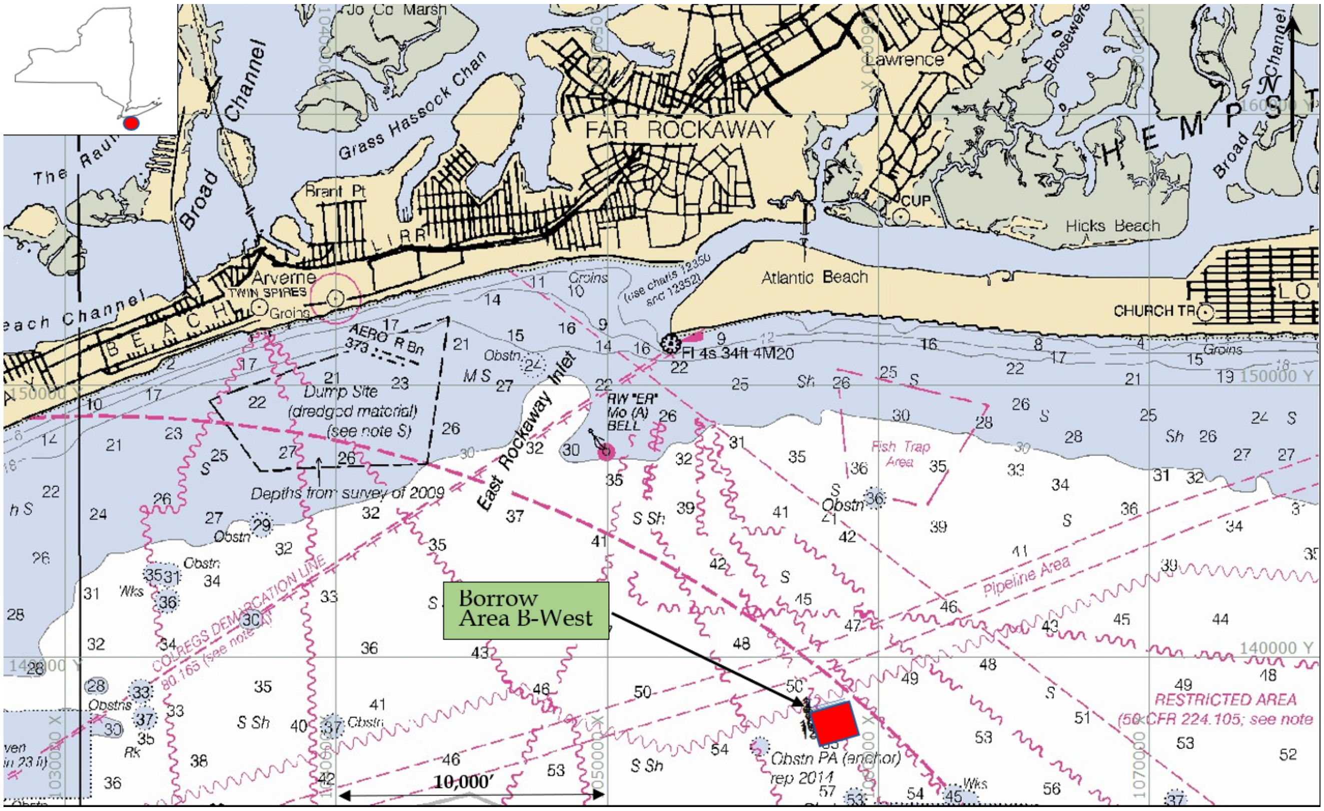


Figure 1. Project Location overlaid on NOAA Chart 12350 “Jamaica Bay and Rockaway Inlet”

1.2 Previously Conducted Cultural Resources Surveys

New York State's Cultural Resource Information System (CRIS) does not contain information for offshore cultural resources investigations beyond approximately one-half mile (0.8km) of the shoreline. However, other borrow areas in the vicinity of Borrow Area B-West have been subjected to cultural resource surveys previously. The results of those surveys are presented in Chapter 2.

1.3 Report Organization

This report contains five chapters, a bibliography, and three appendices. Chapter 1 contains introductory and background information pertinent to the project. Chapter 2 presents the maritime context, prehistoric, and historic background for the project area. Chapter 3 presents the methodological approaches used to gather and analyze data for this Phase I underwater archaeological investigation. Chapter 4 presents the results of the survey and data analysis, and Chapter 5 presents a summary of findings and recommendations for this Phase I underwater archaeological investigation. The Bibliography presents the sources that were referenced in the production of this report. Appendix I presents a depiction of the vessel setup. Appendix II contains specifications for the remote sensing equipment. Resumes of key LCMM project staff are presented as Appendix III.

2.0 Historic Context

2.1 Geologic Background

Potential resources that may be encountered in the area of Borrow Area B-West include historic shipwrecks and submerged prehistoric sites. While there is a possibility of encountering either of these kinds of archaeological sites within the project area, the probability is low. Undocumented shipwreck sites can be discovered in a project area using remote sensing equipment, however, submerged prehistoric sites are not conclusively identified in this manner. Instead, predictive models for regional locations of prehistoric sites are created based, in general, on landscape features such as close proximity to water and other resources, and on having little to no slope of the land. Remote sensing technologies can help to capture features such as paleochannels and the progression of glaciofluvial movements from the Pleistocene epoch to the estuarine sedimentary deposits of the early Holocene. These features may clarify which areas, now submerged, may have been utilized by humans when the land was exposed (Panamerican Consultants, Inc., 2005; Panamerican Consultants, Inc., 2020; Schwab et al., 2000).

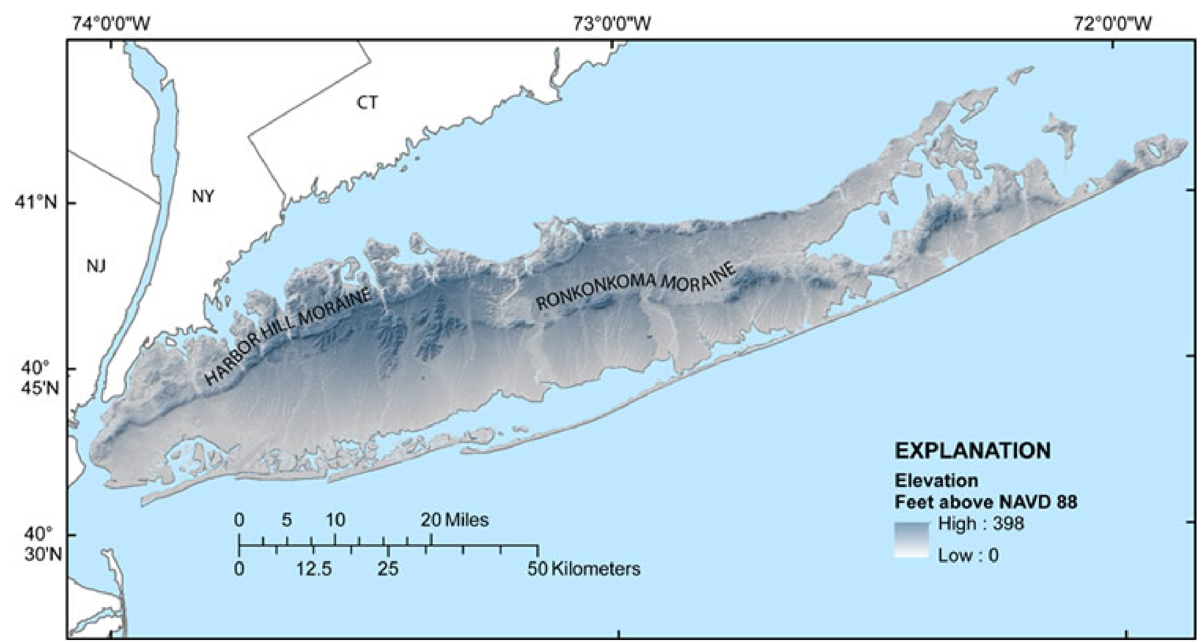


Figure 2: Harbor Hill Moraine and Ronkonkoma Moraine, Courtesy of wikipedia.org

The Ronkonkoma Moraine and the Harbor Hill Moraine generally run east to west across present day Long Island, New York, as seen in Figure 2. The Ronkonkoma Moraine formed during the Pleistocene epoch, early in the Wisconsin Stage. The Harbor Hill Moraine represents the last glacial maximum of the Wisconsin Stage glacier, and the most recent advance of the last glacier in this region about 20,000 years before present (Schuldenrein et al., 2014:54; Stoffer and Messina, 1996). By the Holocene, this glacier was likely melted completely. The gravel, rock, and sand moved by the runoff was deposited on the expansive outwash plain to the coast and the edge of the continental shelf. The sediments that make up this outwash plain are unconsolidated deposits of materials from the Cretaceous period through the present day, resting on a deep crystalline bedrock floor. The southern ocean facing shore of Long Island also sets upon many deposits of unconsolidated sediments and bedrock, with surface materials of beach and wind-blown, medium- to course-grained sands containing shell fragments (Panamerican Consultants, Inc., 2004:2-1). Jamaica Bay and Rockaway Beach are some of the many lagoonal systems in this region that lie across the extent of the southern shore of Long Beach Island, formed from the barrier the island mass creates with the ocean and the changing sea levels over time. The salt marsh deposits that make up Jamaica Bay are fairly recent in geological time, with large portions of these deposits covered over by twentieth century landfill deposits (Panamerican Consultants, Inc., 2004:2-2).

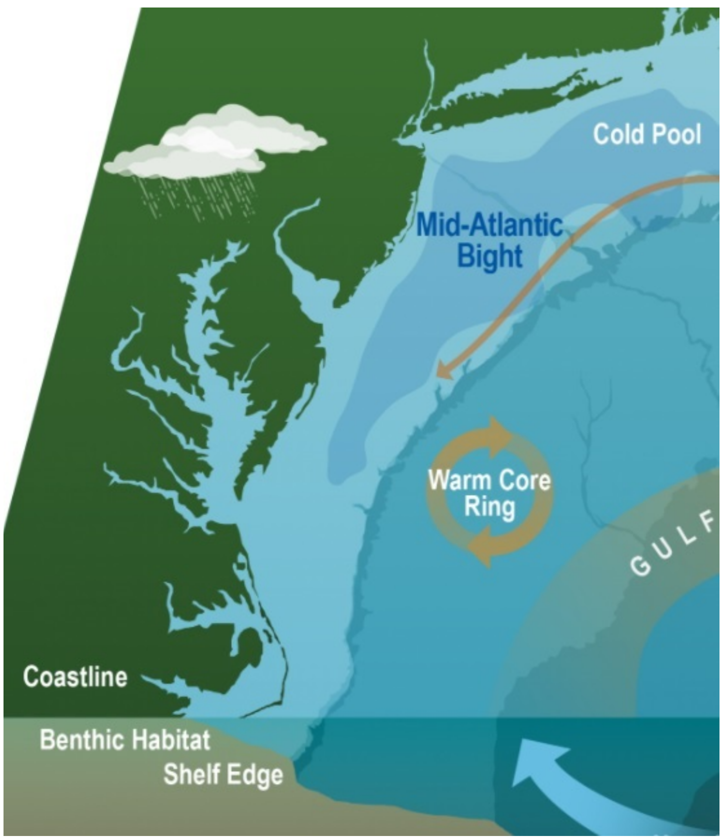


Figure 3: Mid Atlantic Bight
Courtesy of https://www.integratedecosystemassessment.noaa.gov/regions/northeast/mid-atlantic-bight

Area B-West lies on the Mid-Atlantic Bight portion of the Continental Shelf, in the prehistoric outwash plains of the Ronkonkoma and Harbor Hill terminal moraines described above. This area is generally delineated in Figure 3. The melting of glaciers in this region contributed to sea level rise and to isostatic rebound of the land, generally separated into three 'meltwater pulses' between 12,000 and 9,500 years before present. The mid-shelf scarp shown in Figure 4 is likely the shoreline during the Younger Dryas period (12,000- 13,000 years before present) and largely associated with the drastic expansion of human population into areas previously occupied by glaciers in this region (Panamerican Consultants, Inc., 2020; Stoffer and Messina, 1996).

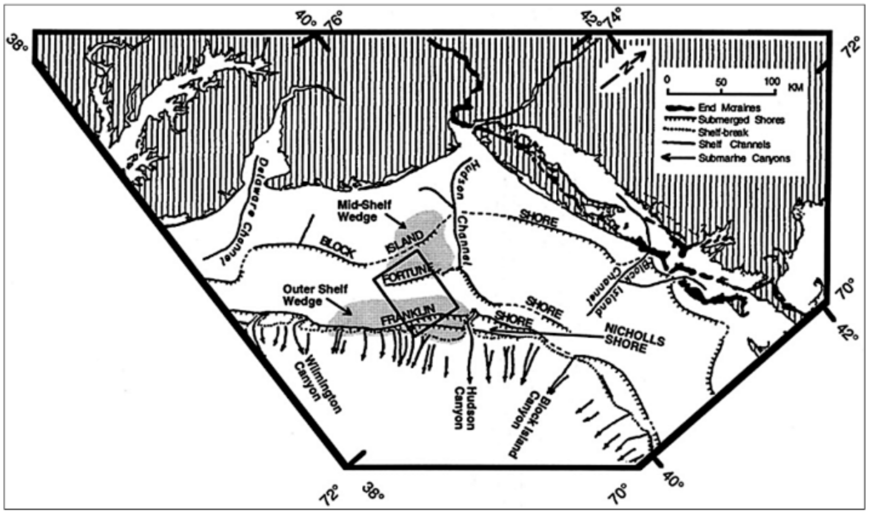


Figure 4: Mid Shelf Scarp and Paleoindian Shorelines of Project Areas, Courtesy of Panamerican Consultants, Inc., 2020:6

2.1.1 Paleoenvironment

The Paleoindian shoreline, mentioned above as the mid-shelf scarp or wedge, is currently 130 feet (40m) below sea level. The New York Bight region follows eustatic models of sea rise from the late Pleistocene to the early Holocene, as the hinge line of isostatic response to glacial weight lies to the south of the survey area (Panamerican Consultants, Inc., 2020:4). The shorelines shifted over time, along with the meltwater pulses, especially in the dynamic areas close to the Hudson paleochannel. Because of the massive flooding events through the Hudson paleochannel and the relatively shallow areas surrounding this outlet, there is the possibility that project Area B-West contains ephemeral sites relating to the Paleoindian or Archaic periods.

Sea rise levels for the New York Bight area between 12,000 to 10,000 years before present inundated the Continental Shelf along with any present evidence of human occupation. The habitable coastal outwash plains of this region stretched about 60 miles (97km) across the Continental Shelf during the Paleoindian period. By 9,000 years before present, this area shrunk to a 10-mile (16km) outwash plain and by 6,000 years before present, sea levels were close to present day levels (Schuldenrein et al., 2014: 25-27).

Examples of Paleoindian features that could be encountered include weir features from the lee of paleobarrier features or midden deposits in close proximity to paleochannels. Other maritime elements of prehistoric cultural material from this region include watercraft and fishing technology elements, though preservation of organics such as bone, leather, or wood have a low chance of surviving in the turbulent, acidic environment of coastal areas of this region (Merwin, 2019: 85). In 1994, the Sea Bright Borrow Area dredging site used to fortify part of Monmouth Beach, New Jersey was found to contain prehistoric artifacts dating from the Early to Late Archaic period (Panamerican Consultants, Inc., 2020: 8-9). The Corcione Collection was collected from the Monmouth Beach site where sediments from the Sea Bright Borrow Area were deposited. The collection contains over 200 stone artifacts, making this one of the largest prehistoric collections to be recovered offshore in eastern North American. The Sea Bright Borrow Area dredging site is within 15-20 miles (24-32km) southwest of Area B-West and lies in a similar proximity to a present-day land mass. Additionally, Pleistocene animal remains such as Mastodon elements have been recovered by fishing trawlers in other nearby offshore locations, indicating that this region was exposed and utilized by humans and the animals they hunted. Due to the stabilization that occurred around 6,000 years before present, where sea levels reached present day levels, there are more data available for Late Archaic sites in nearshore areas than those of Paleoindian and Early Archaic sites that have since been inundated.

Sea level rise further inland resulted in specific sedimentation patterns that are well documented regionally for areas like the New York Bight, but not well defined for smaller localities such as Jamaica Bay (Merwin, 2019: 83; Schuldenrein et al., 2014:26). Additionally, historic era modifications to the landscape in coastal areas like Jamaica Bay have likely destroyed prehistoric sites, resulting in the absence of a material record for prehistoric occupation (Merwin, 2019: 83; Schuldenrein et al., 2014: 28). In predictive models for earlier sites, location and abundance are largely guided by the changing geomorphic environment described above, while later period models and trends are guided more by variable subsistence practices (Schuldenrein et al., 2014: 28).

The New York Bight region during the Late Pleistocene was mostly boreal forest, with mainly coniferous trees such as spruce. During the Holocene between 8,000 to 10,000 years before present, pines almost completely replaced the spruce trees, indicating the warming of the climate in the area, and around 4,000 years before present, oaks made up about 50 percent of the new deciduous forests (Merwin, 2019: 83). These changes in forestation of the region also meant a change in available animal and plant resources for people throughout time. Further, regional maritime adaptations would also be dependent on available resources of the surrounding environment through time (Panamerican Consultants, Inc., 2004: 2-1 to 3-2).

2.1.2 Prehistoric Cultural History

The potential range of prehistoric human occupation of the survey areas extend from pre-Clovis through the Late Archaic culture groups. Pre-Clovis assertions in other areas may be used to infer the presence of humans in this region before the Last Glacial Maximum retreated and therefore likely through the transition phases of melting (Panamerican Consultants, Inc., 2020:13-14). Clovis-era material culture is largely associated with the diagnostic fluted point technology as well as other chipped-stone tools dating to the Late Pleistocene, and documented across eastern North America in abundance. Most evidence of Paleoindian sites are isolated finds of projectile points, but likely the most thoroughly studied Paleoindian site from the greater New York Bight area is the Shawnee-Minisink site in eastern Pennsylvania (Merwin, 2019: 86).

The earliest Archaic sites are accepted as a continuation of Clovis technology and culture through the change of points to notched projectiles from the former lanceolate varieties. The people continued to function in the same smaller migratory bands or groups, gathering plant foods and resources and hunting game (Panamerican Consultants, Inc., 2004: 3-3; Panamerican Consultants, Inc., 2020:15). Rising sea levels at this time pushed back available areas for human occupation and inundated existing sites. Stone tool technologies of the Early Archaic period include corner-notched, stemmed, and bifurcate varieties with some serrated edges, and a marked shift in preference of raw materials to favor non-cryptocrystallin stones such as argillite (Panamerican Consultants, Inc., 2004: 3-3 to 3-4; Panamerican Consultants, Inc., 2020:15).

Middle Archaic sites dated between 8,500 to 5,000 years before present have been more abundantly located, showing diagnostic differences in both bifurcated and stemmed point technologies as well as groundstone tools from the earlier period. Middle Archaic sites are generally larger and often had multiple uses. It is sometimes difficult to discern Late Archaic sites from Middle Archaic based on material culture alone; however, these later sites are often larger indicating an increase of people as well as indications of longer length of stay at sites (Panamerican Consultants, Inc., 2020: 15). Based on more inland studies of this time period in current New York State, human populations in the region rose significantly during the Middle to Late Archaic period, and during the latter, sea levels rose to modern coastline levels (Merwin, 2019: 87-88). Because sea levels have remained about the same since this last rise, Woodland sites are not expected on the Continental Shelf as Paleoindian and Archaic sites are, but instead would only be present in near-present day shore areas (Merwin, 2019: 89). It should be noted that archaeological sites along modern coastlines are in danger of being submerged from current sea level rise (Merwin, 2019: 89).

The shift from Late Archaic to Early Woodland is generally marked by a transition towards horticulture subsistence strategy in addition to the hunting and gathering pattern, as well as the appearance of ceramics (Schuldenrein, 2014:114, 127-128). The Early to Late Woodland period spans from 3,000 years before present up to European Contact. The Transitional period between Late Woodland and European Contact is sometimes dated locally by the presence of the Classons Point phase of East River tradition, with other material culture including shell-tempered pottery and European tradegoods, and site locations at higher elevations to avoid tidal surges (Schuldenrein, 2014: 128).

Around the time of European Contact, the coastal regions of New England were densely populated with indigenous peoples from a myriad of ethnically diverse backgrounds. Although these people are often described under larger European-derived umbrella-terms, it should be noted that these umbrella associations do not always align with the histories that Native descendent communities know, nor do they often account for the level of diversity among the groups placed under single umbrellas. Present day New York Harbor was a main hub of cultural contact and osmosis between many ethnically diverse Native American groups and newly arrived Europeans beginning in the early 16th century.

The Cultural Resources Information System (CRIS) for New York State (NYS) shows five prehistoric sites within about a 10-mile (16k) radius from the B-West project area. Of those prehistoric sites, three are associated with known Canarsie village sites, included burials, and were dated to the Late Woodland through European Contact periods. Of the two remaining prehistoric sites, one was also dated Late Woodland and the other was left undated. All of these prehistoric sites lie above the northeast shore of Jamaica Bay.

2.1.3 General History of Project Area

While the state of New York has been settled for several thousand years by various ethnically diverse Native American groups, the general history of the project area is primarily focused on an abbreviated background of the region since European settlement. With the "discovery" of the region by the Italian explorer Giovanni da Verrazano in 1524 and the subsequent colonization by the Dutch in the 17th century, New York slowly grew and prospered primarily through trade (Workers of the Writer's Program of the Works Projects Administration for the City of New York 2004:22; Panamerican 2020:15, 19). With the seizure of the colony by the British in the late 17th century, the settlements in New York further grew. Through periods of intermittent warfare, the events of the American Revolution, and the founding of the United States in the late 18th century, the region expanded further and continued to prosper in trade. The development of inter-regional railways, canals, and trans-Atlantic routes further changed New York, and by the late 19th and early 20th centuries the state became one of the most important hubs for global commerce. Today, New York State continues to develop as one of the leading industrial and financial centers in the United States.

Europe's first exposure to New York was during the voyages of Giovanni da Verrazano, an Italian from Florence sailing for Francois I, the king of France. Sailing from Europe in 1524 to chart a route to China, he ended up on the eastern coast of the continent of North America. Verrazano traveled far enough north and east to enter New York Bay to reconnoiter the region before continuing his voyage back to France. However, the French did not follow up on Verrazano's discovery which left the area open to exploration by the Dutch in the 17th century (Workers of the Writer's Program of the Works Projects Administration for the City of New York 2004:22-23).

Henry Hudson, an Englishman in the employ of the Dutch East India Company, was the next European after Verrazano to travel into the New York region from the Atlantic Ocean. Working with the Dutch, Hudson and his fellow settlers laid claim to the region and founded a small colony and trading venture in Manhattan. As a small but established trading post, the Dutch called this region the New Netherlands in 1614 and controlled fur-trading operations throughout the surrounding country. In 1623, the Dutch West India Company took over trading operations of the region, and the town of New Amsterdam was founded in 1625 (Workers of the Writer's Program of the Works Projects Administration for the City of New York 2004:23-26).

In 1664, the British took control of New Amsterdam from the Dutch, renamed it New York, and established the Port of New York. Resuming trading operations already established by the Dutch, the British Monarchy continued to develop commercial activities in the area as the Atlantic seaboard provided the perfect route for exports going out of the colony and for imports coming in from Europe (Brouwer 1990:3-13). Flour replaced furs as the main export and was shipped mainly to the West Indies. Well into the 18th century, exports included whale oil, beaver pelts, and some tobacco shipped to England with flour, pork, bread, peas, and horses sent to the West Indies. Imports from England and the West Indies included manufactured goods, rum, molasses, and sugar (Panamerican 2020:17). Shipping increased considerably by the middle of the 18th century. Imports included: "fish oil, blubber, whale fins, turpentine, seal skins, hops, cider, bricks, coal, lamp black, wrought iron, tin, brasury [sic], joinery, carriages and chairs." Exports included chocolate, lumber, "and import goods from both the West Indies and Europe" (Panamerican 2020:17).

Well into the 18th century, interior settlements surrounding New York were well populated in order to support the large-scale production of goods for export to the surrounding colonies and abroad to Europe. Due to the increased trade, the port of New York further expanded with rudimentary, but accessible, interior trade routes connecting to other colonies. There was also an increase in shipbuilding and a need for larger, more economical ships to handle and transport the ever-increasing amount of trade goods. In 1770, New York stood fourth after Philadelphia, Boston, and Charleston among the leading North American ports in total tonnage of imports and exports. Population growth also increased in the region in tandem with the surge in commercial activities (Workers of the Writer's Program of the Works Projects Administration for the City of New

York 2004:45-62; Albion 1984:2-5). However, commerce and trade significantly slowed while the British occupied the state and port during the Revolutionary War. Other events such as the Yellow Fever epidemics of 1795 and 1798, the Embargo Act of 1807, and the shutdown of the port during the War of 1812 further stagnated growth in the region (Panamerican 2020:19).

As the 19th century progressed and the War of 1812 ended, New York once again began to slowly grow. The development and use of railroads in the state allowed for major rail lines to connect the entire region to the interior of the United States, with 12 rail lines directly provisioning the port of New York with freight service (Workers of the Writer's Program of the Works Projects Administration for the City of New York 2004:246-247). The opening of the Erie Canal in 1825 contributed to the expansion of commercial activities. The canal connected the western part of the United States in the Great Lakes region to the eastern seaboard along with the Champlain Canal, which connected the Hudson River to the Saint Lawrence seaway in Canada (Whitford 1922:13-15). Large clipper and packet ships bound for markets in Europe, Asia, and the Western United States contributed to the broader trends of economic development.

In addition to the use of rails and canals, the invention of steam technology and the advancement of ships using steam-power further contributed to the growth of the region. Massive excursion lines, such as the Hudson River Day Line, allowed for effective and timely service from New York City to cities like Albany on the Hudson River (Ringwald 1965). Steamships in the late 19th century eventually replaced traditional sailing craft as the primary cargo haulers and immigration transports to the United States. Well into the 20th century, steamships became larger and more efficient in oceanic travel until petroleum-powered engines eventually replaced older steam-engine technology. The advent of automobiles and the development of the inter-state roads and highways in New York further expanded the progression of the region. The First World War and eventually the Second World War led to increases in global commerce for the port of New York as well.

By the middle of the 20th century, the state of New York had established itself as a central hub for global commerce. Newer and more economic modes of seaborne transportation, such as the container ship, allowed for goods and materials to be packaged and handled in standardized freight containers. New York State combined the main Atlantic port with New Jersey to become the Port of New York and New Jersey and became one of the most advanced and developed ports in the United States (Brouwer 1990:54,204-205). Today, the region of New York is known for its tourism and the iconic city of New York. The Atlantic seaboard of the state continues to serve as one of the busiest ports in the United States with imports and exports constantly flowing through the shared port with the state of New Jersey.

2.2 Maritime History of Project Area

The Maritime History of Rockaway Inlet and the surrounding New York Bay region is diverse and spans through the Paleoindian era to the present day. As a maritime community, the area is known for its commercial activities and fisheries that developed from the early 17th century. While the area and surrounding New York harbors expanded into the 18th and 19th centuries, so too did the use of different types of watercraft. From the simple canoes and early Hudson River sloops, technological development brought the advent of steamboats, canal boats, and trans-Atlantic clipper ships. The infrastructure of the New York ports also developed with rail lines, terminals, wharves, and freight facilities. Well into and throughout the 20th century, the use of lighters, barges, and more modern craft such as oceanic container ships in the port of New York (later known as the Port of New York and New Jersey) dominated the maritime landscape and led to an exponential increase in global commerce. Today, the Port of New York and New Jersey is one of the largest and most technologically advanced ports in the United States.

Figure 5, which depicts one of the first prints of New Amsterdam, hints at the diversity of watercraft used in the regions even during the earliest years of colonization with several canoes in the foreground, a small two-masted sailing vessel in the middle, and three larger square-rigged vessels in the background.

Figure 5: The earliest view of New Amsterdam from a book printed by Joost Hartgen in Amsterdam, 1651, Courtesy of Bank of Manhattan, 1915

The earliest known maritime commercial activity to take place on the broader New York harbor area started in the early 17th century and focused on the fur trade. The first known cargo manifest from the vessel *Wapen van Amsterdam* (*Arms of Amsterdam*) clearing port listed 7,246 beaver skins, 852 otter, 48 mink, 36 wildcat, and 34 muskrat pelts, and "many logs of oak and nut wood" (Workers of the Writer's Program of the Works Projects Administration for the City of New York 2004:34). Based on modern monetary values, the cargo was worth about $25,000.00. The Dutch West India Company maintained a monopoly on the trade and fixed prices on all imports and exports. However, the trade was not as profitable as expected and due to unreasonable maritime regulations imposed by the regional governors, many colonists turned to the occupation of smuggling (Workers of the Writer's Program of the Works Projects Administration for the City of New York 2004:35). Slavery was another commercial venture for the colony, yet it was not a profitable enterprise for the Dutch colony.

For most of the early part of the 17th century, many of the larger ships operating in the area were built abroad. The vessels were generally owned by the West India Company and ships owned by other interests in Holland (Bank of Manhattan Company 1915:9-12). While smaller boats were more than likely made in the surrounding region, the first documented large scale shipbuilding venture began in 1631 with the construction of the vessel *Nieuw Nederlandt* (*New Netherland*) on the banks of the East River (Workers of the Writer's Program of the Works Projects Administration for the City of New York 2004:39). The ship was built much larger than the typical smaller Dutch vessels made for shallow canals and coastal waters of Holland. There are two conflicting accounts of the actual tonnage with one stating the vessel was 600 tons while the other put the ship at 800 tons (Workers of the Writer's Program of the Works Projects Administration for the City of New York 2004:39). Dutch shipbuilders also constructed coastal sailing vessels such as sloops and ketches given the lack of infrastructure to make larger ocean rated vessels.

By 1664, the British sent a naval flotilla of four men-of-war ships to the colony of New Amsterdam and wrested control of the region from the Dutch (Workers of the Writer's Program of the Works Projects Administration for the City of New York 2004:44). Given the ineffectiveness of local rule, the Dutch surrendered the colony with no resistance and the area was renamed New York. Under British rule, the colony was opened up to British trade and interests while supporting continued Dutch commercial ventures. As New York slowly grew, the number of vessels and port activity increased. Statistics from 1683 list three ships, 62 sloops, three barks, 23 sloops, and 41 small boats. By 1696, the number of vessels rose to 60 ships, 62 schooners, 40 square-rigged vessels, and 60 small boats (Hall 1884:115; Albion 1984:3; Panamerican 2020:19-20).

One of the most iconic vessels to be used for trade in the region is the Hudson River sloop. Modified from the original Dutch yacht design used earlier in the 17th century, the Hudson River sloop retained a rounded, full bottom and a characteristic broad beam of most Dutch vessels at the time. The vessel type also had a very light draft, which made it ideal for traveling through the shallows of the Hudson River. The sloop was the standard vessel for transportation and hauling freight between New York and Albany. Also, they were used in coastal commercial trade and passenger service along with shipping to and from the West Indies. By 1771, Hudson River sloops were modified into large, sturdy boats with a record number of 125 being used for service between Albany and New York (Hall 1884:115).

During the beginning of the 18th century, maritime commercial development was relatively slow. However, many of the settlements within the interior of the surrounding region were profitable in manufacturing exportable goods. Merchants were primarily engaged with trade in the West Indies, where provisions were shipped from New York in exchange for products made in the West Indies. In turn, these products were taken to England and exchanged for manufactured goods. Privateering was another lucrative business in New York as many pirates were engaged in slavery, smuggling, and taking the prize of ships (Workers of the Writer's Program of the Works Projects Administration for the City of New York 2004:53-61).

The industry of shipbuilding and commerce exponentially increased over the years in addition to maritime infrastructure. Docking and shipping facilities were developed and the number of ship owners and consortiums rose (Workers of the Writer's Program of the Works Projects Administration for the City of New York 2004:61-62). Leading to an ever-increasing capitalistic market system, the British Monarchy imposed harsh restrictions and taxation. This was a contributing factor leading to the outbreak of the Revolutionary War and, by 1775, trade had slowed yet again due to this same issue. During the war, New York was predominantly used as a naval base for the British fleet given its strategic importance and location.

After the end of the Revolutionary War, trade renewed again at the tail end of the 18th century and by 1797 New York had become one of the leading seaports in the world (Panamerican 2020:20). Throughout the 19th century, American shipbuilding in New York continued to thrive and newer technology such as steam power was introduced. Represented in Figure 6, the successful test and launch of Robert Fulton's *Hudson River Steam Boat* in 1807 ushered in a new era of maritime commerce. Owning a monopoly on all steamboat production until 1824, Fulton's control was deemed unconstitutional by the United States Supreme Court. This opened up the steamboat business to competing companies and newer and larger vessels (Ringwald 1965:1-12). By the 1840s, the use of steamboats along the Hudson River and ports of New York was at a peak given the increasing amount of steamers in service (Ringwald 1965:7).

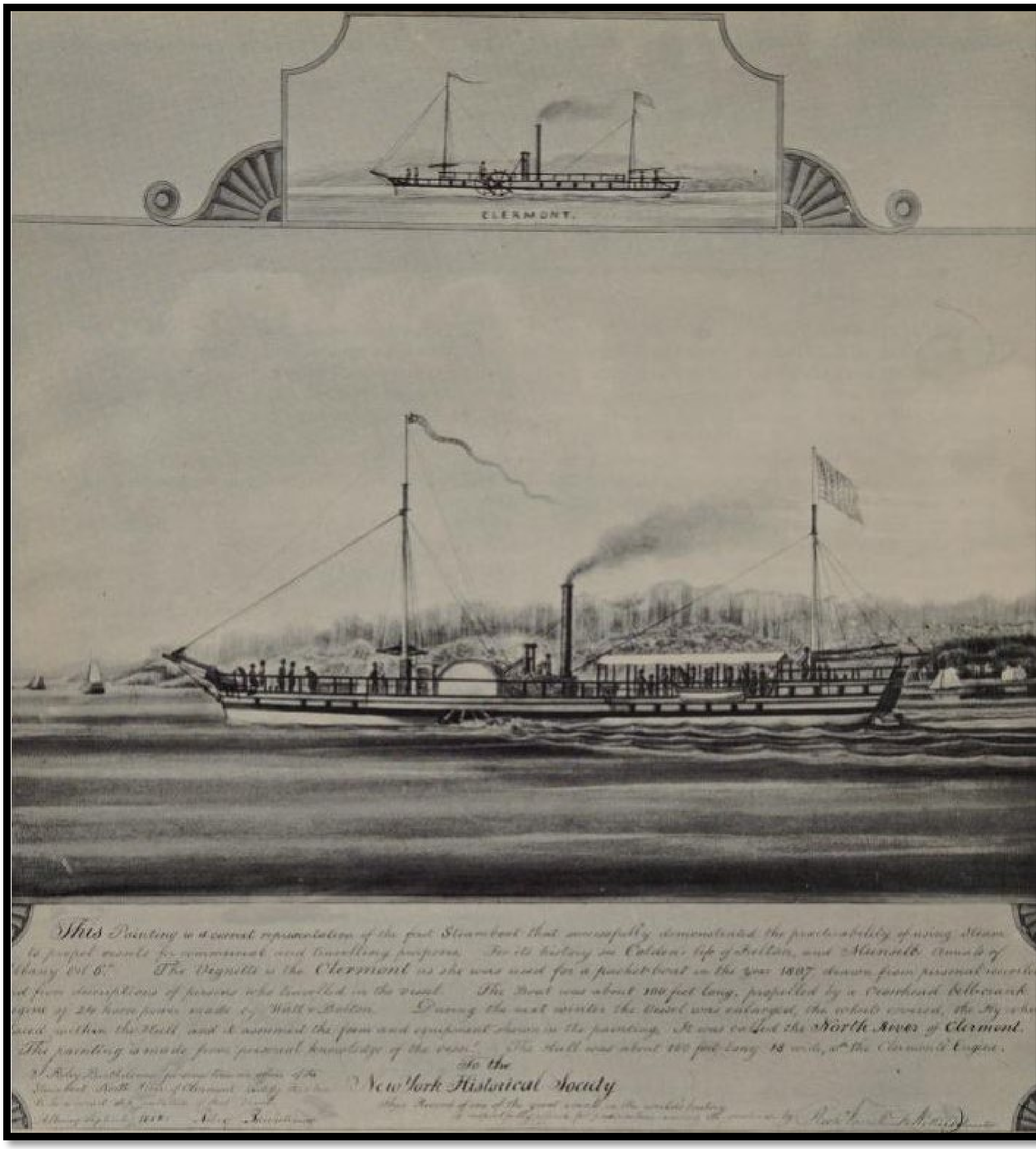


Figure 6: Watercolor painting of *North River Steam Boat* (also known as *Claremont*) by Richard Varick De Witt, 1858, Courtesy of Ringwald 1965

The opening of the Erie Canal in 1825 contributed to the broadening of marine commercial activities in the ports of New York. The Erie Canal connected the western part of the United States to the eastern seaboard along with the northern connection through the Champlain Canal. Traditional canal boats and sailing canal boats were common vessels seen throughout the ports (Whitford, 1922:13-15). Trans-Atlantic clipper ships and packets bound for markets in Europe, Asia, and the Western United States contributed to the broader trends of economic development as well. By the middle of the 19th century, the ports of New York had radically developed into a bustling hub of trade. Figure 7 depicts a view of New York Harbor in 1849, with several Hudson River steamboats, square-rigged three-masted ships, and smaller sail-rigged vessels, most likely sloops.

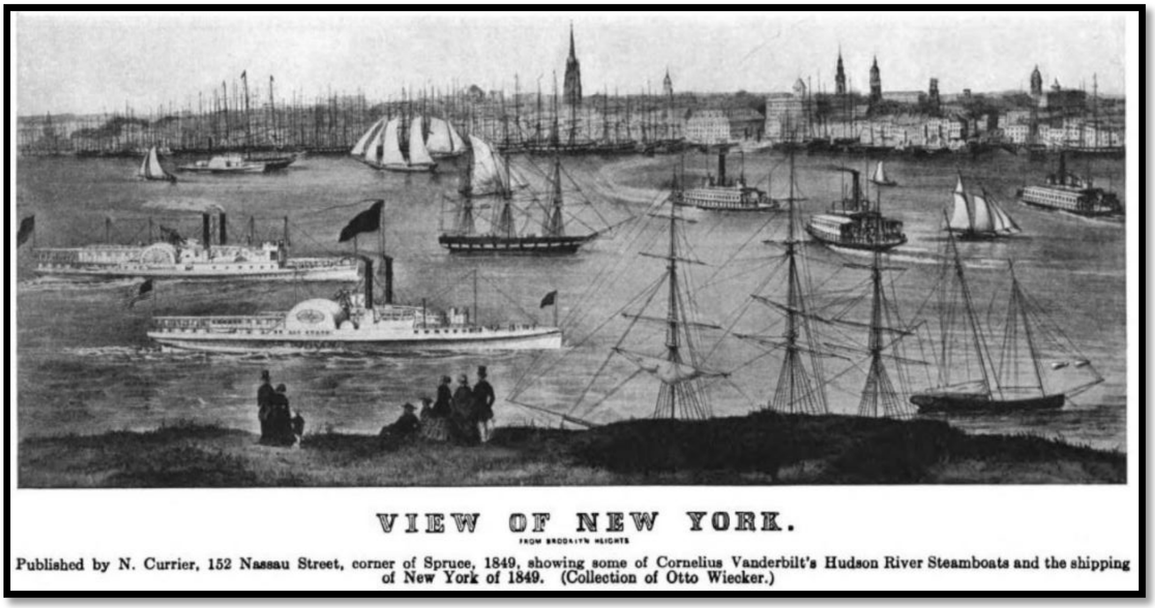


Figure 7: View of New York, 1849, Courtesy of the Bank of Manhattan Company 1915

Other canals constructed in Delaware, Maryland, and Pennsylvania further bolstered commercial activity and maritime transportation through inland waterways connecting to the ports of New York. The Delaware & Raritan Canal brought coal from Pennsylvania to New Brunswick, New Jersey. Canal boats and barges were instrumental in hauling cargoes of coal, with steam tugs acting as towboats for them. Facilitating the increased coal trade into the Upper New York Bay area was the Arthur Kill and Kill Van Kull waterways, which were important corridors for waterborne transportation. The expansion of rail lines and terminals into the region further increased the amount of coal into the maritime ports by the middle and late 19th century (Albion, 1984:134-137).

Historically, the broader New York region and Jamaica Bay, in particular, was known for its fisheries of clams, crabs, and oysters (Bellot, 1917:62). With the various interspersed islands and shallow draft navigable waterways, it was the perfect area for fishing using small watercraft like sloops, canoes, and pettyaugers.[1] After European settlement, the town started to impose restrictions on fishing and the indiscriminate taking of shellfish in a notice from July 1763, stating the following:

> "Whereas divers persons, without any right or license to do so, have of late, with sloops, boats, and other craft, presumed to come to Jamaica bay and taken, destroyed and carried away quantities of clams, mussels, and other fish, to the great damage of said town, this is to give warning to all persons who have no right or liberty that they do forbear to commit any such trespass in the bay in the future; otherwise they will be prosecuted at law for the same by Thomas Cornell, Jr., and Waters Smith. By order of the town" (Bellot, 1917:62).

By 1869, the town adopted measures to further control fishing access to Jamaica Bay by recommending the exclusion of all non-residents from the fisheries in the bay. Stakes and other obstructions illegally standing in the bay and local marshes were to be removed as well. In 1871, the Legislature passed an act that authorized the board of auditors to lease to residents of Jamaica Bay portions of land under the water for planting oysters. Conditions were ascribed for each lease and penalties if any trespass were to occur on leased allotments. However, by the early 20th century the local fishing trade changed with more people fishing for leisure rather than for-profit (Bellot, 1917:63). People also flocked to the area for vacation as the local villages had

[1] A pettyauger is a vessel that is also known as a type of large dugout canoe termed a "periauger." Referenced in the late 18th century journal of Landon Carter, a member of the House of Burgesses and prominent landowner in Virginia, the term pettyauger may be a corrupted version of the word from 1776 that has since been lost. Other examples in the United States at the time are petty augur, pettiaguer, pirogue, and pettiaugre (Wolfe 2011).

prominent summer resorts. Pleasure vessels such as catboats, single-engine motorboats, luxury motor launches, and large excursion steamers were common in the summer months.

Railroads and connecting terminal facilities in the harbors of New York also had an impact on the development of maritime commerce and building in the latter 19th century and well into the 20th century. Twelve rail lines served the port directly with the New York Central having direct access to Manhattan with freight service (Workers of the Writer's Program of the Works Projects Administration for the City of New York 2004:246-247). Railroad companies servicing the port had to be able to manage outgoing freight, goods, and getting people to their final destinations via the water. Additionally, incoming cargoes from ocean-going vessels were far greater in tonnage than cargo transported overland. A system of using lighters to transport various merchandise and freight from these vessels to wharves and terminals was devised, primarily using barges with cranes called "stick lighters" as shown in Figure 8. Lighters are defined as a vessel with a deck used to convey freight about harbors or in contiguous waters and consisted of a variety of craft, such as self-propelled barges, tow-assisted barges, sail-equipped craft, and steam-powered tugboats (Harding 1912:14-15; Panamerican 2020:21-22).

Figure 8: Stick lighters unloading a ship in New York Harbor in the early 20th century, Courtesy of the New York Lighterage Company

As the ports of New York developed at the end of the 19th century, the use of clipper ships and sail packets gradually came to an end with the increased use of railways and canals. The opening of the Suez Canal in 1869 had a substantial impact on commercial activity in New York harbors as well. The Suez Canal allowed more direct shipping through the North Atlantic to the Indian Ocean destined for markets in Europe and Asia. The route negated the need for ships to spend more time circumnavigating the dangerous route around Africa (Britannica 2020). Advancements in steam technology, such as the development of the triple expansion steam engine and the use of screw propellers over paddle wheels, resulted in better and larger steamships rated for ocean service. Ultimately, these factors led to a decline in shipbuilding, especially wooden-hulled vessels, by the end of the century (Brouwer 1990:46; Workers of the Writer's Program of the Works Projects Administration for the City of New York 2004:154-187).

In the 20th century, the Port of New York was brimming with lighters, ferries, excursion steamboats, and newer steel-hulled ocean liners. The construction of the Barge Canal from 1903 to 1918 allowed newer and larger canal boats and ships to transport goods like grain from the Midwestern states of the U.S. into the Atlantic seaboard. The introduction of the automobile and subsequent highway systems had no real impact on marine transportation in the harbors until the 1930s when the use of private automobiles took away much of the business of excursion vessels (Brouwer 1990:51-54). Many of the communities alongside the coastal areas of New York, particularly Rockaway Inlet and Jamaica Bay, established summer resorts. These resorts drew thousands of people from the region to the various beaches and boardwalks that lined the Atlantic Ocean (Panamerican 2020:23-31). Recreational boating and fishing became in vogue, where rowboats, sailboats, and petroleum-powered motorboats were common craft seen in the area.

Both the First and Second World Wars briefly brought increases in commercial activity and modern shipbuilding. However, by 1950 much of the impetus driving these activities fell. The development of container ships and their modern counterparts led to the construction of new terminals and infrastructure adapted to handling standardized freight containers. Container ships could easily and quickly transfer their cargos to trains, trucks, and specialized ships (Brouwer 1990:54,204-205). The area also incorporated the harbors of New Jersey and became known as the Port of New York and New Jersey. The use of lighters gradually slowed and ultimately ceased by 1976 as they could not compete with the containership trade. Much of these vessels and other vessels related to the lighterage system were deposited and abandoned in derelict areas and shorelines around the entire Port of New York and New Jersey (Panamerican 2020:22).

Today, the Port of New York and New Jersey is the third busiest port in the United States (The Port Authority of New York and New Jersey 2020). Infrastructure improvements continue to be made as commercial activity is propelled by the containership trade. Much of the area is littered with the remains of ship graveyards, where the practice of ship abandonment was instituted for the deposition of unwanted vessels and scrapped ships. Most notable are the Arthur Kill and Kill Van Kull areas, which are ripe with abandoned vessels primarily dating to the late 19th century and throughout the 20th century (Raber et al 1995). However, given the historic use of the area, there is the potential to find earlier vintage vessels from the 18th century. Additionally, there is a list of known vessels that have foundered and wrecked from East Rockaway Inlet to Jones Inlet (Panamerican 2020:60-72).

2.3 History of Rockaway

The history of Rockaway traces its beginnings to Dutch settlement and fur trade in the early part of the 17th century. Originally, the area was settled by local Canarsie Indians. The first European settler of what is now Rockaway was John Palmer who received a patent for the land from English governor Thomas Dongan. Palmer soon sold his land to the first known white settler in the Rockaway peninsula, Richard Cornell, who around 1690 constructed a house at what is now known as Far Rockaway (Bellot 1917:10-11). In the early 18th century, other families began moving into the area. According to Frederick Black, before the middle of the 19th century, nearly all those living in the land surrounding Jamaica Bay engaged in farming for a living (Black 1981:18).

When the British took control of the region, there was a commercial change from fur exportation to that of flour and other exports including whale oil, beaver pelts, tobacco, pork, bread, peas, and horses while imports from England and the West Indies included manufactured goods, rum, molasses, and sugar. Shipping continued to increase in New York during the 1700s and beyond. Privateering or the preying on enemy commerce was also common and often strayed into piracy. During the American Revolution, many residents in the Rockaway area remained loyal to the Crown. However, there were some who sided with the Americans and minor military encounters took place on the peninsula. When the British arrived following the Battle of Long Island on August 27, 1776, the American Army and many of those loyal to the cause fled. Following the victory of the British, the entire area remained under British occupation until the end of the war in 1783 (Black 1981:19).

The Rockaway peninsula began to attract the upper classes of New York City as early as the 1830s. In 1830, John Leake Norton formed the Rockaway Association, purchased land from the Cornell estate, and constructed the Marine Pavilion on the former location of the Cornell homestead, which was razed during the project. This was an elite hotel associated with such persons as John A. King, governor of New York State, and Philip Hone, the former New York City mayor. The hotel attracted summer vacationers such as Henry Wadsworth Longfellow, Washington Irving, and others. The Pavilion is depicted on Hassler's 1844 map and Dripps' 1852 map as seen in Figures 9 and 10. It was destroyed by fire in 1864 (Bellot 1917:84). Other hotels, including one owned by Henry Mott, sprang up to accommodate summer vacationers and in 1868, the Wave Crest Land

Company, formed of lands previously owned by John Norton, began to sell lots in the area for summer cottages to wealthy New Yorkers (Bellot 1917:21).

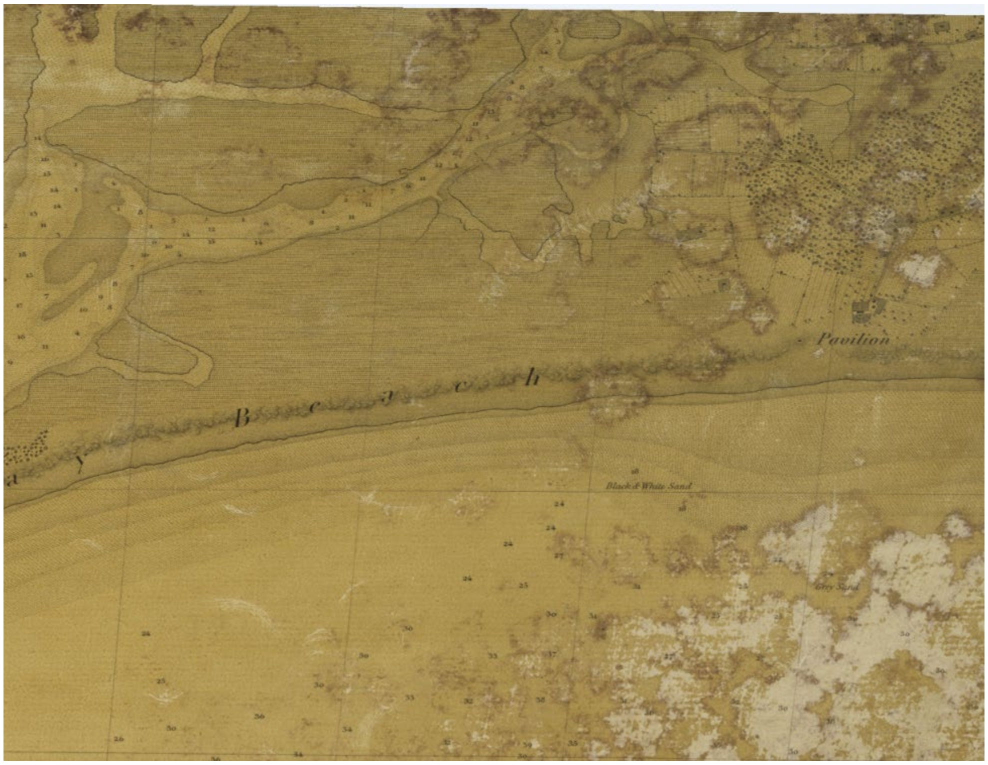


Figure 9: Greater Project Area in 1844, Courtesy of Hassler 1844

Figure 10: Greater Project Area in 1852, Courtesy of Dripps 1852

Well into the latter 19th century, Rockaway continued to be developed, with wealthy individuals further purchasing tracts of land. Much of the land was subdivided into lots with the existing marshes filled in and dunes leveled to accommodate housing and infrastructure (Bellot 1917:98-99). The Rockaway Railway, a division of the South Side Railroad, was a steam railroad that first provided train service between Far Rockaway and Rockaway Beach, passing through Arverne near the Atlantic coast. Later, part of the Long Island Railroad Company moved the track inland from the beach and a station was centrally located at Arverne. By the early 1900s, the line had been electrified (Bellot 1917:34-35). After 1900, land south of the railroad tracks filled up and landholders began developing the marshlands on the Jamaica Bay side.

Well into the 20th century, Rockaway peninsula was further developed with hotels and housing. The Arvene and Edgemere marsh areas were further drained and filled in to make way for new construction. The developments in Edgemere proceeded slower along Jamaica Bay than with Arverne and both developments concentrated on the ocean side until those lots were taken (Bellot 1917:96). Real estate ventures, like the Sommerville Realty Company, made quick progress on filling in the remaining marsh, constructing a bulkhead at the shoreline, and filling it in with sand pumped from the bay (Bellot 1917:100). The company also laid out modern streets and parkways, with other landowners constructing more bulkheads which increased their property acreage.

Throughout the 19th and early 20th century, recreational activities such as fishing, boating, and bathing were extremely popular in the bay. In the late 1800s, Waldman and Solecki estimated that approximately 5,000 individual fishing vessels were using the bay for recreational fishing on a yearly basis. Brant Point, Broad Channel, and Edgemere were popular fishing spots. Commercial fishermen also frequented the bay, causing conflicts between recreational fishing and commercial interests. Hunting and harvesting/seeding oysters were also common activities. Sailing and sailboat racing organized by local yacht clubs remained major recreational activities on Jamaica Bay through the early 20th century. Later, motorboat races were popular (Waldman and Solecki 2018:10, 37). The area was a popular summer destination for bathers and people who wanted to enjoy the beaches, as shown in Figure 11 which shows people at Rockaway Seaside in 1906.

Figure 11: Bathing scene at Rockaway's Seaside in 1906, Courtesy of the Chamber of Commerce of the Rockaways 2020

Today, the Rockaway peninsula and surrounding communities have grown slowly and have become a day trip destination for residents of New York City. The area has been mentioned in the 2007 New York Magazine as a great vacation destination and a place to visit for recreational scuba diving due to the presence of sunken ships (Urban Areas.Net, 2020). The area tends to be busier and more populated in the summer with an influx of tourists visiting the beaches. In 2012, the communities of Rockaway were devastated by Hurricane Sandy and suffered significant damage and coastal erosion. The Army Corps of Engineers is currently working to restore sections affected by Hurricane Sandy.

2.4 Previous Archaeology

The NYS CRIS system does not currently contain extensive records of submerged sites and shows no sites in the area around the Borrow Area B-West project area.

The most applicable previous archaeology surveys that have occurred in the vicinity of Borrow Area B-West are the various surveys of other borrow areas in the region.

The following map in Figure 12 shows the various borrow areas that have been utilized for a variety of projects in previous decades.

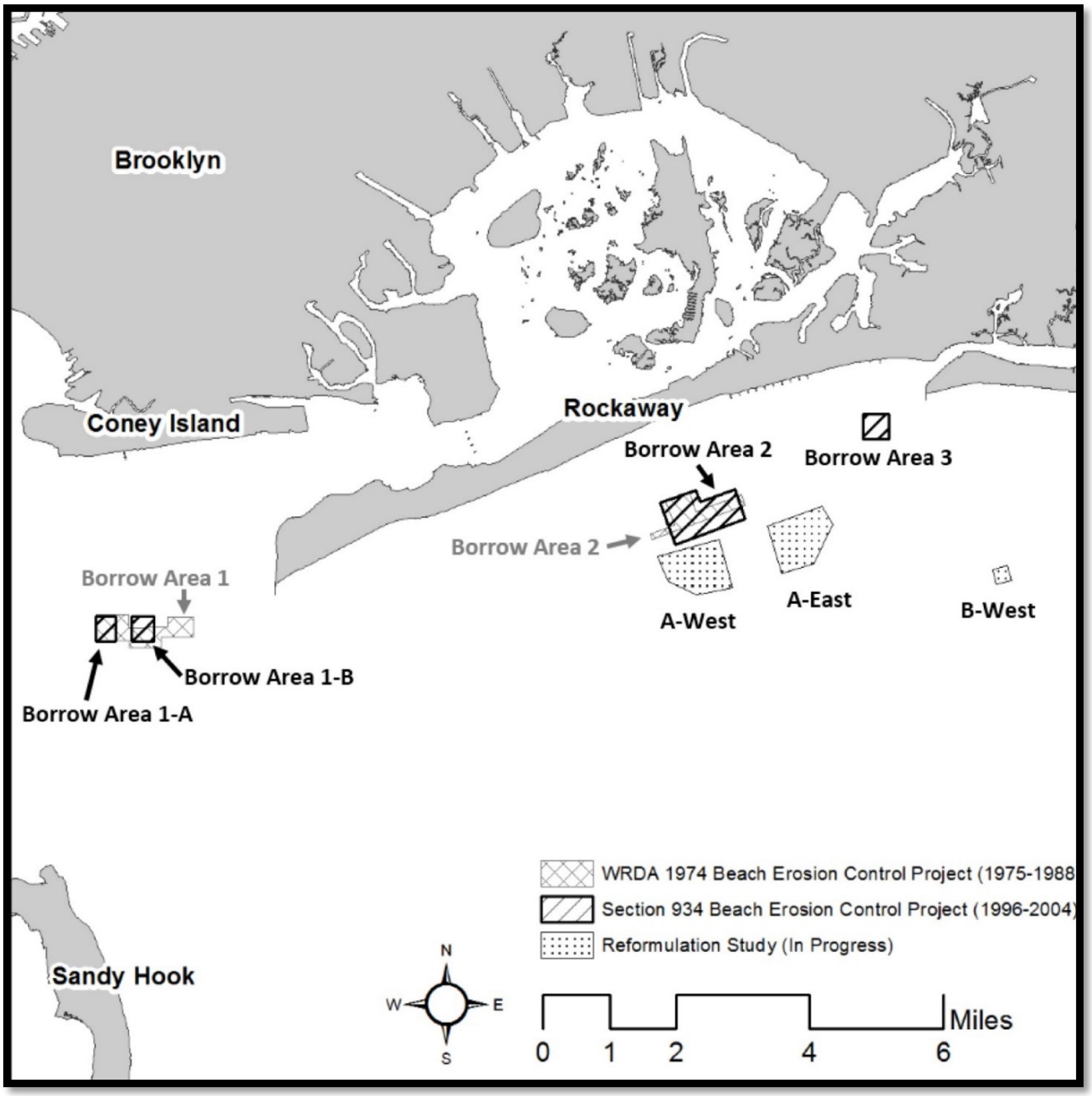


Figure 12: Map showing Borrow Areas in the vicinity of Borrow Area B-West, Courtesy of Army Corps of Engineers

In 2005 Panamerican Consultant, Inc. conducted a remote sensing survey of an area that encompasses Borrow Areas A-West and A-East (Krivor 2005:1). This survey utilized marine magnetometer and side scan sonar to assess the area for potentially significant submerged cultural resources. A total of 60 Magnetic anomalies were revealed during this survey and 10 of them were determined to be cultural in origin. The sites were not further investigated, and avoidance was recommended to eliminate the possibility of impacting these resources.

In 1993, the Army Corps of Engineers contracted WCH Industries of Waltham Massachusetts, to carry out a remote sensing survey of Borrow Areas 1A and 1B which are located east of Borrow Area B-West. This survey, which employed both marine magnetometer and side scan sonar, revealed seven possible targets of cultural significance in Area 1A and four targets in Area 1B (Riess, 1993:7). Avoidance of these targets was recommended, and no further archaeological examination or characterization of those targets was conducted.

Also under contract to the Army Corps of Engineers in 1993, WCH Industries conducted remote sensing survey of Borrow Area 2. This survey identified 34 remote sensing targets that were considered “possible cultural resources” (Reiss 1994b:i). These 34 targets were later subjected to diver evaluation by archaeologists from Panamerican Consultants, Inc. in 1999. All 34 targets were identified as nonsignificant modern debris and no further archaeological work was carried out in this area.

3.0 Methodology

3.1 Project Location and Description

The APE is Offshore Borrow Area B-West, which is in the Atlantic Ocean, 2.5 nautical miles south/southeast of East Rockaway Inlet, Queens Borough, New York, New York (Figure 1). Borrow Area B-West is a square-shaped area that covers an area approximately 33.26 acres or 1,448,750 square feet in size. The sides of the APE are slightly more than 1,200 feet in length. Water depth at the APE ranged from 49 to 61 feet.

3.1.1 Location of Borrow Area B- West

Coordinates for the corners of Offshore Borrow Area B-West in the Atlantic Ocean are expressed in the New York State Plane Coordinate System (Long Island Zone, feet) in Table 2. These coordinates were provided by the U.S. Army Corps of Engineers, New York District. See Figure 1)

Table 2: Coordinates of the Corners of Offshore Borrow Area B-West

Corner	Northing	Easting
1	136,950	1,057,900
2	138,100	1,057,600
3	138,400	1,058,750
4	137,250	1,059,100

3.2 Project Personnel

The field crew consisted of: Lee Cox, RPA, maritime archaeologist (Dolan Research); George Rollins, boat captain and remote sensing specialist (Waterway Surveys); and Rob Propster, remote sensing technician (Waterway Surveys).

3.3 Survey Vessel

All remote sensing survey operations were conducted from a 23-foot (7m) long by 8-foot (2.4m) wide Parker fiberglass survey vessel which is suitable for offshore and shoal water operations. The vessel was outfitted with a Yamaha 225hp, four-stroke outboard engine. Magnetic, acoustic, sub-bottom, and bathymetric data were collected simultaneously across the B-West project area. The survey’s horizontal reference is the New York (Long Island) State Coordinate System, NAD83, in feet.

3.4 Technology Employed

The fieldwork on site was completed by September 24, 2020. The magnetic, acoustic, and seismic remote sensing fieldwork was carried out from a 23-foot (7m) fiberglass survey vessel suitable for shoal water operations. The survey equipment employed includes the following equipment.

3.4.1 Magnetometer

Magnetic data were collected with a Geometrics 881 cesium marine magnetometer, capable of +/- 1/10 gamma resolution. A 10 Hz sampling rate by the magnetometer's towed sensor, coupled with a four-knot vessel speed, generated a magnetic sample every 0.58 feet (.01m). The magnetometer sensor was towed 80 feet (24.3m) aft from the port side of the survey vessel.

3.4.2 Side Scan Sonar

Sonar data were gathered with a Marine Sonic HDS two channel digital side-scan sonar unit with a dual frequency 600/1200kHz side-scan sensor. The sonar sensor was towed 20 feet (6m) aft from the starboard side of the survey vessel and operated at a range of 150 feet (45.7m) in either channel. This created a swath of acoustic coverage 300 feet (91m) wide on each survey lane. Marine Sonic data acquisition software was used to merge the acoustic data with real-time positioning data.

3.4.3 Sub Bottom Profiler

A 10-kHz SyQwest, Inc. StrataBox HD sub-bottom profiling system was used to collect sub-bottom data. This boom-mounted profiling system is capable of up to 100 feet (30.4m) of sediment penetration in ideal conditions and strata resolution of approximately 2.36 inches (5.9cm). The sub-bottom transducer was attached to the port side of the survey vessel's hull, amidships.

3.4.4 Bathymetry

Bathymetry data were obtained by using an Odom CV100 single beam fathometer operating at 200 kHz with the transducer mounted directly below a Leica GS18 GPS antenna to minimize offsets. The CV100 was calibrated for the localized sound velocity with a Digibar Pro sound velocity cast. Horizontally, the data is referenced to the New York State Grid (NY-LI) based on NAD83(2011). Vertically, single beam data is referenced to NAVD88 computed using the Geoid18. Quality control checks against RTK Tides were done using the United States Geological Survey's automatic tide station #01311850 in Jamaica Bay at Inwood Marina and the National Oceanic and Atmospheric Administration's automatic tide station #8531680 operating in Sandy Hook, New Jersey.

3.5 Position Keeping Equipment

The boat's horizontal and vertical positions were obtained by using a Leica GS18 GPS unit with Real-Time Kinematic (RTK) corrections coming from the NYDOT NTRIP server via a cellular internet connection. A Windows 10 laptop running Hypack 2020 interfacing the positioning, single beam and magnetometer data was used for survey acquisition and data processing. Positioning data for side-scan sonar and sub-bottom data were obtained with a Hemisphere differential GPS and all post-processing for those two data sets was achieved with their specific software programs. All magnetometer, side-scan sonar, sub-bottom, and bathymetric offsets on the vessel survey are depicted in a cutsheet of the boat's set up (Appendix I).

3.6 Survey Procedures

The onboard laptop running Hypack was used to guide the survey vessel precisely along predetermined survey lines that had been established at 100-foot (30.4m) offsets and oriented in a roughly east-west direction (Figure 13). While surveying, vessel positions were continually updated on the computer monitor to assist the vessel operator, and the X,Y data were continually logged onto all remote sensing units for post-processing and plotting. Bathymetric data were collected and contoured at one-foot intervals to provide additional remote sensing information for the evaluation of remote sensing targets (Figure 14).

Figure 13: Survey Tracks in Offshore Borrow Area B-West

Notes:
1) Lane Spacing = 100 feet
2) Thirteen (13) survey lanes were completed in a West-East orientation
3) Four corners for the survey area were provided by the U.S. Army Corps of Engineers, New York District
4) Background Grid = New York (Long Island) State Plane Coordinates, NAD83, feet

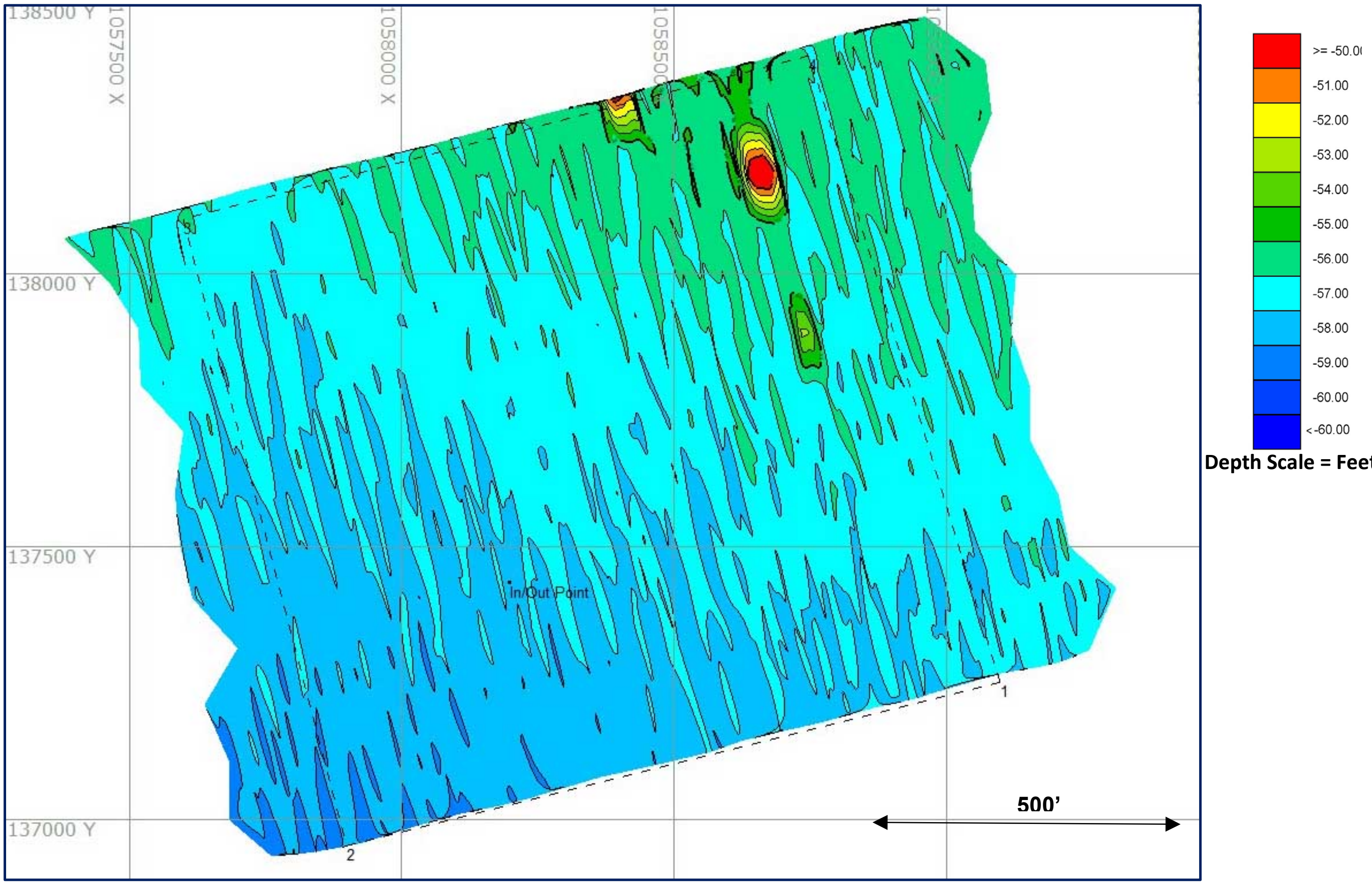


Figure 14: Bathymetric Contours of the Offshore Borrow Area B-West

Notes: 1) Depth Contour Intervals = One Foot
2) Black dashed line = APE
3) Background Grid = New York State Plane Coordinates, NAD83, feet

3.7 Data Analysis

3.7.1 Data Products - Magnetometer

The magnetometer collected data on the ambient magnetic field strength by measuring the variation in cesium electron energy states. As the sensor passed over objects containing ferrous metal, a fluctuation in the earth's magnetic field was recorded. The fluctuation was measured in nanoteslas (nT) and is proportional to the amount of ferrous metal contained in the sensed object and the distance from the sensor.

Magnetic data were edited for detailed analysis of all anomalies. During the editing process background noise spikes were removed and a magnetic contour map was created with 10-nT (or gamma) intervals for the survey area. Magnetic data editing consisted of using *Hypack's* magnetic data editing program to review raw data (of individual survey lines) and to delete any artificially induced noise or data spikes. Once all survey lines for the project area were edited, the edited data were converted to an XYZ file also using *Hypack* (easting and northing coordinates, and magnetometer data – measured in nT). Next, the XYZ files were imported into a Triangular Irregular Network (TIN) modeling program in *Hypack* that was used to contour the data in 10-nT intervals (Figure 15).

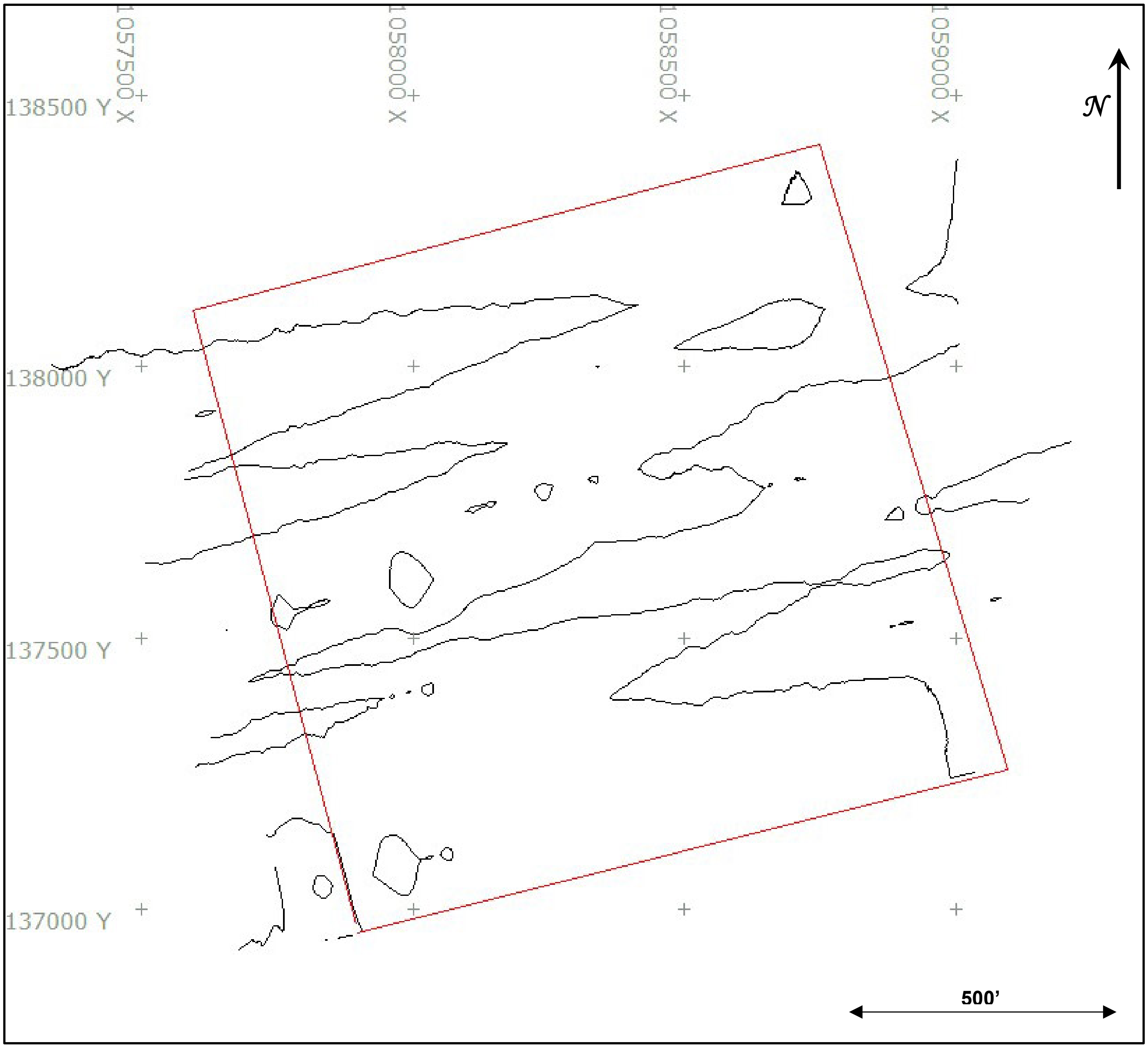


Figure 15: Magnetic Contours at 10 nT (gamma) Intervals at Offshore Borrow Area B West

Notes: 1) Contour Interval = 10 nT (gamma)
2) Red lines = APE
3) Background Grid = New York (Long Island) State Plane Coordinates, NAD83, feet

3.7.2 Data Products - Side Scan Sonar

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

Acoustic energy reflected from any bottom discontinuities (exposed pipelines, rocks, or other obstructions) is received by the set of transducers, amplified and transmitted to the survey vessel via a tow cable. The digital output from state-of-the-art sonar units is essentially analogous to a high angle oblique photograph providing detailed representations of bottom features and characteristics. Sonar allows display of positive relief (features extending above the bottom) and negative relief (such as depressions) in either light or dark opposing contrast modes on a video monitor. Examination of the images thus allows a determination of significant features and objects present on the bottom within a survey area.

Raw sonar records were inspected for potential man-made features and obstructions present on the bottom surface. Sonar data were saved in separate files for each survey lane. Individual acoustic data files were initially examined using *SeaScan* acoustic data review software to identify any unnatural or man-made features in the records. Once identified, acoustic features were described using visible length, width, and height from the bottom surface. Acoustic targets are normally defined according to their spatial extent, configuration, location, and environmental context. As a last step, edited acoustic data were merged into a geo-referenced sonar mosaic that was overlaid onto a background plan of the survey area (Figure 16). The sonar mosaic was also overlaid with the magnetic contour map of the APE (Figure 17).

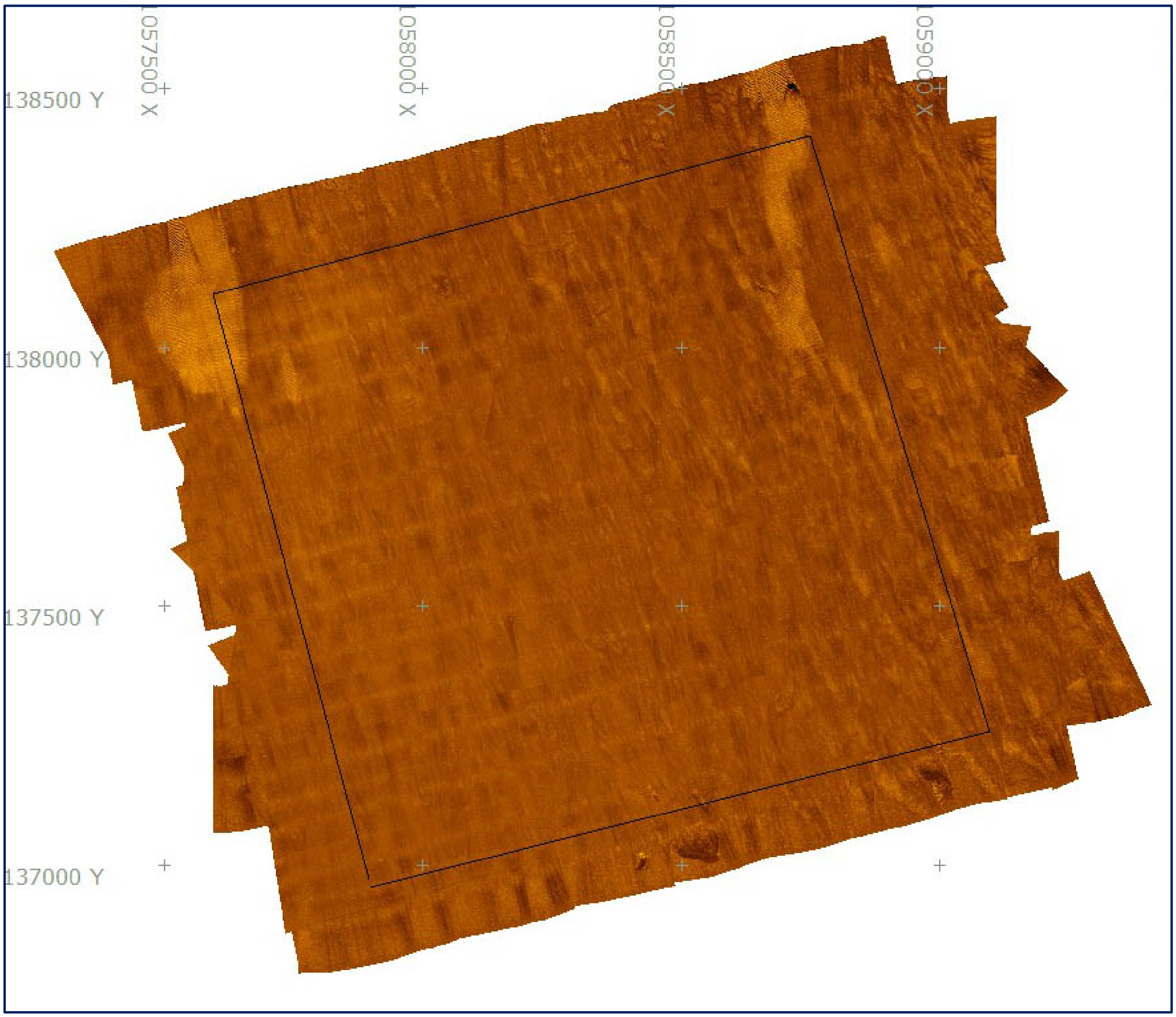


Figure 16: Sonar Mosaic of Offshore Borrow Area B-West

Notes:
1) Locations of 14 sonar targets are indicated and listed in Table 1.
2) Black lines = APE
3) Background Grid = New York (Long Island) State Plane Coordinates, NAD83, feet

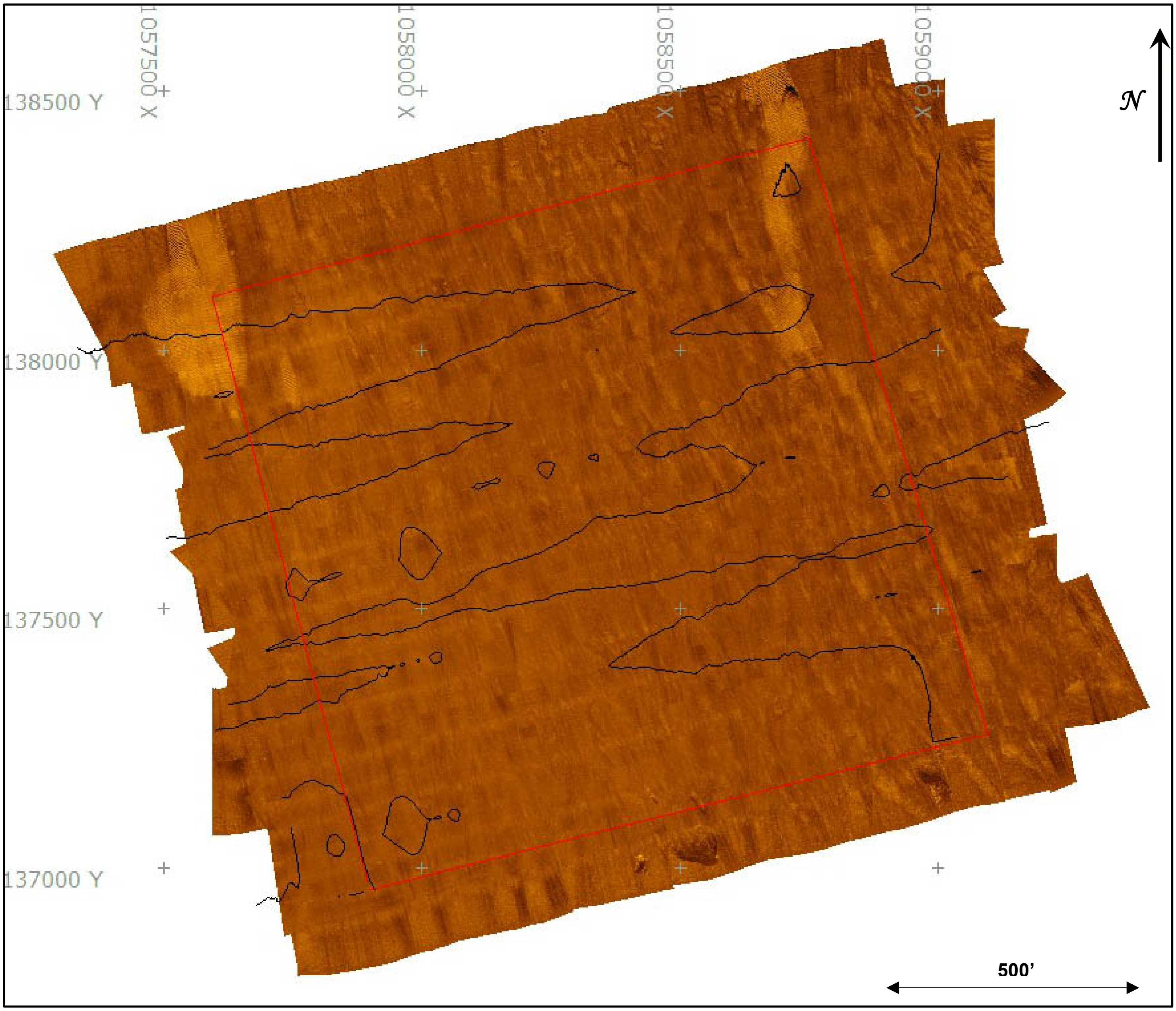


Figure 17: Sonar Mosaic and Magnetic Contours at 10 nT (gamma) Intervals at Offshore Borrow Area B West

Notes: 1) Contour Interval = 10 nT (gamma)
2) Red lines = APE
3) Background Grid = New York (Long Island) State Plane Coordinates, NAD83, feet

3.7.3 Data Products – Sub Bottom Profiler

Sub-bottom survey data utilizes reflective energy to interpret conditions below the sea floor. Reflective energy intensity depends on different densities of the sea floor and can be affected by various factors. The primary interpretation is that the denser (harder) the riverbed, the stronger the reflective signal. The reflected signal travels back through the water to the boat mounted transducer/receiver assembly that is fixed with DGPS coordinates. This data is returned to on-board computers for real-time display and digital filing. All sub-bottom data were saved in RAW formats in *Stratabox* software, Version 2.20, developed by Ocean Equipment Corporation. During post-processing sub-bottom data were converted to JPEG formats.

The quality of these records depends greatly on the presence of subsurface horizons or anomalies that reflect the acoustic energy. Differences in soil types, density, water content, gas pockets, and degree of solidification greatly influence the reflective properties of buried layers. There are several other factors that bear upon the success of sub-bottom reflective surveys. These can be grouped into three areas: external, vessel, and instrumentation limitations. All these factors make it difficult to identify individual features in the sub-bottom strata. Sub-bottom profiling acoustic data for each survey lane were reviewed to identify subsurface signatures of potential man-made structures. Representative imagery of the sub-bottom records are provided with data from two survey lanes across the APE (Figures 18 and 19).

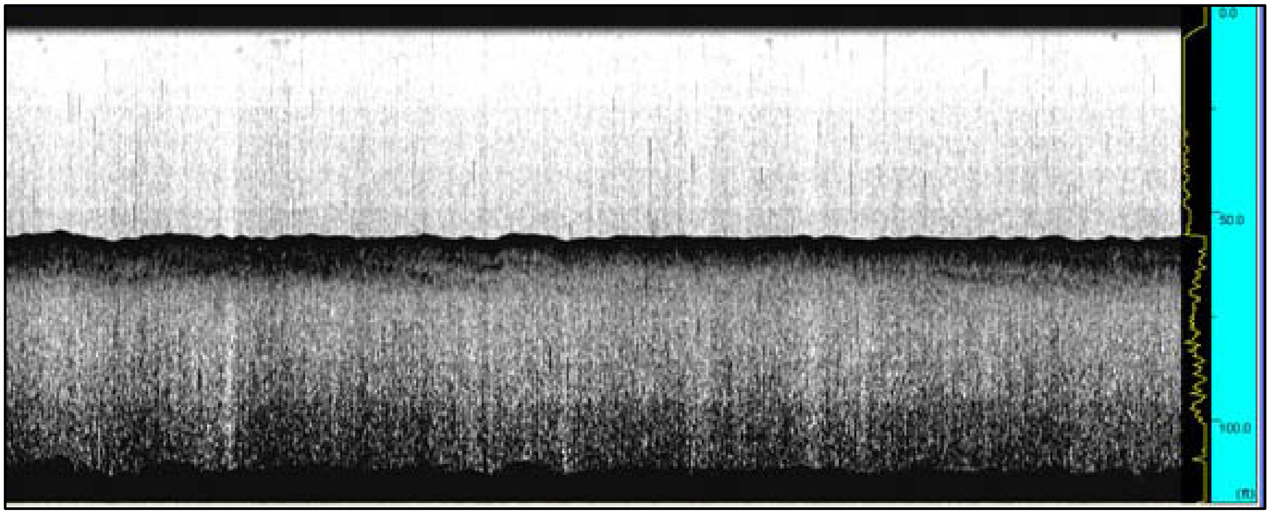


Figure 18: Representative Sub Bottom Data - Survey Lane 8

Notes: 1) File # 103538
2) Scale in Feet

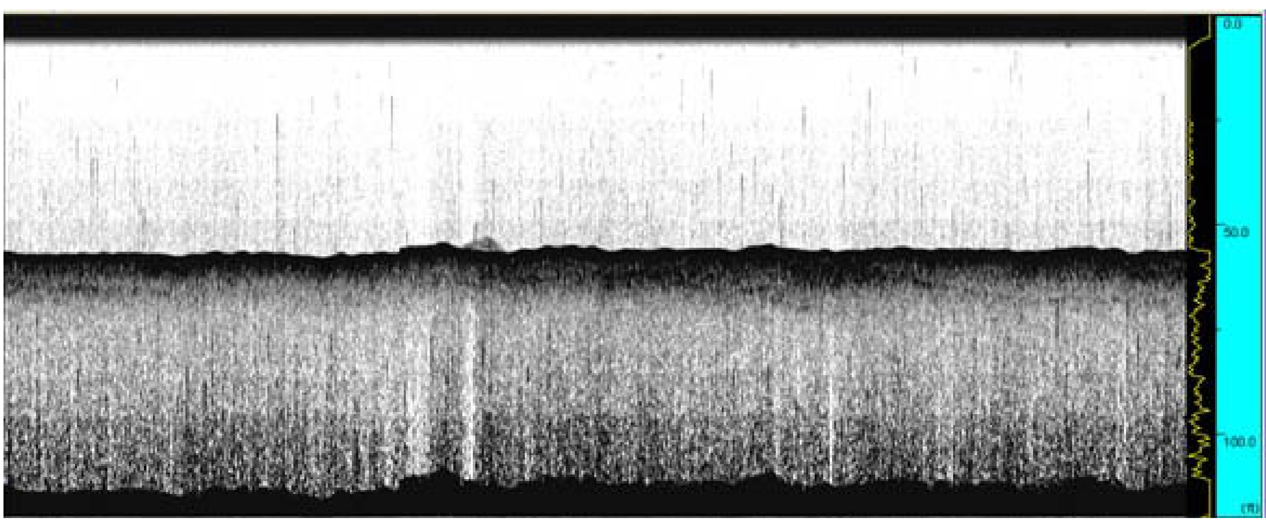


Figure 19: Representative Sub Bottom Data - Survey Lane 12

Notes: 1) File # 102325
2) Scale in Feet

3.8 Evaluation of Remote Sensing Targets

Target signatures were evaluated using the National Register of Historic Places (NRHP) criteria as a basis for the assessment. For example, although an historic object might produce a remote sensing target signature, it is unlikely that a single object (such as an historic anchor or cannon ball) has the potential to meet the criteria for nomination to the NRHP.

Target assessment was based primarily on the nature and characteristics of the acoustic and magnetic signatures. Shipwrecks – large or small – often have distinctive acoustic signatures which are characterized by geometrical features typically found only in a floating craft. Most geometrical features identified on the bottom (in open water) are manmade objects. Often an acoustic signature will have an associated magnetic signature. Generally, if the acoustic signature demonstrates geometric forms or intersecting lines with some relief above the bottom surface and have a magnetic signature of any sort; it can be categorized as a potentially significant target. Often, modern debris near docks, bridges, or an anchorage is easily identified solely based on the characteristics of its acoustic signature. However, it is more common to find material partially exposed. Frequently, these objects produce a record that obviously indicates a man-made object, but the object is impossible to identify or date. Also, in making an archaeological assessment of any sonar target, the history and modern use of the waterway must be taken into consideration. Naturally, historically active areas tend to have greater potential for submerged cultural resources. The assessment process prioritizes targets for further underwater archaeological investigations.

Magnetic target signatures alone are more difficult to assess. Without any supporting acoustic records, the type of the bottom sediments and the water currents become more important to the assessment process. A small, single-source magnetic signature has the least potential to be a significant cultural resource. Although it might represent a single historic object, this type of signature has limited potential to meet NRHP criteria.

A more complex magnetic anomaly, represented by a broad monopolar or dipolar type signature, has a greater potential to be a significant cultural resource, depending on bottom type. Shipwrecks that occur in areas where the sea floor is relatively firm tend to remain exposed and are often visible on sonar records. A magnetic anomaly that is identified in such an area and has no associated acoustic signature frequently can be discounted as being a historic shipwreck. Most likely, such an anomaly is modern debris such as wire rope, chain, discarded materials, or other ferrous material.

Soft migrating sand or mud can bury large wrecks, leaving little or no indication of their presence on the bottom surface (via sonar data). The types of magnetic signatures that a boat or ship might produce are infinite because of the large number of variables including location, position, chemical environment, other metals, vessel type, cargo, sea state, etc. These variables are what determine the characteristics of every magnetic target signature. Since shipwrecks occur in a dynamic environment, many of the variables are subject to constant change. Thus, in assessing a magnetic anomaly's potential to represent a significant cultural resource, investigators must be circumspect in their predictions.

Broad, multi-component signatures (again, depending on bottom characteristics and other factors) often have the greatest potential to represent a shipwreck. On the other hand, high-intensity, multi-component, magnetic signatures (without an accompanying acoustic signature) in areas of relatively high velocity currents can be discounted as a historic resource. Eddies created by the high-velocity currents almost always keep some portion of a wreck exposed. Generally, wire rope or some other low-profile ferrous debris produces this type of signature in these circumstances. Many types of magnetic anomalies display characteristics that are not easily interpreted. The only definitive method of determining the nature of the object creating these anomalies is by physical examination.

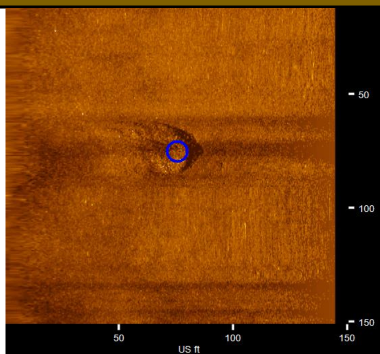
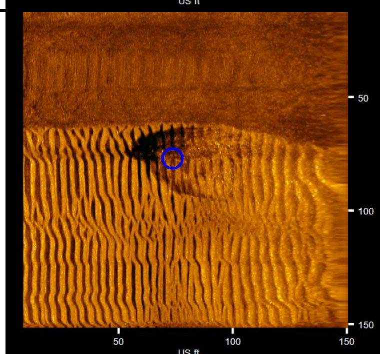
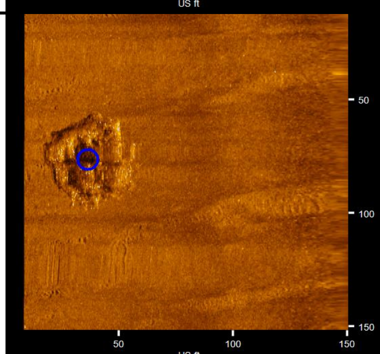
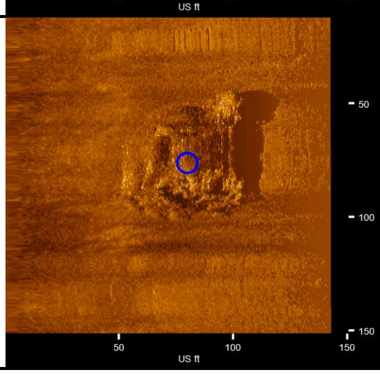
Typically, target locations with suspect cultural resource images on the sonar records coupled with associated and appropriate magnetic signatures are classified as high probability targets.

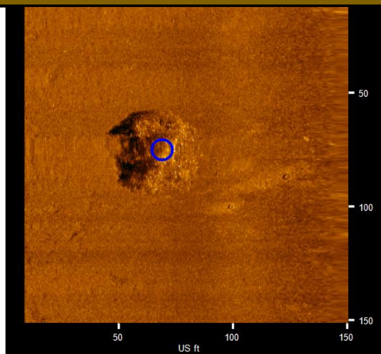
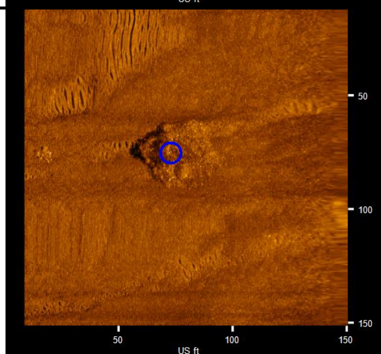
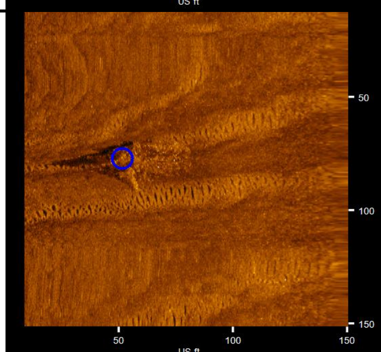
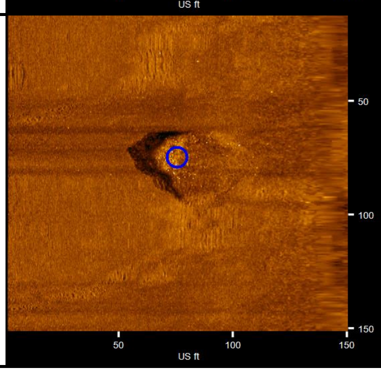
4.0 Results

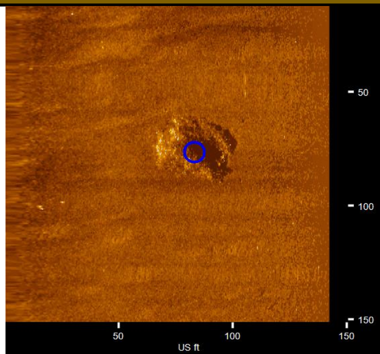
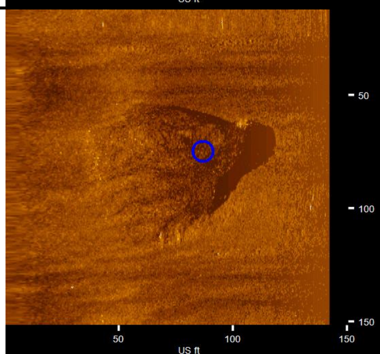
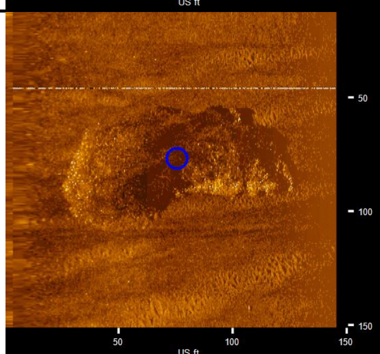
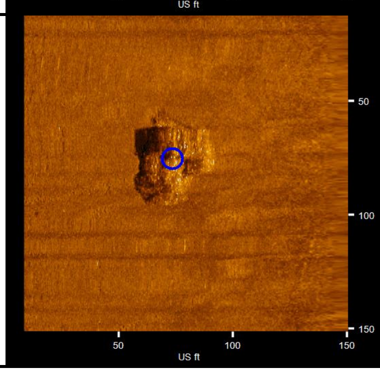
Magnetic data were contoured and plotted at 10 gamma intervals. Sonar and sub-bottom records were inspected for potential man-made features present on and beneath the bottom surface.

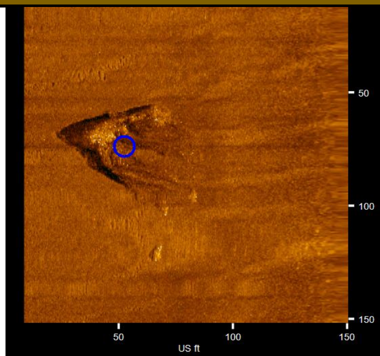
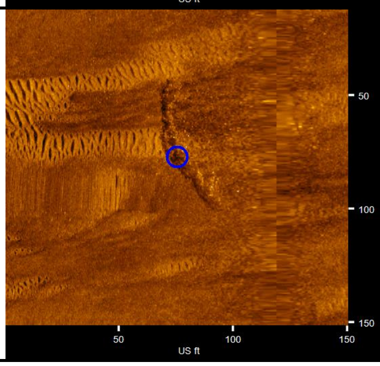
After all the remote sensing data sets were processed, reviewed, and cross-referenced a total of 14 remote sensing target locations were identified in the APE. All 14 targets were side-scan sonar targets with no associated magnetic signature. There was little magnetic variation across the APE and no sustained magnetic anomalies or magnetic targets were identified. However, none of the 14 sonar targets that were identified were considered to be suggestive of submerged cultural resources. All sonar targets appear to be natural features or formations that are isolated on an otherwise featureless bottom – except for two pockets of well-defined sand ridges/waves within the northern portion of the APE. The sonar targets vary in size and configuration; several of the targets appear to be pockets of hard bottom materials that extend above the otherwise flat sand/mud bottom sediments. Complete descriptions of the 14 sonar targets are contained in Table 3.

Table 3. Sonar Targets in Offshore Borrow Area B-West (14)

Target Image	Target Information	Characteristics
	1 ● Click Position 40° 32.72492' N 073° 44.12904' W (WGS84) (X) 1057765.13 (Y) 138097.09 (Projected Coordinates) ● Map Projection: NY83-LIF ● Acoustic Source File: F:\Sonar Data\Rockaways\Offshore\B-West\2020SEP24_0002.sds ● Line Name: 2020SEP24_0002	Dimensions and attributes ● Target Width: 19.46 US ft ● Target Height: 1.97 US ft ● Target Length: 19.51 US ft ● Mag Anomaly: No ● Description: Small mound that appears to be natural and is isolated.
	2 ● Click Position 40° 32.79095' N 073° 43.92088' W (WGS84) (X) 1058728.13 (Y) 138500.92 (Projected Coordinates) ● Map Projection: NY83-LIF ● Acoustic Source File: F:\Sonar Data\Rockaways\Offshore\B-West\2020SEP24_0002.sds ● Line Name: 2020SEP24_0002	Dimensions and attributes ● Target Width: 21.38 US ft ● Target Height: 3.12 US ft ● Target Length: 30.86 US ft ● Mag Anomaly: No ● Description: Mound that is part of a large pattern of exposed sand waves on bottom surface.
	3 ● Click Position 40° 32.69041' N 073° 44.08602' W (WGS84) (X) 1057965.06 (Y) 137888.09 (Projected Coordinates) ● Map Projection: NY83-LIF ● Acoustic Source File: F:\Sonar Data\Rockaways\Offshore\B-West\2020SEP24_0004.sds ● Line Name: 2020SEP24_0004	Dimensions and attributes ● Target Width: 32.12 US ft ● Target Height: 1.24 US ft ● Target Length: 36.94 US ft ● Mag Anomaly: No ● Description: Rounded feature that may be part of natural bottom.
	4 ● Click Position 40° 32.72704' N 073° 44.06678' W (WGS84) (X) 1058053.51 (Y) 138110.84 (Projected Coordinates) ● Map Projection: NY83-LIF ● Acoustic Source File: F:\Sonar Data\Rockaways\Offshore\B-West\2020SEP24_0004.sds ● Line Name: 2020SEP24_0004	Dimensions and attributes ● Target Width: 48.31 US ft ● Target Height: 3.64 US ft ● Target Length: 54.14 US ft ● Mag Anomaly: No ● Description: Large rounded bottom feature/formation that may be natural.

Target Image	Target Information	Characteristics
	5 ● Click Position 40° 32.61318' N 073° 44.13343' W (WGS84) (X) 1057746.88 (Y) 137418.50 (Projected Coordinates) ● Map Projection: NY83-LIF ● Acoustic Source File: F:\Sonar Data\Rockaways\Offshore\B-West\2020SEP24_0010.sds ● Line Name: 2020SEP24_0010	Dimensions and attributes ● Target Width: 24.99 US ft ● Target Height: 3.44 US ft ● Target Length: 35.46 US ft ● Mag Anomaly: No ● Description: Rounded feature/formation on the bottom that may be natural.
	6 ● Click Position 40° 32.65401' N 073° 43.92218' W (WGS84) (X) 1058724.64 (Y) 137669.38 (Projected Coordinates) ● Map Projection: NY83-LIF ● Acoustic Source File: F:\Sonar Data\Rockaways\Offshore\B-West\2020SEP24_0010.sds ● Line Name: 2020SEP24_0010	Dimensions and attributes ● Target Width: 25.46 US ft ● Target Height: 2.13 US ft ● Target Length: 31.65 US ft ● Mag Anomaly: No ● Description: Rounded feature/formation on the bottom that may be natural.
	7 ● Click Position 40° 32.66545' N 073° 43.87903' W (WGS84) (X) 1058924.33 (Y) 137739.50 (Projected Coordinates) ● Map Projection: NY83-LIF ● Acoustic Source File: F:\Sonar Data\Rockaways\Offshore\B-West\2020SEP24_0010.sds ● Line Name: 2020SEP24_0010	Dimensions and attributes ● Target Width: 15.73 US ft ● Target Height: 3.30 US ft ● Target Length: 29.21 US ft ● Mag Anomaly: No ● Description: Oblong feature/formation that may be natural.
	8 ● Click Position 40° 32.59405' N 073° 43.92778' W (WGS84) (X) 1058699.82 (Y) 137305.23 (Projected Coordinates) ● Map Projection: NY83-LIF ● Acoustic Source File: F:\Sonar Data\Rockaways\Offshore\B-West\2020SEP24_0012.sds ● Line Name: 2020SEP24_0012	Dimensions and attributes ● Target Width: 28.22 US ft ● Target Height: 4.32 US ft ● Target Length: 38.68 US ft ● Mag Anomaly: No ● Description: Rounded formation on the bottom that appears to be natural.

Target Image	Target Information	Characteristics
	9 ● Click Position 40° 32.54524' N 073° 43.98768' W (WGS84) (X) 1058423.26 (Y) 137008.02 (Projected Coordinates) ● Map Projection: NY83-LIF ● Acoustic Source File: F:\Sonar Data\Rockaways\Offshore\B-West\2020SEP24_0014.sds ● Line Name: 2020SEP24_0014	Dimensions and attributes ● Target Width: 21.14 US ft ● Target Height: 3.08 US ft ● Target Length: 28.39 US ft ● Mag Anomaly: No ● Description: Circular formation that appears to be natural.
	10 ● Click Position 40° 32.54907' N 073° 43.96269' W (WGS84) (X) 1058538.93 (Y) 137031.61 (Projected Coordinates) ● Map Projection: NY83-LIF ● Acoustic Source File: F:\Sonar Data\Rockaways\Offshore\B-West\2020SEP24_0014.sds ● Line Name: 2020SEP24_0014	Dimensions and attributes ● Target Width: 45.91 US ft ● Target Height: 4.50 US ft ● Target Length: 57.00 US ft ● Mag Anomaly: No ● Description: Hard formation extending up above the surrounding bottom sediments. Appears to be a natural formation.
	11 ● Click Position 40° 32.57088' N 073° 43.86817' W (WGS84) (X) 1058976.36 (Y) 137165.42 (Projected Coordinates) ● Map Projection: NY83-LIF ● Acoustic Source File: F:\Sonar Data\Rockaways\Offshore\B-West\2020SEP24_0014.sds ● Line Name: 2020SEP24_0014	Dimensions and attributes ● Target Width: 42.49 US ft ● Target Height: 2.40 US ft ● Target Length: 95.21 US ft ● Mag Anomaly: No ● Description: Large oblong formation on the bottom that appears to be natural.
	12 ● Click Position 40° 32.56582' N 073° 43.98386' W (WGS84) (X) 1058440.58 (Y) 137133.07 (Projected Coordinates) ● Map Projection: NY83-LIF ● Acoustic Source File: F:\Sonar Data\Rockaways\Offshore\B-West\2020SEP24_0016.sds ● Line Name: 2020SEP24_0016	Dimensions and attributes ● Target Width: 29.77 US ft ● Target Height: 0.00 US ft ● Target Length: 34.76 US ft ● Mag Anomaly: No ● Description: Rounded feature/formation on the bottom that appears to be natural.

Target Image	Target Information	Characteristics
	13 • Click Position 40° 32.56540' N 073° 43.96051' W (WGS84) (X) 1058548.76 (Y) 137130.83 (Projected Coordinates) • Map Projection: NY83-LIF • Acoustic Source File: F:\Sonar Data\Rockaways\Offshore\B-West\2020SEP24_0016.sds • Line Name: 2020SEP24_0016	Dimensions and attributes • Target Width: 28.43 US ft • Target Height: 3.62 US ft • Target Length: 39.54 US ft • Mag Anomaly: No • Description: Hard formation extending up above the surrounding bottom sediments. Appears to be a natural formation like Target 10.
	14 • Click Position 40° 32.69828' N 073° 43.92148' W (WGS84) (X) 1058727.08 (Y) 137938.21 (Projected Coordinates) • Map Projection: NY83-LIF • Acoustic Source File: F:\Sonar Data\Rockaways\Offshore\B-West\2020SEP24_0022.sds • Line Name: 2020SEP24_0022	Dimensions and attributes • Target Width: 2.09 US ft • Target Height: 1.50 US ft • Target Length: 52.79 US ft • Mag Anomaly: No • Description: A linear formation that rises slightly above the surrounding bottom surface. Appears to be a natural formation.

5.0 Summary and Recommendations

In conjunction with the District's East Rockaway Inlet to Rockaway Inlet and Jamaica Bay Integrated Hurricane Sandy General Reevaluation Project, a Phase I Underwater Archaeological Remote Sensing Investigation was performed to assess the presence or absence of potential submerged cultural resources within offshore Borrow Area B-West.

A comprehensive magnetic, acoustic, seismic, and bathymetric remote sensing survey was conducted across the 33.26 acres (13.5 hectares) APE that was located in the Atlantic Ocean, 2.5 nautical miles south/southeast of East Rockaway Inlet, Queens Borough, New York, New York.

The goal of the underwater work was to determine the presence or absence of potential submerged cultural resource sites that might be affected by the proposed sand harvesting activities within the APE. The potential range of prehistoric occupation of the survey area extends from pre-Clovis through the Late Archaic period, when sea rise inundated whatever ephemeral sites may have been present (Panamerican Consultants, Inc., 2020: 12-15). Historic background research confirms an extensive level of maritime activity off Long Island's Atlantic Coast, dating back to the 17th century. Dutch sailors colonized the region and were the first to extensively use the approaches to New York Harbor to connect their settlements with the rest of the world. Since the 17th century, the approaches to New York, including routes off the south shore of Long Island and northern New Jersey, have provided transportation arteries that fostered the subsequent economic and social development of the entire region. However, maritime activity within the offshore regions was almost exclusively transient. Vessels crossing the offshore area south of Long Island were involved with coastal trading networks linking New York with all major European ports as well as other coastal ports from Maine to Texas. Additionally, maritime traffic from New York City extended to ports in the Caribbean, Central and South America.

As a result of these historic activities offshore of Long Island's Atlantic Coast, submerged cultural resources that are associated with every phase of the region's historical development may have been deposited in Long Island's coastal waters. Historic research documented hundreds of shipwreck losses and accidents along Long Island's Atlantic Coast since the 17th century. The proposed dredging of the Offshore Borrow Area B-West may impact any potentially significant submerged cultural resources that have been deposited in the APE.

Analysis of fieldwork data confirms the presence of 14 side-scan sonar targets in the APE. All 14 locations were acoustic-only targets with no associated magnetic signatures. All sonar targets appear to be natural features or formations that are isolated on an otherwise featureless bottom. The sonar targets vary in size and configuration; several of the targets appear to be pockets of hard bottom materials that extend above the otherwise flat sand/mud bottom sediments.

In summary, inspection of the remote sensing data from the project APE identified 14 remote sensing targets; all were side-scan sonar targets. However, none of the target locations generated an associated magnetic signature and none are considered high probability targets, suggestive of submerged cultural resources.

No additional underwater archaeological investigations are recommended in the Offshore Borrow Area B-West.

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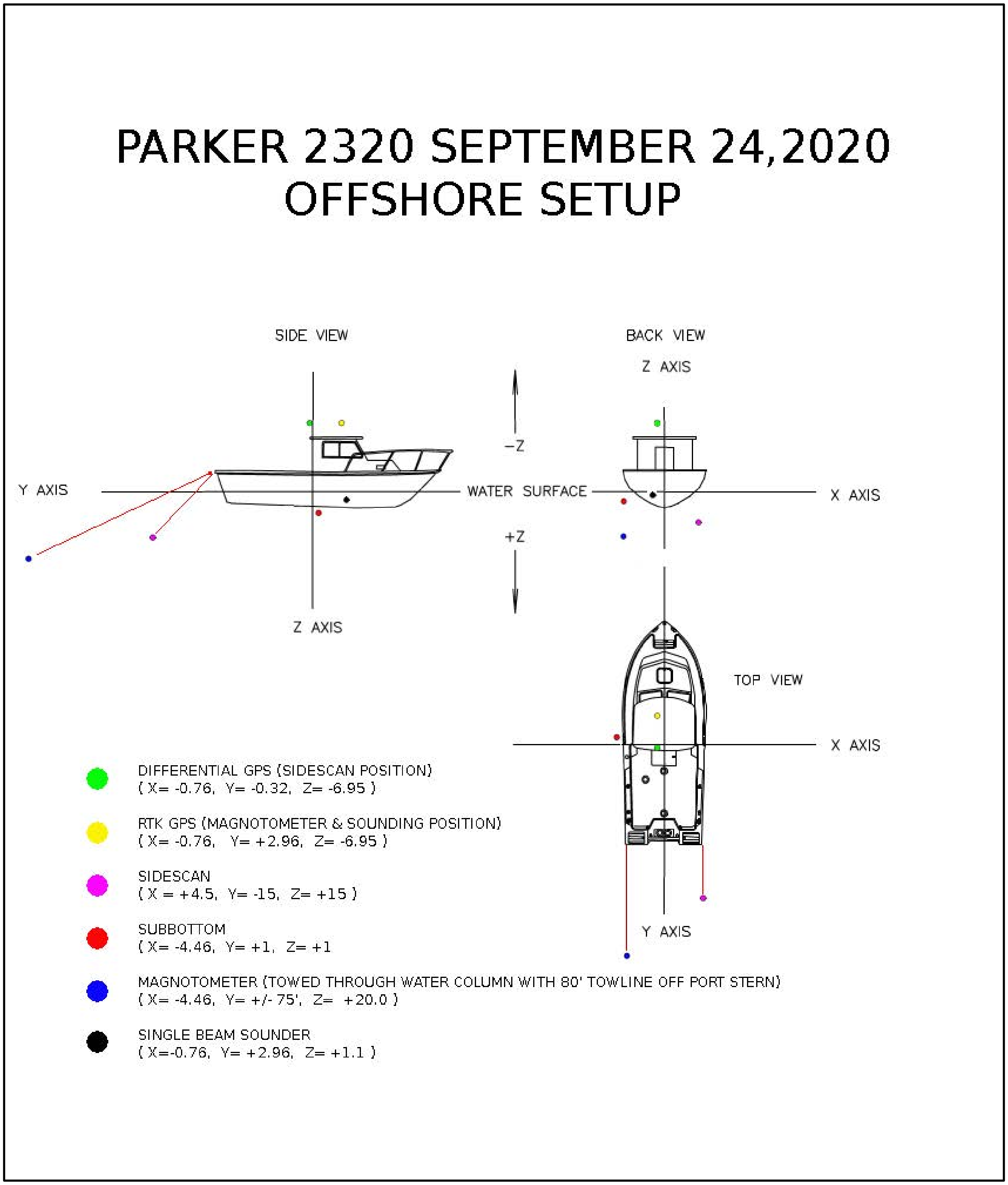
Appendix I: Vessel Setup



Cut Sheet of Offsets on Survey Boat

Appendix II: Remote Sensing Equipment Specifications

Geometrics 881 Magnetometer

GEOMETRICS

G-881 MARINE MAGNETOMETER

- *CESIUM VAPOR HIGH PERFORMANCE - Improved range and probability of detecting all sized ferrous targets*
- *LOW SYSTEM PRICE - cost effective compared to competing technologies*
- *HIGH SENSITIVITY _ 0.01 nT/_Hz RMS with the internal CM-221 Mini-Counter*
- *DIGITAL OUTPUT - COMPUTER LOGGING Use your computer with MagLog-Lite™ RS-232 logging/display software or Geometrics supplied CM-201 View utility program*
- *EASY PORTABILITY & HANDLING - no winch - single man operation, 44 lbs with 200 ft cable*
- *COMBINE TWO SYSTEMS FOR INCREASED COVERAGE - CM-221 Mini-Counter provides multi-sensor data concatenation allowing side by side coverage which maximizes detection of small targets and reduces noise*

Very high resolution Cesium Vapor performance has been incorporated into a low cost, small size no-frills system for professional surveys in shallow water. High sensitivity and sample rates of total field measurements are maintained for all applications. The well proven Cesium sensor is combined with a unique new CM-221 Larmor counter and ruggedly packaged for small boat operation. Use your computer with our MagLog-Lite™ or MagLog NT™software to log, display and print RS-232 data transmissions from the mag and GPS receiver. Model G-881 is the lowest priced - highest performance fully operational marine mag system ever offered.

The G-881 is focused for operation in small boat, shallow water surveys. Being small and lightweight (44 lbs net) it is easily deployed and operated by one man. Power may be supplied from a 24 to 30 VDC battery supply. The tow cable uses high strength Kevlar and it's length is fixed at 200 ft (61 m). The shipboard end of the tow cable is attached to a junction box for quick and simple hookup to power and output of data into any small computer. (Upon request Geometrics will provide both computer and logging software for recording and display of magnetics and GPS location.) A rugged fiber-wound fiberglass housing incorporates selective orientation of the sensor and therefore maintains operations throughout the world with small limitations as to direction of survey in Equatorial regions.

The Cesium magnetometer provides nearly the same operating sensitivity and sample rates as the larger model G-880. Utility software is supplied with each magnetometer and allows display of data and recording to hard disk. Available options include a small notebook computer with MagLog™ installed which provides superior visual presentation of magnetics and GPS data, and a dot matrix printer for real time hard copy. Additional options include: Post

acquisition analog trace plotting software MagPlot, The G-881 system is particularly well suited for the detection and mapping of all sizes of ferrous objects. This includes anchors, chains, cables, pipelines, ballast stone and other scattered shipwreck debris, munitions of all sizes, aircraft, engines and any other object with magnetic expression. Objects as small as a 5 inch screwdriver are readily detected provided that the sensor is close to the seafloor and within practical detection range.(Refer to table at right).
The design of this special marine unit is directed toward the largest number of user needs. It is not intended to meet all marine requirements such as deep tow through long cables or monitoring fish altitude. Rugged design with highest performance at lowest cost are the goals.

and Surfer for Windows for generating contour maps.

Typical Detection Range For Common Objects

Ship 1000 tons	0.5 to 1 nT at 800 ft (244 m)
Anchor 20 tons	0.8 to 1.25 nT at 400 ft (120 m)
Automobile	1 to 2 nT at 100 ft (30 m)
Light Aircraft	0.5 to 2 nT at 40 ft (12 m)
Pipeline (12 inch)	2 to 3 nT at 125 ft (38 m)
Pipeline (6 inch)	2 to 3 nT at 80 ft (24 m)
100 KG of iron	2 to 3 nT at 50 ft (15 m)
100 lbs of iron	2 to 3 nT at 30 ft (9 m)
10 lbs of iron	3 to 4 nT at 15 ft (5 m)
1 lb of iron	2 to 3 nT at 8 ft (2.5 m)
Screwdriver 5 inch	0.5 to 2 nT at 12 ft (4 m)
1000 lb bomb	4 to 5 nT at 100 ft (30 m)
500 lb bomb	0.5 to 5 nT at 50 ft (16 m)
Grenade	1 to 2 nT at 6 ft (2 m)
20 mm shell	0.5 to 2 nT at 5 ft (1.8 m)

MODEL G-881 CESIUM MARINE MAGNETOMETER SYSTEM SPECIFICATIONS

OPERATING PRINCIPLE:	Self-oscillating split-beam Cesium Vapor (non-radioactive)
OPERATING RANGE:	20,000 to 100,000 nT
OPERATING ZONES:	The earth's field vector should be at an angle greater than 6° from the sensor's equator and greater than 6° away from the sensor's long axis. Automatic hemisphere switching.
CM-221 COUNTER SENSITIVITY:	<0.01 nT/ _Hz rms. Typically 0.5 nT P-P at a 0.1 second sample rate or 0.005 nT at 1 second sample rate. Up to 10 samples per second
HEADING ERROR:	±1 nT (over entire 360° spin and tumble)
ABSOLUTE ACCURACY:	<3 nT throughout range
OUTPUT:	RS-232 at 9600 Baud
MECHANICAL:	
Sensor Fish:	Body 2.75 in. (7 cm) dia., 5.75 ft (1.75 m) long with ring fin (15 in. OD), 27 lbs. (12.3 kg) Includes Sensor and Electronics
Tow Cable:	Kevlar Reinforced multiconductor tow cable. Breaking strength 4,000 lbs, 0.47 in OD, 200 ft maximum. Weighs 17 lbs (7.7 kg) with terminations.
OPERATING TEMPERATURE:	-30°F to +122°F (-35°C to +50°C)
STORAGE TEMPERATURE:	-48°F to +158°F (-45°C to +70°C)
ALTITUDE:	Up to 30,000 ft (9,000 m)
WATER TIGHT:	O-Ring sealed for up to 200 ft (61 m) depth operation
POWER:	24 to 32 VDC, 0.75 amp at turn-on and 0.5 amp thereafter
ACCESSORIES:	
Standard:	CM-201 View Utility Software operation manual and ship case
Optional:	AC Power supply, Surfer for Windows, GPS, Computer
MagLog-Lite™ or MagLog NT™ Software:	Logs, displays and prints Mag and GPS data at 10 Hz sample rate.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE ***6/98***

GEOMETRICS, INC. 2190 Fortune Drive, San Jose, California 95131
408-954-0522 • Fax 408-954-0902 • Internet: sales@mail.geometrics.com

GEOMETRICS Europe Manor Farm Cottage, Galley Lane, Great Brickhill, Bucks, England MK179AB • 44-1525-261874 • Fax 44-1525-261867

GEOMETRICS China Laurel Industrial Co. Inc. - Beijing Office, Room 2509-2511, Full Link Plaza
#18 Chaoyangmenwai Dajie, Chaoyang District, Beijing, China 100020
10-6588-1126 (1127..1130), 10-6588-1132 • Fax 010-6588-1162

GEOMETRICS

Marine Sonic HDS Side Scan Sonar

SEA SCAN® HDS

MARINE SONIC TECHNOLOGY

The Sea Scan HDS is the Backbone of the industry in digital Side Scan Sonar. Utilized by Military, Police, and Fire & Rescue Agencies all over the world! It is extremely rugged, and built for the harshest environments...

Known as the most trusted side scan system available the Sea Scan HDS is a glutton for abuse. Used by, and made for professionals who need their equipment to work anytime, everytime, in any enviroment, for every mission.

If it's locating lost mines in the old war zones of Cambodia, conducting a recovery in the swamps of North Carolina, or locating lost ships in the great lakes from the 1800's. The HDS won't fail you.

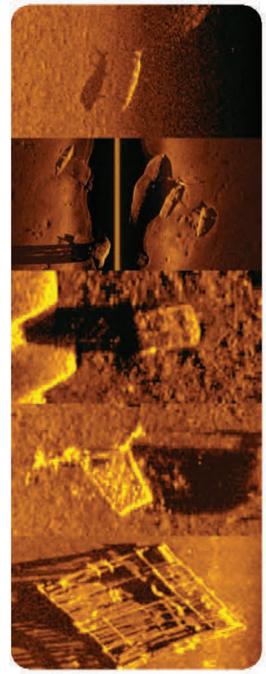
With the optional Magnetometer Integration kit you can seamlessly connect the HDS to your Marine Magnetics SeaSPY Magnetometer for dual operation.

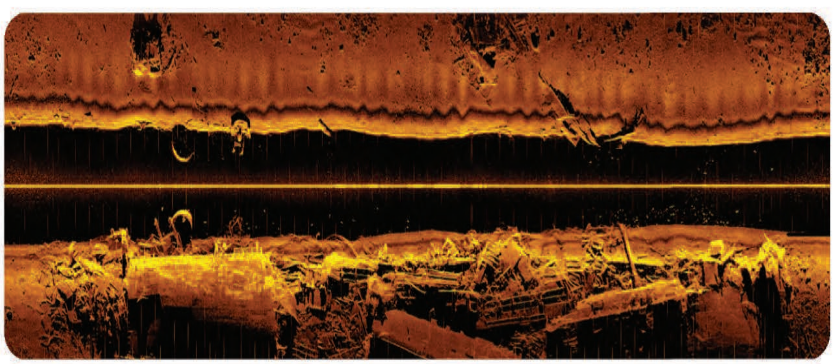
User friendly, Rugged, Field Proven, & Ready when the mission calls. Put your trust in the Sea Scan HDS digital Side Scan Sonar.

ATLAS NORTH AMERICA
A company of the ATLAS ELEKTRONIK Group

KEY FEATURES:

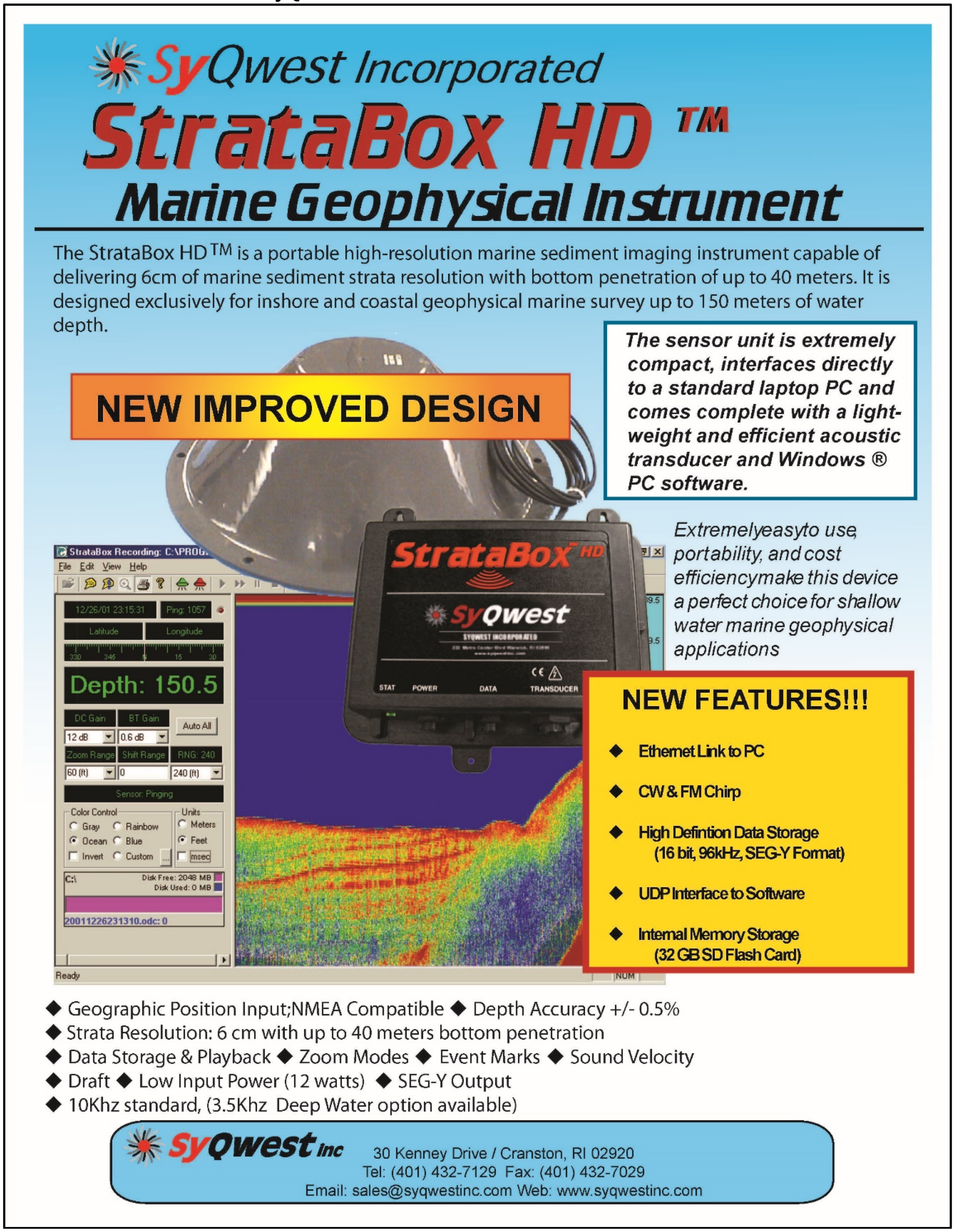
- Fully Digital
- Solid PVC Tow Body
- Enclosed Durable Fin Assembly
- Dual Frequencies, Your Choice
  300/900kHz - 600/1200kHz - 900/1800kHz
- 30m & 100m Kevlar Tow Cables
- Splash-Proof Topside Box
- Splash-Proof GPS
- Tools & Spares Kit
- Rugged Shipping & Storage containers
- 100% Made in the U.S.A





The standard Sea Scan® HDS system includes:

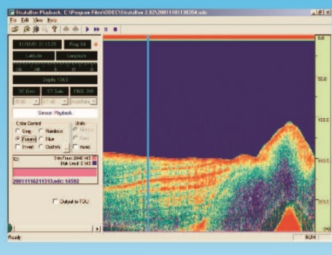
- A solid PVC 300/900, 600/1200 or 900/1800 kHz dual frequency tow fish that provides an excellent combination of long-range search capability and ultra high resolution images for the detection of small objects (additional frequencies available upon request).
- A portable splash-proof Topside Communications Unit (TCU) that connects through USB.
- 30m and 100m Kevlar tow cables (custom lengths also available).
- A tools and spares kit.
- A splash-proof USB GPS unit.
- Rugged splash-proof shipping cases for all components.
- All the software and manuals

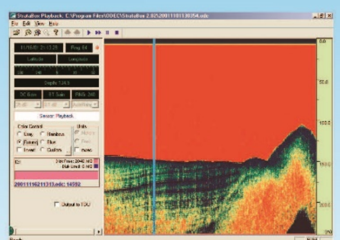

SyQwest Incorporated
StrataBox HD TM
Marine Geophysical Instrument
The StrataBox HD TM is a portable high-resolution marine sediment imaging instrument capable of delivering 6cm of marine sediment strata resolution with bottom penetration of up to 40 meters. It is designed exclusively for inshore and coastal geophysical marine survey up to 150 meters of water depth.
NEW IMPROVED DESIGN
The sensor unit is extremely compact, interfaces directly to a standard laptop PC and comes complete with a light-weight and efficient acoustic transducer and Windows ® PC software.
Extremely easy to use, portability, and cost efficiency make this device a perfect choice for shallow water marine geophysical applications
StrataBox HD
SyQwest
Depth: 150.5
NEW FEATURES!!!
◆ Ethernet Link to PC
◆ CW & FM Chirp
◆ High Defintion Data Storage (16 bit, 96kHz, SEG-Y Format)
◆ UDP Interface to Software
◆ Internal Memory Storage (32 GB SD Flash Card)
◆ Geographic Position Input;NMEA Compatible ◆ Depth Accuracy +/- 0.5%
◆ Strata Resolution: 6 cm with up to 40 meters bottom penetration
◆ Data Storage & Playback ◆ Zoom Modes ◆ Event Marks ◆ Sound Velocity
◆ Draft ◆ Low Input Power (12 watts) ◆ SEG-Y Output
◆ 10Khz standard, (3.5Khz Deep Water option available)
SyQwest Inc
30 Kenney Drive / Cranston, RI 02920
Tel: (401) 432-7129 Fax: (401) 432-7029
Email: sales@syqwestinc.com Web: www.syqwestinc.com

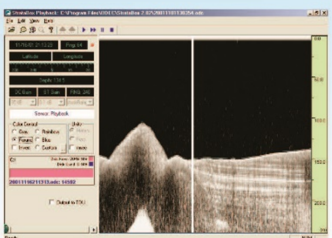
SyQwest Incorporated

StrataBox HD ™

SPECIFICATIONS

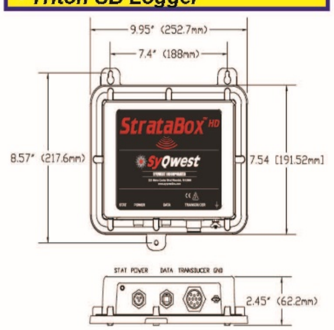






Units:	Feet or Meters
Depth Ranges:	0-15, 30, 60, 120, 240, 450 Feet. 0-5, 10, 20, 40, 80, 150 Meters. Auto-ranging Modes in all units.
Draft Offset:	0 to 30 feet (10 meters)
Manual Gates:	Shallow & Deep, (0.1 ft / 0.1mt resolution)
Shift Range:	1 foot (1meter) increments to bottom of selected range
Zoom Range:	15, 30, 60, 120, 240 feet 5, 10, 20, 40, 80 meters
Zoom Modes:	Bottom Zoom, Bottom Lock, Marker Zoom, Zoom (Playback Only)
Display:	Normal Data, Zoom Data, Selectable Color Palette
Depth Resolution:	0.1 feet (0.1 meters)
Depth Accuracy:	+/-0.5% of depth
Sound Velocity:	4600 - 5250 ft/sec (1400 - 1600 mt/sec)1 mt/sec int.
Navigation Input:	NMEA 0183, GLL, GGA, RMC, VTG, VHW, HDT. Selectable Baud Rate, RS-232 .
Data Output:	NMEA 0183; DPT, DBT, PMC; ODEC
StrataBox I/F:	Ethernet via RJ-45
Printer Output:	(Parallel Port) interface to Thermal Printers
Heave Input:	TSS1 Format, 9600 Baud Rate
Shallow Water Operation:	<2.5 meters; bottom type dependent
Transmit Rate:	Up to 10 Hz, depth and operator mode dependent.
Eventing:	Manual, Periodic, External (user selectable)
Frequency Output:	10 Khz (standard) 3.5Khz (*optional)
Data File Storage:	External- ODEC Format(8 bit, 800 pixel), SEG-Y Format envelope (16 bit, 96kHz rate), Internal-32 GB SD Flash.
Data File Playback:	Files played back and printed at Normal, Rapid Advance ,or Scroll Bar, with Pause and Zoom
Transmit Output Power:	300 Watts (pulsed), 1000 Watts capable
Input Power:	10-30 Volts DC, Nominal Power 12 watts, Reverse Polarity and Over Voltage Protected.
Dimensions:	25.4 cm (10") Length, 15.876 cm (6.25") Width, and 6.25 cm (2.5") Height. (sensor unit only)
Weight:	1.1 kg (2.4 lbs). (sensor unit only)
Environmental:	25°C to +60°C Operating Temperature (-55°C to +90°C Storage) Water Resistant to EN60529 IP65 EMC meets EN60945 Emissions,CE Compliant

Options:
- Over The Side Mount Kit
- 3.5Khz Operation
- Deep Water transducer
- TDU-850 Thermal Printer
- TDU-1200 Thermal Printer
- SonarWiz
- Hypack
- Triton SB Logger



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Email: sales@syqwestinc.com Web: www.syqwestinc.com

ver 0417

Odem CV100 Single Beam Fathometer

A Teledyne Odom Hydrographic Echo Sounder Datasheet

Teledyne Odom Hydrographic

Echotrac CV100

Single or Dual Channel Echo Sounder

Compact Survey Solution

Move into the digital age with echo sounders from Teledyne Odom Hydrographic. If your survey does not require traditional paper records, then forget about piles of hard copy – the CV-100 has eliminated all that in favor of digital imaging on a PC-based data acquisition system.

With the same technology as the popular Echotrac CV and Echotrac MKIII, including Ethernet communications, Teledyne Odom's CV100 single or dual channel sounder is ready to simplify your transition to the convenience of an all-digital system.

Photo courtesy of Teledyne Oceanscience.

PRODUCT FEATURES

- Multiple time varied gain (TVG) curves (10, 20, 30, and 40 log)
- DSP digitizer with manual filter control
- Manual or auto scale changes (phasing)
- Calibration menu with controls for transducer draft and index plus sound velocity and bar depth controls
- Rugged and waterproof (IP65)
- Help menus
- Flash memory upgradeable
- Auto Gain and Auto Power Modes for minimal operator input
- Suitable for autonomous vessels

TELEDYNE ODOM HYDROGRAPHIC
Everywhereyoulook™

A Teledyne Marine Company

A Teledyne Odom Hydrographic Echo Sounder Datasheet

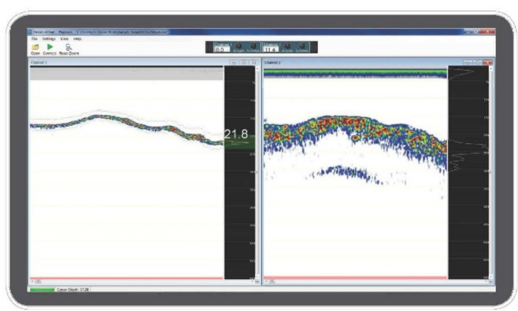
Echotrac CV100

Digital Hydrographic Echo Sounder

TECHNICAL SPECIFICATIONS

Single Channel Configuration[1]	High: 100kHz-750kHz (manual tuning in 1-kHz steps) Low: 3.5kHz-50kHz (manual tuning in 1-kHz steps) variable receiver bandwidth
Dual Channel Configuration	High: 100 kHz-340kHz Low: 24 kHz-50kHz
Resolution	0.01m, 0.1 ft.
Accuracy *(corrected for sound velocity)*	200kHz-0.01 m +/- 0.1% depth 33kHz-0.10 m +/- 0.1% depth
Output Power	Up to 300 watts RMS < 1 watt minimum
Ping Rate	Up to 20Hz in shallow water (10m) range
Depth Range	From <30cm to 600m (depending on frequency and transducer selected)
Input Power Requirement	9-32VDC < 15 watts
Weight	5kg (11lbs)
Dimensions	28cm W (11 in) x 23cm H (9 in) x 11.5cm (4.5 in) D
Mounting	Desktop or bulkhead mount (fixing hardware included)
Ports/Interface	Ethernet (LAN) plus 4 x RS232 or 3 x 232 and 1 x RS422 Inputs from external computer, motion sensor, sound velocity Outputs to external computer or remote display Output string: Odom Echotrac SBT, NMEA DBS, NMEA DBT, DESO 25 Heave Input-TSS1 or "Sounder Sentence" Echotrac Control SW - Simple Windows compatible graphical user interface Storage of full ping to seabed data in DSO format with e-Chart (easily compressed or converted to .XTF for additional processing)
Environmental	Operating 0-50°C Storage -20°-70°C
Options	Heave Sensor
Software Control & Logging Software	Windows based software included: eChart Display

1 Frequency agile in 2 bands (specify band at time of order).



eChart Software.

TELEDYNE ODOM HYDROGRAPHIC
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Teledyne Odom Hydrographic
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Leica GS18 T
Data sheet

Engaging software

The Leica GS18 T is accompanied with the revolutionary Captivate software, turning complex data into the most realistic and workable 3D models. With easy-to-use apps and familiar touch technology, all forms of measured and design data can be viewed in all dimensions. Leica Captivate spans industries and applications with little more than a simple swipe, regardless of whether you work with GNSS, total stations or both.

Seamlessly share data among all your instruments

Leica Infinity imports and combines data from your GNSS RTK rover, total station and level instruments for one final and accurate result. Processing has never been made easier when all your instruments work in tandem to produce precise and actionable information.

ACC»

Customer care only a click away

Through Active Customer Care (ACC), a global network of experienced professionals is only a click away to expertly guide you through any challenge. Eliminate delays with superior technical service, finish jobs faster and avoid costly site revisits with excellent consultancy support. Control your costs with a tailored Customer Care Package (CCP), giving you peace of mind you are covered anywhere, anytime.

PART OF HEXAGON

leica-geosystems.com

- when it has to be **right**

Leica Geosystems

Leica GS18 T

GNSS TECHNOLOGY		
Self-learning GNSS	Leica RTKplus SmartLink (worldwide correction service) SmartLink fill (worldwide correction service)	Adaptive on-the-fly satellite selection Remote precise point positioning (3 cm 2D)[1] Initial convergence to full accuracy 20 - 40 min, Re-convergence < 1 min Bridging of RTK outages up to 10 min (3 cm 2D)[1]
Leica SmartCheck	Continuous check of RTK solution	Reliability 99.99%
Signal tracking		GPS (L1, L2, L2C, L5), Glonass (L1, L2, L2C, L3[2]), BeiDou (B1, B2, B3[2]), Galileo (E1, E5a, E5b, Alt-BOC, E6[2]), QZSS (L1, L2C, L5, L6[2]), NavIC L5[3], SBAS (WAAS, EGNOS, MSAS, GAGAN), L-band
Number of channels		555 (more signals, fast acquisition, high sensitivity)
Tilt compensation	Increased measurement productivity and traceability	Calibration-free Immune to magnetic disturbances
MEASUREMENT PERFORMANCE & ACCURACY[1]		
Time for initialisation		Typically 4 s
Real-time kinematic (Compliant to ISO17123-8 standard)	Single baseline Network RTK	Hz 8 mm + 1 ppm / V 15 mm + 1 ppm Hz 8 mm + 0.5 ppm / V 15 mm + 0.5 ppm
Real-time kinematic tilt compensated	Topographic points (not for static control points)	Additional Hz pole tip uncertainty typically less than 8 mm + 0.4 mm/° tilt down to 30° tilt
Post processing	Static (phase) with long observations Static and rapid static (phase)	Hz 3 mm + 0.1 ppm / V 3.5 mm + 0.4 ppm Hz 3 mm + 0.5 ppm / V 5 mm + 0.5 ppm
Code differential	DGPS / RTCM	Typically 25 cm
COMMUNICATIONS		
Communication ports	Lemo Bluetooth®	USB and RS232 serial Bluetooth® v2.1 + EDR, class 1.5
Communication protocols	RTK data protocols NMEA output Network RTK	Leica, Leica 4G, CMR, CMR+, RTCM 2.2, 2.3, 3.0, 3.1, 3.2 MSM NMEA 0183 v4.00 and Leica proprietary VRS, FKP, iMAX, MAC (RTCM SC 104)
Built-in data links	GSM / UMTS / LTE phone modem Radio modem	Fully integrated, external antenna Fully integrated, receive and transmit, external antenna 403 - 470 MHz, 1 W output power, up to 28800 bps over air
External data links		GSM / GPRS / UMTS / LTE / CDMA and UHF / VHF modem
GENERAL		
Field controller and software	Leica Captivate software	Leica CS20 field controller, Leica CS35 tablet
User interface	Buttons and LEDs Web server	On / Off and Function button, 8 status LEDs Full status information and configuration options
Data recording	Storage Data type and recording rate	Removable SD card, 8 GB Leica GNSS raw data and RINEX data at up to 20 Hz
Power management	Internal power supply External power supply Operation time[4]	Exchangeable Li-Ion battery (2.8 Ah / 11.1 V) Nominal 12 V DC, range 10.5 - 26.4 V DC 7h receiving (Rx) data with internal radio, 5 h transmitting (Tx) data with internal radio, 6 h Rx/Tx data with internal phone modem
Weight and dimensions	Weight Dimensions	1.20 kg / 3.50 kg standard RTK rover setup on pole 173 mm x 173 mm x 108 mm
Environmental	Temperature Drop Proof against water, sand and dust Vibration Humidity Functional shock	-40 to 65°C operating, -40 to 85°C storage Withstands topple over from a 2 m survey pole onto hard surfaces IP66 / IP68 (IEC60529 / MIL STD 810G CHG-1 510.6 I / MIL STD 810G CHG-1 506.6 II / MIL STD 810G CHG-1 512.6 I) Withstands strong vibration (ISO9022-36-08 / MIL STD 810G 514.6 Cat.24) 95% (ISO9022-13-06 / ISO9022-12-04 / MIL STD 810G CHG-1 507.6 II) 40 g / 15 to 23 msec (MIL STD 810G 516.6 I)

LEICA GS18 T GNSS RTK ROVER	PERFORMANCE	UNLIMITED
SUPPORTED GNSS SYSTEMS		
Multi-frequency	✔	✔
GPS / GLONASS / Galileo / BeiDou / QZSS	✔ / • / • / • / •	✔ / ✔ / ✔ / ✔ / ✔
SUPPORTED GNSS SYSTEMS		
DGPS/RTCM, RTK Unlimited, Network RTK	✔	✔
SmartLink fill / SmartLink	• / •	✔ / •
POSITION UPDATE & DATA RECORDING		
5 Hz / 20 Hz positioning	✔ / ✔	✔ / ✔
Raw data / RINEX data logging / NMEA out	✔ / • / •	✔ / ✔ / ✔
ADDITIONAL FEATURES		
Tilt compensation	✔	✔
RTK reference station functionality	✔	✔
LTE Phone / UHF Radio (receive & transmit) modem	✔ / •	✔ / •

✔ Standard • Optional

[1] Measurement precision, accuracy, reliability and time for initialisation are dependent upon various factors including number of satellites, observation time, atmospheric conditions, multipath etc. Figures quoted assume normal to favourable conditions. A full BeiDou and Galileo constellation will further increase measurement performance and accuracy.

[2] Believe to comply, but subject to availability of BeiDou ICD and Galileo commercial service definition. Glonass L3, BeiDou B3, QZSS L6 and Galileo E6 will be provided through future firmware upgrade.

[3] Support of NavIC L5 is incorporated and will be provided through future firmware upgrade.

[4] Might vary with temperature, age of battery, transmit power of data link device.

Leica Geosystems AG
Heinrich-Wild-Strasse
9435 Heerbrugg, Switzerland
+41 71 727 31 31

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Appendix III: Key Personnel Resumes

DAVID C. BERG
First Environment, Inc.
Historic Preservation Specialist / Architectural Historian / Architectural Photographer

EDUCATION

M.A. Cert. / 1993 / Historic Preservation / University of Maryland
M.A. / 1990 / U.S. History / University of Maryland
B.A. / 1984 / History/ Wheaton College

EXPERIENCE

Mr. Berg is an Architectural Historian, Historic Preservation Specialist and Photographer with 30 years of professional experience managing historic preservation projects. He has prepared National Register of Historic Places Nomination Forms, cultural resource reports identifying historic sites and documenting National Register of Historic Places eligibility, and Section 106 reports evaluating potential effects to historic architectural properties in and adjacent to proposed project areas. Mr. Berg has prepared plans for the protection and maintenance of historic properties and has conducted mitigation efforts for buildings and structures, including written histories, the delineation of measured drawings and large-format photography in accordance with HABS-HAER-HALS standards.

RECENT PROJECT EXPERIENCE

Telecommunications Infrastructure and Tower Review, Nationwide. For Advantage Environmental Consultants, LLC of Severn, Maryland, performing Section 106 Review and coordination for FCC infrastructure and tower projects in 18 states in accordance with FCC Programmatic Agreements and state-specific requirements.

Section 110 Eligibility Assessment of Cold War Era Resources – Aberdeen Proving Ground (APG), Aberdeen, Maryland. Under contract to the Department of the Army, conducting an architectural resource survey and study (eligibility assessment) of certain Cold War-Era (CWE) facilities at APG. A total of 650 facilities are being evaluated.

Determination of Eligibility, 2100 Guilford Avenue, Baltimore, Maryland. For the Maryland Department of Motor Vehicles, prepared a formal Determination of Eligibility (DOE) for former Maryland Motor Vehicle Commission Offices at 2100 Guilford Avenue in Baltimore, Maryland. The building was found to be eligible for the National Register of Historic Places and at the State level for its role in the early history of the automobile age and the development of the Maryland Department of Transportation's Motor Vehicle Administration as well as the early history of the Maryland State Police.

HABS Level II Documentation, U.S. Coast Guard Station, Eatons Neck, New York. For the US Coast Guard, prepared photographic, graphic and written documentation of the historic Pump House at this Coast Guard facility.

HABS Level II Documentation, U.S. Naval Academy, Annapolis, Maryland. For the U.S. Naval Academy Alumni Association, prepared HABS Level II photographic, graphic and written documentation of three early twentieth century buildings at the U.S. Naval Academy in Annapolis. Buildings included the Gardener's Cottage, Stable Keepers Cottage and the Stable building.

Section 110 Eligibility Assessment of Cold War Era Resources – Joint Base McGuire-Dix-Lakehurst (JB-MDL). Under contract to the Department of the Army, Fort Worth District, Corps of Engineers, conducted an architectural resource survey and study (eligibility assessment) of certain Cold War-Era (CWE) facilities at JB-MDL in New Jersey. A total of 1,111 facilities were evaluated. Of these, 396 facilities were documented on NJ HPO survey forms either individually or combined on single form in logical groups.

J. LEE COX, M.A., RPA
Dolan Research, Inc.
Principal Investigator / Underwater Archaeologist

EDUCATION:
M.A., Maritime History/Underwater Archaeology, East Carolina University, 1985
B.A., Anthropology/Archaeology, Duke University, 1981

SUMMARY OF EXPERIENCE:
J. Lee Cox, Jr., RPA is a professional underwater archaeologist with 34 years of submerged cultural resource experience and has directed hundreds of projects in 24 different states, primarily along the East Coast. The vast majority of his experience has focused on projects in New York, New Jersey, Pennsylvania and New England waters. He has obtained a thorough knowledge of Section 110 and Section 106 of the National Historic Preservation Act as amended (NHPA) and applying the National Register of Historic Places (NRHP) eligibility criteria to submerged cultural resources. Mr. Cox has widely recognized in his field and has presented research results and findings within academic and public sector venues and numerous publications. In addition, Mr. Cox has designed and directed a wide variety of remote sensing projects to locate and identify underwater debris and utilities for commercial clients in all types of marine environments.

The Society of Professional Archaeologists certified Mr. Cox in 1988 in underwater archaeology, marine survey, and museology. He is presently a member of the Register of Professional Archaeologists (RPA) and he is also HazMat certified. Mr. Cox serves as the firm's Principal Investigator on several ID/IQ's for underwater archaeological services for Federal and state agencies, including USACE, NJ Transit, MD SHA, SC DOT and VA DOT.

RELEVANT PROJECT EXPERIENCE:

Principal Investigator, NHPA Cultural Resources Investigations USACE NY and St Louis Districts, National Register Eligibility Studies of Three Breakwaters; Rouses Point, NY and Gordons Landing and Swanton Harbor, VT. American Recovery and Reinvestment Act 2009, Section 110 Compliance, Technical Report #5, submitted to NYCOE in conjunction with John Milner Associates.

Principal Investigator, Phase II Documentation, Underwater Archaeological Resources (Phase 1 Dredge Areas), Hudson River PCBs Superfund Site, Fort Edward and Moreau, Washington and Saratoga Counties, New York. Report submitted by URS and GE to U. S Environmental Protection Agency.

Principal Investigator, Phase I Underwater Investigations, Silver Run Project, Delaware River, Salem County, NJ and New Castle County, DE. Comprehensive Phase I project incorporating historical research, and acoustic, magnetic and seismic remote sensing data sets to identify and evaluate the significance of potential submerged cultural resources within the APE of a proposed utility crossing under Delaware Bay.

Principal Investigator, Phase I Underwater Investigations for West Point Transmission Project, Hudson River, New York. A Phase I underwater archaeological evaluation of geophysical datasets collected within the proposed path of a submerged transmission line under a 77-mile long stretch of the Hudson River, between Athens, Greene County, NY and Buchanan, Westchester County NY. Work conducted for ESS Group, Inc. (ESS) on behalf of the Powerbridge LLC's West Point Transmission Project.

Principal Investigator, Phases I and II Underwater Archaeological Investigations for New Jersey Beach Renourishment Projects. Eleven shipwreck sites and two offshore borrow areas were studied in conjunction with the beach restoration projects. Work conducted for U.S. Army Corps of Engineers, Philadelphia District.

Principal Investigator, Phase II Investigation of Target M4/S5, Proposed South Terminal Marine Infrastructure Park New Bedford, Massachusetts. The Phase II investigation included two principal components: additional underwater archeological investigation to collect more information on Target M4/S5, and documentary research to assist in confirming the identity the wreck as the *Thomas H. Lawrence*, a three-masted schooner constructed in Boston in 1891. Data collected from the underwater investigation and through historical research was used to evaluate the significance of the wreck in terms of the National Register of Historic Places eligibility criteria (36 CFR 60.4).

Paul Willard Gates. MA, MS, Registered Professional Archaeologist #10331

Phone: 717-368-1742
Email: pwgates84@gmail.com, paulg@lcmm.org

Education:

MA Maritime Studies, East Carolina University, Greenville, North Carolina, December 2019.
Thesis: *What Lies Beneath at the Pine Street Barge Canal Breakwater Ship Graveyard: Site Formation Processes as a Document of Change in Burlington, Vermont (C. 1820-1960).*
MS Historic Preservation. University of Vermont, Burlington, Vermont, December 2015.
BA History, University of Vermont, Burlington, Vermont, December 2007.

Professional Experience:

Lake Champlain Maritime Museum
Project Manager, July 2019 - present.
Conservation Technician and Archaeological Diver, May 2012 - August 2016.
Volunteer in Conservation Lab, September 2008 - May 2012.
Intern, May 2008 - August 2008.
East Carolina University, History Department
Graduate Assistant to Dr. Nathan Richards, August 2017 - December 2017.
Graduate Assistant to Dr. Donald Parkerson, January 2017 - May 2017.

Selected Projects:

- *Project Manager*, Historic Context for New York State Canal Corporation (NYSCC) Vessels to Aid in the Determination of Historic Significance. Lake Champlain Maritime Museum. Vergennes, Vermont. July 2019 – Present.
- *Principal Investigator*, Thesis Research and Fieldwork on the Pine Street Barge Canal Breakwater Ship Graveyard. Burlington, Vermont. January 2017 - October 2019.
- *Archaeological Diver*, Basin Harbor Shipwreck Underwater Archaeology Field School. Lake Champlain Maritime Museum. Vergennes, Vermont. May - June 2018.
- *Archaeological Technician and Conservator*, Pappy's Lane Wreck in Pamlico Sound, Outer Banks, North Carolina. East Carolina University Maritime Studies Program Fall Field School August 2017 - January 2018.
- *Graduate Student*, Morgan's Island Wreck, East Carolina University Maritime Studies Program Summer Field School, Bermuda. May 2017 - June 2017.

Selected Writings and Publications:

2020 Gates, Paul Willard. **Hudson River, New York Barrel Buoy Conservation Project.** New York State Museum. In - process

2019 Gates, Paul Willard, Cherilyn Gilligan, Christopher R. Sabick. **Historic Context for New York State Canal Corporation (NYSCC) Vessels to Aid in the Determination of Historic Significance.** New York State Parks, Recreation, and Historic Preservation. In - process.

2019 Gates, Paul Willard. ***What Lies Beneath at the Pine Street Barge Canal Breakwater Ship Graveyard: Site Formation Processes as a Document of Change in Burlington, Vermont (C. 1820-1960).*** Master's Thesis, submitted to East Carolina University Graduate School.

2018 Gates, Paul Willard, and George Huss. **Fall Field School in Outer Banks.** Published in *Stem to Stern* Volume 34, Newsletter for East Carolina University Maritime Studies Program.

2017 Sabick, Christopher R. and Paul Willard Gates, **Underwater Archaeological Resource Assessment Carried Out In Support Of The Tier II Boating Infrastructure Grant Project, Burlington Harbor, Chittenden County, Vermont.** Submitted to City of Burlington Parks, Recreation and Waterfront.

CHERILYN GILLIGAN

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PROFILE

Ms. Gilligan is an archaeologist with more than 10 years of experience in the field and lab. She has a working knowledge of the Section 106 process as well as the Federal Regulations for curation standards and practices. Her training in underwater photogrammetric technique is helping the Lake Champlain Maritime Museum to produce new site models of the Lake Champlain Underwater Historic Preserve. These efforts will help make our local historic resources more accessible to local communities and beyond.

EDUCATION:

M.A./ Applied Archaeology, Indiana University of Pennsylvania, 2017

B.A./ Anthropology, Minor in Plant and Soil Science, University of Vermont, 2008

EXPERIENCE:

Lake Champlain Maritime Museum — **2010 to Present**
Staff Archaeologist

- CRM project management, research, and technical report writing.
- Management duties for writing grant proposals and fulfillment of agreements.
- Field supervisor for underwater and land excavations.
- Annual presentations for regional conferences on recent work.
- Data capture, processing, and production of photogrammetric site and artifact models.
- Advanced SCUBA Certification and training in underwater archaeological techniques.
- Cleaning, identifying, and cataloging artifacts according to Vermont curation guidelines.
- Conservation of a range of archaeological materials.

Navarro & Wright Consulting Engineers — **2015-2016**
Archaeological Field Technician

A.D. Marble & Company — **2015**
Archaeological Field Technician

AECOM — **2015**
Archaeological Field Technician

McCormick Taylor — **2015**
Archaeological Field Technician

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References Available Upon Request

Recent Publications:

Gates, Paul W., Cherilyn A. Gilligan, Christopher R. Sabick. Lake Champlain Maritime Museum. *Historic Context for New York State Canal Corporation (NYSCC) Vessels to Aid in the Determination of Historic Significance*. Vergennes, Vermont: New York State Canal Corporation, 2020, Pending.

Gilligan, Cherilyn A., Christopher R. Sabick, Patricia N. Reid. Lake Champlain Maritime Museum. *Document Review and Archaeological Assessment of Selected Areas from the Revolutionary War and War of 1812, Plattsburgh, New York.* Vergennes, Vermont: City of Plattsburgh, American Battlefield Protection Program, National Park Service, 2019.

Sabick, Christopher R., Cherilyn A. Gilligan. Lake Champlain Maritime Museum. Phase 1B Underwater Archaeological Assessment and Inventory, Cohoes, Albany County, New York. Vergennes, Vermont: EPA, 2020, Pending.

Sabick, Christopher R., Cherilyn A. Gilligan. Lake Champlain Maritime Museum. *Phase I Underwater Archaeological Investigation for Proposed Crosslake Fibre Project in U.S. Waters of Lake Ontario from the U.S. – Canadian International Border to the Town of Wilson, Niagara County, New York*. Vergennes, Vermont: Ecology & Environment, Inc., March 2018.

Sabick, Christopher R., Sarah L. Tichonuk, and Cherilyn A. Gilligan. Lake Champlain Maritime Museum. Phase 3 Underwater *Archaeological Documentation of Anomaly 13 (A13), Subsite of the Onondaga Lake Superfund Site, Onondaga County, New York.* Vergennes, Vermont: Honeywell, Parsons, November 10, 2016.

Recent Presentations:

Gilligan, Cherilyn A. "Moravian Ethnic Diversity: An Archival and Faunal Analysis of Moravian Mission Towns in Colonial Ohio." Paper presented at Society for Historical Archaeology, Saint Charles, Missouri, January 2019.

Gilligan, Cherilyn A. "Battle of Plattsburgh 2019 Research Highlights: Imagining the Common Soldier's Experience." Paper presented at Battle of Plattsburgh Event, Plattsburgh, New York, September 2019.

Gilligan, Cherilyn A. "Salt horse, salt horse, what brought you here?": A look at Shipboard Diet Among the King's Shipyard." Paper presented at Society for Historical Archaeology, Boston, Massachusetts, January 2019.

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Education:

MA Anthropology, Texas A&M University, College Station, Texas, 2004.
Thesis: *His Majesty's Hired Transport Schooner* Nancy
BA Anthropology and History, Ball State University, Muncie, Indiana, 1995.

Professional Experience:

Lake Champlain Maritime Museum
Director of Research and Archaeology, March 2014-present
Interim Archaeological Director, September 2013 – March 2014
Director of Conservation, May 2000 – August 2013
Archaeological Conservator, June 1999 - May 2000

Selected Projects:

- Director, Matton Shipyard Archeological Inventory. October 2019-present
- Co-Director, Kings Shipyard Survey, Ticonderoga New York. May 2019-present
- Principal Investigator, Basin Harbor Shipwreck Underwater Archaeology Field School. May-June 2018
- Principal Investigator, Phase III Investigation of Wreck Site A13, Onondaga Lake, NY. 2014-2016
- Archaeological Director, Sloop Island Canal Boat 3D Sonar Documentation Project. July 2012-prestent
- Archaeological Diver, Onondaga Lake Cultural Resources Survey 2010-present
- Archaeological Diver, Hudson River PCB Superfund Clean-up. 2009-present
- Archaeological Diver and Conservator, Sloop Island Canal Boat Documentation Project. 2002-2003

Selected Publications:

2019 Sabick, Christopher R., Cherilyn Gilligan. **Matton Shipyard Archaeological Inventory, Cohoes, Albany County, New York**. In-process.

2018 Sabick, Christopher R, Cherilyn Gilligan. **Phase I Underwater Archaeological Investigation for Proposed Crosslake Fibre Project in U.S. Waters of Lake Ontario from the U.S.-Canadian International Border to the Town of Wilson, Niagara County, New York.** Submitted to New York SHPOs office.

2017 Sabick, Christopher R. and Paul Gates, **Underwater Archaeological Resource Assessment Carried Out In Support Of The Tier II Boating Infrastructure Grant Project, Burlington Harbor, Chittenden County, Vermont**. Submitted to City of Burlington Parks, Recreation and Waterfront.

2016 Sabick, Christopher R., Sarah Lyman, Cherilyn Gilligan. **Phase III Underwater Archaeological Documentation of Anomaly (A13)**, **Subsite of the Onondaga Lake Superfund Site, Onondaga County, New York**. Submitted to New York SHPOs office.

2015 Sabick, Christopher R., Paul W. Gates. **Underwater Archaeological Resource Assessment for the North Hero-Grand Isle BFH 028-1(26) Bridge Rehabilitation Project**, **Grand Isle County, Vermont**. Submitted to Vermont Division of Historic Preservation and Hartgen Archaeological Associates.

2013 Sabick, Christopher R. **His Majesties' Royal Transport Schooner *Nancy*: History and Construction**. *Coffins of the Brave: The Archaeology of War of 1812 Shipwrecks.* Texas A&M University Press.

2012 Gates, Paul, Adam Kane, Christopher R. Sabick. **Fort Edward Canal Infrastructure Survey**. Submitted to USEPA Region 1.

February 2021

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