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Contract No. DACW51-97-D-0009
Task Number 0062

U.S. Army
Corps of Engineers
New York District

REMOTE SENSING SURVEY IN CONNECTION WITH THE NEW YORK AND NEW JERSEY HARBOR NAVIGATION STUDY UPPER AND LOWER BAY PORT OF NEW YORK AND NEW JERSEY KINGS, QUEENS, NEW YORK AND RICHMOND COUNTIES, NEW YORK ESSEX, HUDSON, MONMOUTH AND UNION COUNTIES, NEW JERSEY

FINAL REPORT

December 2002

Panamerican Consultants, Inc.
15 South Idlewild Street
Memphis, Tennessee 38104

PREPARED FOR:

U.S. Army Corps of Engineers
New York District
Environmental Analysis Section
Jacob K. Javits Federal Building
26 Federal Plaza
New York, New York 10278-0090

UNDER SUBCONTRACT TO:

Barry A. Vittor and Associates, Inc.
8060 Cottage Hill Road
Mobile, Alabama 36695

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Andrew D.W. Lydecker and Stephen R. James, Jr.

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ABSTRACT

From August 6–28, 2001, archaeologists with Panamerican Consultants, Inc. (Panamerican) of Memphis, Tennessee conducted archaeological investigations in selected areas of New York and New Jersey Harbor. Performed under subcontract to Barry A. Vittor and Associates, Inc. of Mobile, Alabama, this investigation is part of the New York and New Jersey Harbor Navigation Study Upper and Lower Bay Port of New York and New Jersey, Contract Number DACW51-97-D-0009, Task Number 0062. The purpose of this investigation was threefold: 1) to conduct a remote-sensing survey of selected areas to determine the presence or absence of significant submerged cultural resources, 2) to conduct a cultural resources evaluation of the South Elizabeth Channel, and 3) to located submerged cable in a cable crossing area in the Verazzano Narrows. The project was comprised of a review of previous cultural resources reports and an intensive remote-sensing survey of the project area.

Of the 93 magnetic anomalies and 24 sidescan targets recorded during the remote-sensing survey, 28 anomalies and 11 sidescan targets have signal characteristics indicative of potentially significant cultural resources. It is recommended that the source areas for these targets be avoided during the dredging operations. If avoidance is not possible, the anomalies identified as potential shipwreck sites should be archaeologically investigated prior to dredging operations to determine their historic significance, including, if required, diver investigation and NRHP assessment. The remaining anomalies may represent modern debris typically found in an active navigation area, and as such should be treated with caution.

A cultural resources evaluation of the South Elizabeth Channel was also conducted. This evaluation included an archival review and a low water visual survey. No significant or potentially significant cultural resources were discovered in the project area.

A remote-sensing survey using a magnetometer, sidescan sonar, and sub-bottom profiler was conducted in a cable crossing area in Ambrose Channel south of the Verazzano Narrows. This survey failed to determine with confidence the location of any buried cable in the area.

ACKNOWLEDGMENTS

The successful completion of this project is the direct result of the input and hard work of numerous individuals. The authors would first like to thank the U.S. Army Corps of Engineers, New York District, and specifically Ms. Lynn Rakos for allowing Panamerican the opportunity to conduct this investigation. We would also like to extend our gratitude to Barry Vittor and Associates, Inc. under whose contract this project was conducted, and to Mr. Carl Way who administered the contract for the firm.

The authors would also like to thank the archaeological survey crew who partook in this investigation. Many thanks to Captain Paul Hepler and Ruth Hepler of the *Venture III* who assisted the Panamerican crew during the project. The Heplers' knowledge of area waters and boat handling experience was truly impressive, making our job that much easier.

In-house Panamerican personnel who must be thanked for their assistance with this report production include Kelly Blount, report editor and Kate Gilow, office manager.

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1. INTRODUCTION

From August 6–29, 2001, Panamerican Consultants, Inc. (Panamerican) of Memphis, Tennessee conducted an underwater archaeological investigation for Barry A. Vittor and Associates, Inc. This investigation is part of the New York and New Jersey Harbor Navigation Study Upper and Lower Bay Port of New York and New Jersey, conducted under contract number DACW51-97-D-0009, Task Number 0062. It was performed in accordance with Section 106 of the National Historic Preservation Act of 1966, as amended through 1992, and the Advisory Council on Historic Preservation Guidelines for the Protection of Cultural and Historic Properties (36 CFR Part 800). The purpose of this investigation was threefold: 1) to conduct a remote-sensing survey of selected areas to determine the presence or absence of significant submerged cultural resources, 2) to conduct a cultural resources evaluation of the South Elizabeth Channel, and 3) to located a submerged cable in a cable crossing area in the Verrazano Narrows. The results of the South Elizabeth Channel evaluation are included in a separate letter report, and are included as an appendix to this report.

The current project includes the deepening and widening of numerous channels in the Port of New York and New Jersey. (Figure 1). The survey area consisted of an area extending 100 feet past each edge of the channels, which includes Ambrose, Anchorage (west side only), Kill Van Kull, Arthur Kill to Howland Hook Berth, Newark Bay and South Elizabeth Channels. Areas surveyed in Newark Bay Channel included the east side to the northern edge of the Port Newark Channel, the west side between Kill Van Kull and South Elizabeth Channel, and the east side between Port Elizabeth and Port Newark Channels (to 250 feet). A dredged pit in the area of Robbins Reef and the intersection of Newark Bay and Kill Van Kull Channels were also included. Finally, a cable crossing area in The Narrows was surveyed using magnetometer, sidescan sonar, and subbbottom profiler to locate any buried cables. Water depths ranged from two to 40 feet.

The project area was surveyed using a magnetometer, sidescan sonar, satellite positioning, and subbottom profiler (in selected parts only). Certain areas were not surveyed due to a number of reasons, including shallow water, obstructions, and unsafe conditions. Preliminary analysis revealed 28 magnetic anomalies and 11 sidescan targets that met established criteria for recommendation of additional investigation. It is recommended that the 39 located targets be avoided. If avoidance is not possible, the course of action should be as follows: (1) refinement and careful delineation with appropriate remote-sensing instruments; (2) specific identification through diver/archaeologist investigation; and (3) evaluation by a maritime archaeologist for potential cultural significance and possible further action.

The survey of the cable crossing area with sidescan sonar, magnetometer, and sub-bottom profiler failed to locate any cables, buried or exposed.

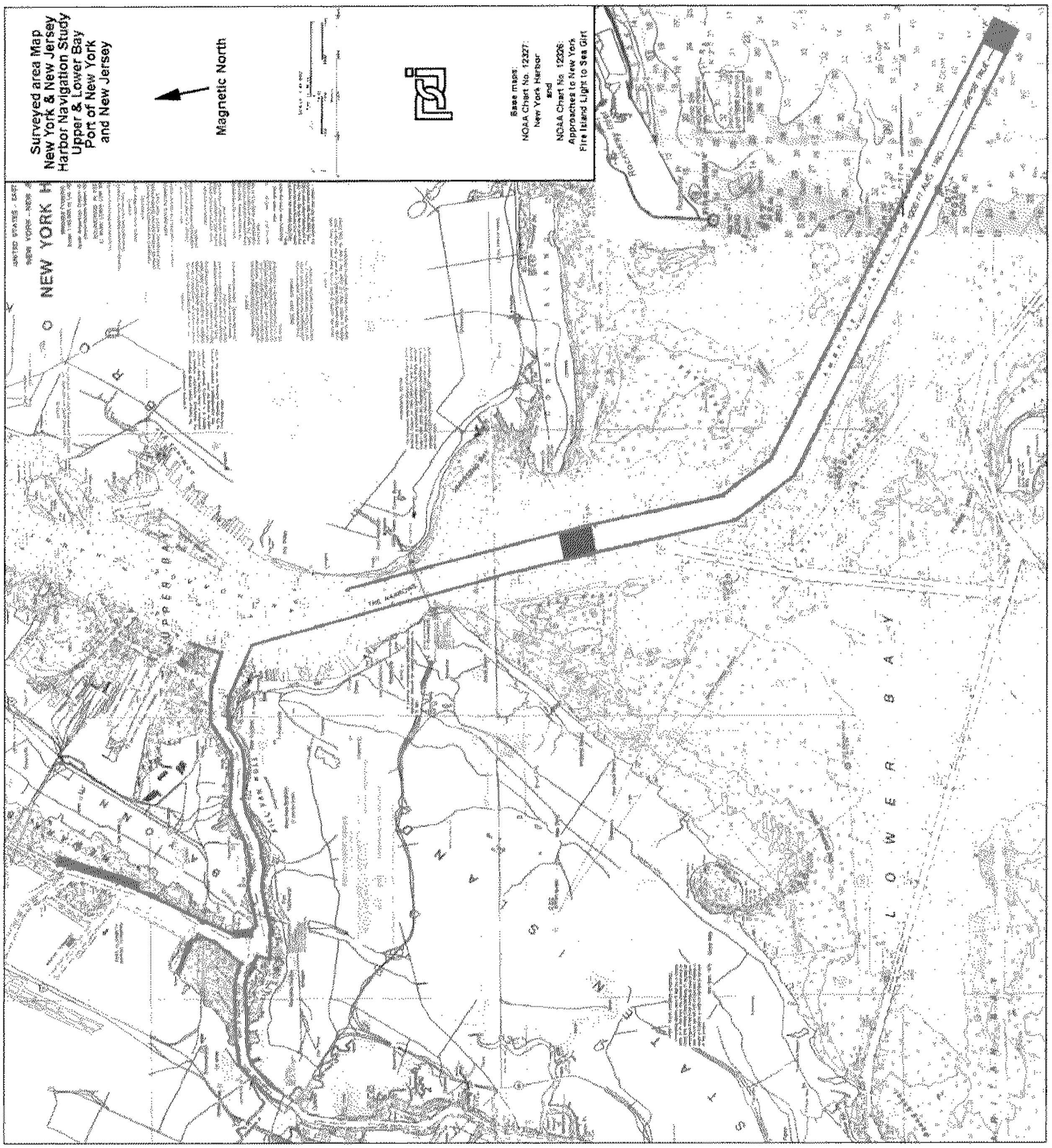

Figure 1. Location of area surveyed; section shaded in blue represents the cable crossing area (base map: NOAA navigation chart Nos. 12327: New York Harbor, and 12326: Approaches to New York Fire Island Light to Sea Girt).

2. ENVIRONMENTAL SETTING

GEOLOGY AND SOILS

The project area rests within the Piedmont Plateau of the Appalachian province, the southern and eastern boundaries section of the Coastal Plain province of the Atlantic slope (Figure 2). The Atlantic Coastal Plain, "a sequence of strata lapping over the margins of the continent," extends from the north shore at Long Island to Florida along the Atlantic Ocean and westward toward the Piedmont (Strahler and Strahler 1973:203). These coastal sediments (exposed sea bottom) consist of sand, clay, and marl layers (Schuberth 1968). The plain has slopes less than five to six feet per mile, though steeper slopes occur inland (Kummel and Lewis 1940).

Bedrock geology underlying the project area consists primarily of widely exposed sedimentary red shales, sandstone, and siltstone up to 10,000 feet thick (Van Houten 1969). The formation (Triassic period Brunswick) underlies the lower Raritan River and the Arthur Kill along the edge of the Piedmont Plateau (Schuberth 1968; COE 1979). As stated in Raber et al. (1995a), much of the Arthur Kill's bedrock is some 30 feet below mean sea level.

The surface geology of Staten Island is generally composed of landform and glacial deposits (ground moraine, terminal moraine, and outwash sediment) left by the Wisconsin ice sheet some 55,000 to 10,000 years ago (Hershkowitz et al. 1985). Glaciers in the vicinity of New York City retreated some 17,000 to 15,000 years ago. In their wake, glacial scarring left diverse microenvironments, i.e., estuaries, bogs, marshlands (fresh and salt water), uplands, and midslope zones.

During this era, pro-glacial Lake Hackensack "deposited a mixture of clay, silts, sands and gravel on western Staten Island" (Berger 1987:4). As the lake drained (13,000 B.P.) a stream cut through sediments to form the Arthur Kill Valley (Silver 1984). Early occupation of the area probably occurred around 12,000 B.P.

Sea levels rose to some 30 feet below its present level by 5,000 B.P. With rising sea levels, the Arthur Kill was an intermittent freshwater stream. The stream, despite its steep valley locale, did not prohibit eastern or western human passage (Silver 1984). Rising sea levels continued to some 14 feet below present levels by 2,000 B.P. The western sections of the Island shifted from an upland and inland grass, oak, and pine forest to a coastal lowland zone (Silver 1984).

BEDROCK GEOLOGY

Staten Island's basement rock is early Paleozoic Wissachickon or Manhattan formation metamorphic gneiss and schist, "...one of the few places in New York City where metamorphic, igneous, and sedimentary rocks occur together in a relatively small area" (Okulewicz 1990:1). During the Richmond Water Tunnel excavation between Staten Island and Brooklyn in the 1960s, a 1,000-foot shaft sunk in Tompkinsville encountered Manhattan schist, Fordham gneiss, and Inwood marble, along with granite intrusions (Okulewicz 1990).

The Fordham gneiss is a metamorphic rock derived from either ancient greywacke sandstone or rhyolitic volcanic ash, dated approximately 575 million years old (Okulewicz 1990). It forms the basement upon which all other overlying rocks in New York City are found.

This group of bedrock, collectively known as the New York City Group, includes metamorphic Manhattan schist, an initial deposition of sedimentary black shale, and a 435-million-year-old marine basin from the Cambrian period of the Paleozoic era (Okulewicz 1990). Manhattan schist is one of several schist members, each distinctive in mineralogy and texture.

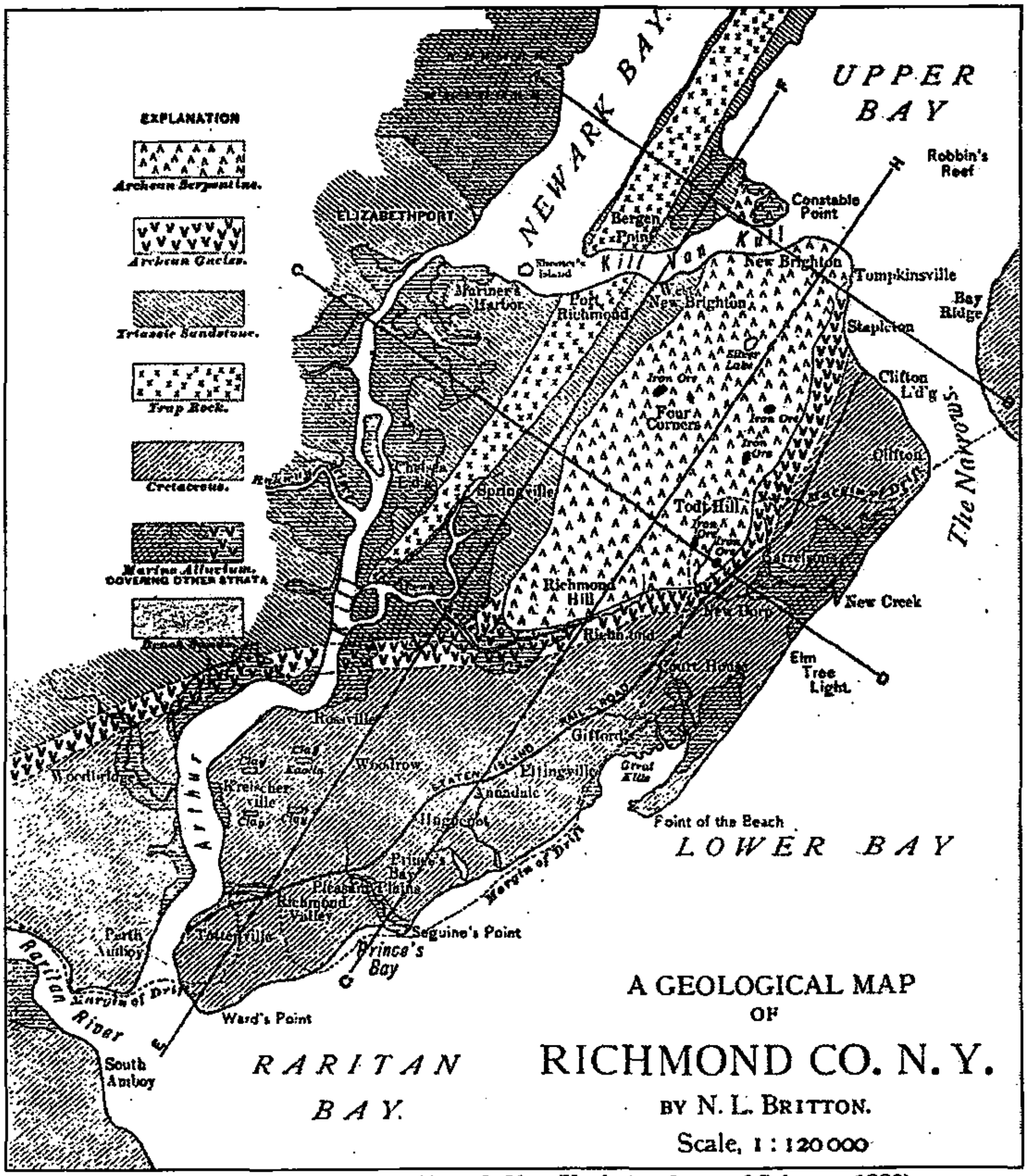

Figure 2. Geology of the project area (Annals New York Academy of Sciences 1882).

Topography and Soils

The Manhattan Prong, characterized "by low, northeast-trending ridges carved from resistant gneisses and schist, and shallow valleys from weaker marble," lies in a confined strip of New York east of the Hudson Highlands and the Hudson River, and underlies Manhattan and Staten Island (Van Diver 1985:12).

The Arthur Kill's New Jersey coastline consists of late nineteenth- and twentieth-century fill at elevations five to 20 feet above mean high water. The fill occupies later Holocene saltwater marsh or occupies up to 300 feet beyond high-water marks documented in the nineteenth century (Raber et al. 1995). For the most part, Staten Island surface soils consist of red clay identified as glacial outwash deposits. Deposition includes about an inch of humus and leaf mold with more loam present near house sites and in the stream valley, a primary result of sheet erosion due to deforestation and urbanization (Hershkowitz et al. 1985).

NATURAL WATERFRONT AREA OF STATEN ISLAND

Numerous saltwater marshes surround the project area, particularly Staten Island. The marshes, fringing the shoreline amid shipwrecks, abandoned piers, and docks, include *Spartina alterniflora* (salt-water cord grass) and *S. patens* (salt-meadow grass). The northwestern section of Staten Island consists of an interlocking network of creeks, tidal and freshwater wetlands, swamps, and marshes (Dinkins and Schaffer 1992). The network includes Mariner's Marsh, a complex of freshwater marshes, ponds, meadows, and streams near Arlington Yard, and Graniteville Swamp, an intact swamp forest (Figure 3).

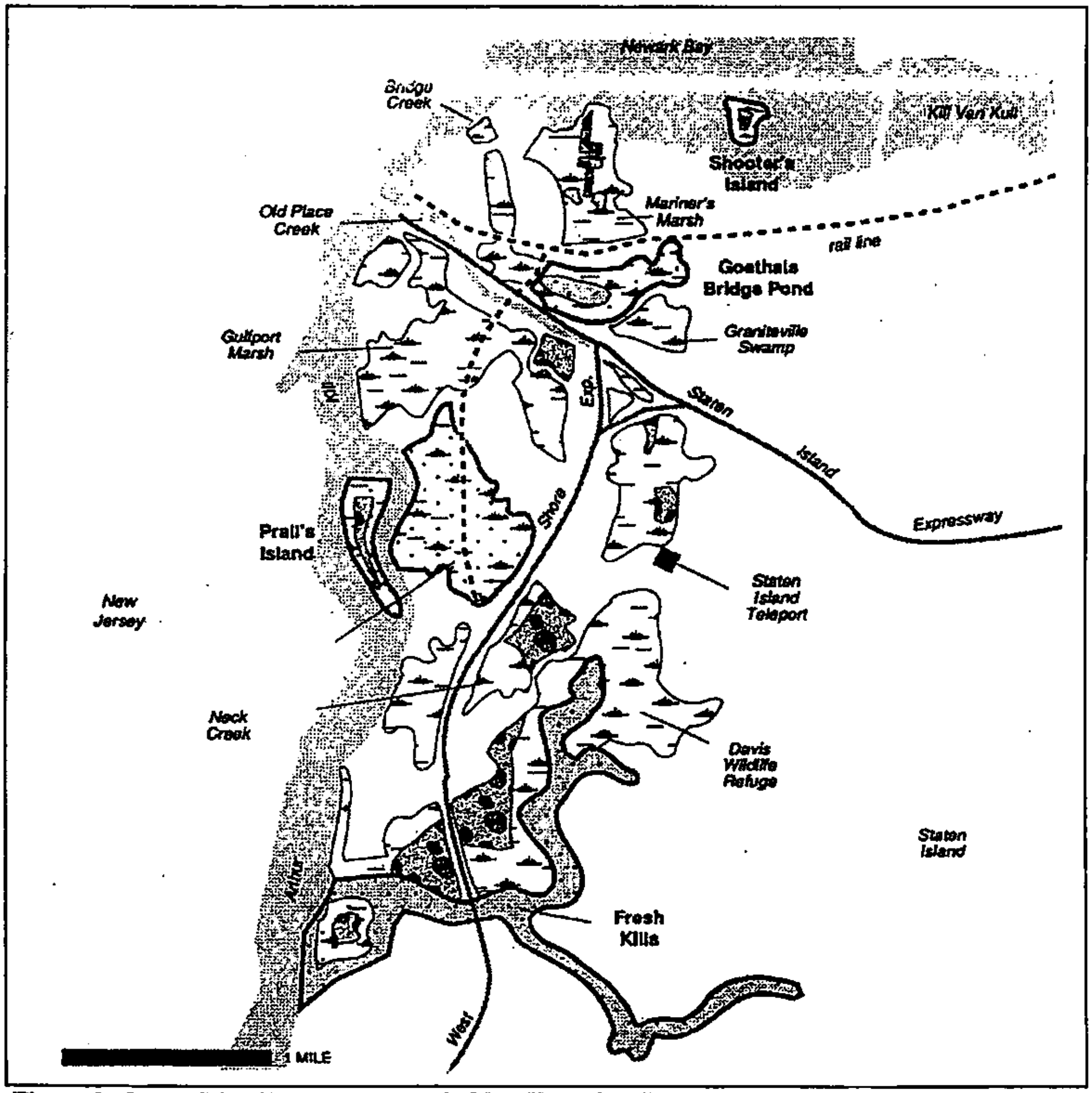

Figure 3. Staten Island's marsh network (New York City Department of City Planning 1992).

The project area is in a temperate zone, with cold winters and warm summers. Temperature extremes are moderated through the effect of the Atlantic Ocean. Average temperature over a five-year period at Newark airport measured 54.85 degrees F. Winter snowfall generally occurs from December to March, with traces falling during November and April (Corps 1979).

The study area is directly under the influence of ocean tidal action via the upper New York Bay, the Kill Van Kull, and the Arthur Kill channels. In the Arthur Kill, flood tide sets from Raritan Bay to Newark Bay. In the Kill Van Kull, the flood tide sets westward and the ebb tide eastward. Data generated during environmental impact studies by the COE for Shooters Island (1979) indicated a semi-diurnal tide with a mean range of 4.6 feet at St. George, Staten Island, near the easterly entrance of the Kill Van Kull. Measured ranges from three other areas in the channel indicated increments from 4.6 to 5.1 feet (COE 1979).

VESSEL/SITE CONDITIONS

Hull deficiencies in wooden vessels associated within the project area are typically grouped into three categories: time, environmental stress, and structural damage, particularly due to salvage and burning. Serious deterioration of wooden-hulled vessels can occur with little or no outward sign of damage. Decay (dry rot) is most often found in wood exposed to wind and water, which is the case with most of the project area sites. Wood decay is caused by various fungi whose growth depends on temperature (50° to 90° Fahrenheit), available food (wood), and moisture. Wood suitable for fungus growth must have at least a 20 to 30% moisture content, a condition promoted by poor ventilation (Pearson 1987).

Dry wood or waterlogged wood does not rot. Not all wood has the same resistance to decay; under freezing conditions, wood structural members with high moisture content may appear sound, when in fact they may be in advanced stages of decay.

The other principal form of shipwood deterioration is marine borer attack. Marine borers are present in varying degrees in almost all salt and brackish waters. Wood-boring mollusks are the worms (Teredinidae) and piddocks (Pholodaceae). Mollusks bore into wood below the mudline "by the rasping action of their clam shell grinders" (Pearson 1987:15). No species of wood is immune to attack, and no method of protection is completely effective. Heavy pollution of the Arthur Kill and Kill Van Kull channel between ca. 1880-1910 probably had the same effect on *Teredine* spp. colonies as it did on oyster colonies. In the case of the project area, only a few wrecks exhibit visible signs of infestation, though infestation below the water line is obviously not visible. Approximate dates for *Teredine* eradication are not available.

Historically, New York Harbor has been a vital link for the import and export of supplies and products to a host of industries. The waterfront along the shoreline of many of the channels consists of factories, bulkheads, marshlands, marinas, derelict boats, environmental ruin, and industrial intensity. The landscape is characterized as "an environmental wasteland of belching smokestacks, huge holding tanks, weathered bulkheads and dilapidated piers" (Hirsh 1980:D10). Six towns front both the Arthur Kill and the Raritan River. Coupled with these townships are hundreds of petroleum storage tanks. The area is heavily industrialized.

Pollution in New York Harbor is unfortunately part of its history. The harbor's heavy industrialization, particularly in the nineteenth century, "exacted a heavy ecological toll on the Kills, establishing patterns of pollution that persist to this day" (Hurley 1992:16). During the first half of 1990, the Arthur Kill and Kill Van Kull suffered from a series of refinery and tanker accidents. Over one million gallons of petroleum spilled (Hurley 1992).

American oil industrialization began in 1859 when Edward Drake discovered crude oil in western Pennsylvania. Railroad and pipeline transportation networks naturally gravitated toward New York City's port facilities. Companies located in Queens and Brooklyn first, then moved west across the Hudson to northern New Jersey, the refiners' preferred location (Hurley 1992).

Although smaller refineries occupied waterfront sites from the Raritan River to Jersey City during the 1870s, the area gained its reputation as a giant petroleum district when Standard Oil

Company moved into Bayonne in 1877 (Hurley 1992). By the turn of the century, Standard Oil claimed the Bayonne refinery was the largest refining plant in the world. Standard Oil built another refinery, the Bayway plant along the Arthur Kill in Linden, New Jersey, in 1909. By the 1920s, refineries along New Jersey's eastern shoreline produced nearly 1,000 barrels of finished oil per day (Hurley 1992).

Almost every stage of the refining process involved pollution: crude oil storage tank seepage, distillation waste, spilled kerosene, and the disposal of thousand of gallons of sulfuric acid and caustic sodas. Unlike other urban rivers, oceanic tidal flows entering the Kills from north and south eliminated much-needed flushing action. Oil and acidic sludge saturating the refinery grounds eventually seeped into the channel. A Standard Oil plant investigator stated:

> [A] ditch...carried 'oily and waxy refuse' from paraffin stills to a marsh on the premises 'from whence it eventually finds its way into the creek or remains as a thick and offensive coating on the ground.' In one area, this 'nasty semifluid mass' formed a lake thirty feet across. Far worse conditions prevailed at another nearby refinery, the Ocean Oil Company, where high tides swept the premises, washing oil, tar, and sludge acid into the Kill Van Kull [Hurley 1992:18].

Pollution decimated the area's oyster crop. Fish fared some better, though caught fish tasted of oil and kerosene. Pollution eventually ended commercial fishing in the project area.

Oil production increased during WWI, as did the pollution. The refineries along the Arthur Kill and Kill Van Kull in New Jersey made the project area one of the busiest shipping lanes in the world. Oil spills became such a problem that in the early 1920s, areas on the channel occasionally broke out in flames (Hurley 1992).

Since WWI, New Jersey's northeastern shoreline has established itself as a petroleum-based manufacturing center. Tanker and barge traffic in the Kills is heavy. Despite efforts by the Federal government to regulate water quality (Clean Water Act of 1972, etc.) "tankers spill over 50,000 gallons of oil into New York Harbor each year" (Hurley 1992:19).

Since the 1990 Exxon (Standard Oil) disaster, the project-area waters are apparently on the mend, but to a limited degree. Industrial and residential runoff, coupled with industrial discharge, continually pollute the channel, but Ed Johnson, Curator of Science at the Staten Island Institute of Arts and Sciences, stated that things have improved in the Kill since 1990. "A lot of people think all these waterways are so polluted [around Staten Island]...they are...but they're a lot cleaner" (*Advance,* July 29, 1994).

3. HISTORIC OVERVIEW

GENERAL NAVIGATION HISTORY OF THE PROJECT AREA

Europe's first exposure to the New York Bay was during the voyages of Verrazano. An Italian from Florence sailing for Francois I, the king of France, he left European waters in January 1524 to find a route to China. His vessel, *La Dauphine*, named after the French heir to the throne, measured 100 tons and was manned by a crew of 50. In early March he came close to Cape Fear, North Carolina. By mid-April Verrazano had coasted far enough north and east to enter New York Bay. After some brief reconnaissance he continued on his voyage and returned to France in July. Being a competent seaman and navigator, Verrazano was able to conclude that he did not reach China, but rather a new world (Morison 1971:314). However, the French did not follow up on Verrazano's discovery of the best harbor in the Americas.

Henry Hudson, an Englishman in the employ of the Dutch East India Company, investigated portions of the American east coast in 1609 (Labaree et al. 1999). Hudson was the next European to enter New York Harbor; he then sailed 150 miles up the river that was to bear his name. The Dutch were a bit more industrious and inaugurated European control of the region. Headquartered at Manhattan, private trading operations were established on the Hudson in 1613. Numerous exploratory ventures occurred after the founding of the trading post, and by the mid-1610s much of the area was well known. The Dutch named this region the New Netherlands in 1614, with private fur-trading operations expanding into 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 (Roberts et al. 1979:A-12, A-13).

The Dutch expansion caused conflict with the English by extending east toward New England. To the south, the Dutch absorbed the Swedish settlement at present-day Wilmington, Delaware. Trade connections were established with the Chesapeake Bay colonists, South America, and Europe. New Amsterdam was growing, and rivaled Boston as a center for maritime trade, with furs, fish, beef, and flour being exported, tobacco, slaves, and sugar being trans-shipped, and European goods imported. New Amsterdam appeared to be the rising star of American colonial ports. However, with the restoration of Charles II in England and a more aggressive colonial policy, the English took the colony in 1664 (Labaree et al. 1999).

Soon after the beginning of English rule, New Amsterdam was renamed New York and flour replaced furs as the port's main export, shipped mainly to the West Indies. In the eighteenth century exports included whale oil, beaver pelts, and some tobacco to England, and flour, pork, bread, peas, and horses to the West Indies. Imports from England and the West Indies included manufactured goods and rum, molasses, and sugar respectively (Watts 1986:11-12). Shipping increased considerably by the mid-1700s. 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 (Roberts et al. 1979:B-9).

New York did not confine her shipping activities to trade; her vessels were also heavily involved in privateering. Preying on enemy commerce led to the inevitability that some would turn to the often-glamorized activity of pirating. The infamous Captain Kidd and various lesser-known pirates made New York a rendezvous around 1700 (Albion 1984:2-5). Not only was New York a rendezvous, her merchants supported trade and reaped a profit by supplying pirates inhabiting such far-off places as Madagascar (Cordingly 1995). Frederick Philipse, a merchant of New York, loaded ships with clothing, liquor, naval stores, guns, and ammunition, and had his local agent, Adam Baldridge, sell them to the pirates in return for their ill-gotten gain (Ritchie 1986). Commerce, with varying levels of ethics, was driving the growth of the port.

By the second decade of the eighteenth century, the interior settlements surrounding New York were sufficiently established to allow for the production of significant amounts of export goods. As a result of the increased trade, the port expanded accordingly, as did its need for larger, more economical vessels with which to ship goods (Watts 1986:11-12). Port records indicate that prior to 1720, few vessels entering the port registered over 100 tons. Larger vessels became more common within the next few years (Watts 1986:11-12). In 1770, New York stood fourth after Philadelphia, Boston, and Charleston among the American ports in total tonnage arriving and clearing (Albion 1984:2-5). Data relative to the increase in number and nationalities of vessels entering New York throughout the eighteenth century are presented in Table 1.

Table 1. Eighteenth Century Shipping Data For The Port of New York.

Destination/Origin	**Year**				
Outward bound (Clearances)	**1726**	**1739**	**1754**	**1768**	**1772**
Great Britain	12	9	31	56	39
Ireland	--	15	23	30	19
Europe	8	21	19	45	48
Africa	--	4	2	--	9
Bahama Islands	--	1	3	4	5
Bermuda	3	3	3	7	3
Caribbean	95	113	180	156	199
Thirteen Colonies	90	97	51	125	324
Other American Colonies	5	10	12	55	54
	213	**273**	**324**	**478**	**700**
Inward bound (Entries)					
Great Britain	31	27	28	79	61
Ireland	1	4	10	15	11
Europe	10	22	25	31	38
Africa	--	--	5	2	--
Bahama Islands	--	1	6	9	11
Bermuda	9	14	3	3	5
Caribbean	85	105	177	158	208
Thirteen Colonies	69	93	23	139	352
Other American Colonies	5	11	7	26	24
	210	**277**	**284**	**462**	**710**

(as presented in Roberts et al. 1979:B-13)

With intercolonial trade well established and foreign imports and exports on the increase, the port of New York continued to grow. By the last decade of the eighteenth century the port of New York had surpassed Boston in importance; by the first decade of the nineteenth century, the port was larger than Philadelphia. Two-thirds of all the nation's imports and one-third of its exports went through the port by 1860, with only London and Liverpool exceeding the port in the volume of shipping and value of imports and exports (Albion 1984:336; Ferguson 1986:17). Population growth mirrored the increase in shipping activities, declining only through war and epidemics. Associated reductions in maritime commerce occurred while the British occupied the port during the Revolutionary War, the yellow fever epidemics of 1795 and 1798, the Embargo Act of 1807, and the British closure of the port during the War of 1812 (Ferguson 1986:17).

During the nineteenth century, sailing vessels of varying sizes and shapes entered and exited the port of New York. These vessels included sloops, coastal schooners, merchantmen, and packet ships, which increased in size as time and technology progressed. The late 1840s and 1850s saw the famous clipper ships entering the port, to be followed in the 1890s by the last of the American square-rigged, deep-water sailing ships (the "down easter"). These were followed by large, multi-masted schooners–the largest sailing vessels ever constructed. In addition to these major vessel categories, other vessel types present in the area included schooner barges, pilot boats, lighters, fishing boats, and other types of small craft (Morris and Quinn 1989:87-88).

The invention of the steam engine in the late eighteenth century and its application on vessels at the turn of the century played a profound role in the history of the port, and cut into the trades previously controlled by sailing vessels. After Fulton's *North River Steam Boat* completed its successful voyage from New York to Albany in 1807, steam power became the dominant method of vessel propulsion and would form the catalyst for the evolution of not only vessel shape and type, but trade and economics as well (Brouwer 1987).

The advent of steam heralded the creation of the famous river and coastal sidewheel steamers, several of which are listed as having wrecked near the approaches to New York. Huge transatlantic liners followed in the wake of the sidewheel steamers, making New York the center for passenger travel to and from foreign ports. Steam also allowed the ever-important "tug boat" to evolve. After 1860 the tug boat industry expanded rapidly, with steam being employed on the tugs until just after World War I (Morris and Quinn 1989:87-88).

With the port of New York immediately to the north, some of the many vessels transiting the waters were wrecked by storm, accident, or poor seamanship. It is known that numerous vessels wrecked while approaching or leaving New York. Long Island to the east and the shores of New Jersey to the south act as a funnel through which vessels enter New York Harbor. During the age of sail, vessels were dependent on the capricious winds for motive force–many were reported lost due to contrary winds. However, early steam vessels, without modern navigation aids such as radar, loran, or GPS, have had accidents in the ever-confining waters that mark the approaches to New York. In the modern era, technology has yet to abolish accidents caused by human error.

To ameliorate the affects of maritime disasters, numerous organizations were incorporated around the coasts. Local organizations took the responsibility of aiding the victims of shipwrecks. In an era of a small Federal government, each locality took responsibility for situations occurring within its immediate jurisdiction. During the mid-nineteenth century the port of New York rose to such prominence in commercial and emigration activities that the local resources could not sustain a full service for wrecked mariners and passengers. A Congressman from New Jersey, William Newell, once witnessed a shipwreck where no effective rescue was possible. In 1847 he persuaded Congress to appropriate money to provide lighthouses with lifeboats. However, the money was not spent for that purpose. The next year he obtained more funds for life-saving equipment to be used between Sandy Hook and Little Egg Inlet, New Jersey, under the direction of the Revenue Marine (Bennett 1998). The following year Congress extended the network of stations to include the rest of the New Jersey shore and to the coast of Long Island, New York. Thus, the Federal government took its first tentative steps toward a remedy for mariners in distress.

Maritime History of the New York Harbor Area

Unlike early colonial enterprises founded on political or religious principles, New York's development was prompted by trade. Early maritime commerce in the New York Harbor area began in the early 1600s, centering around the limited trade and barter of fur, probably beaver (Bank of Manhattan Company 1915). After the area was discovered by the Italian explorer Verrazano in 1524, the Dutch began initial colonization of Manhattan Island, with the Dutch West India Company establishing a trading post of eight men in 1625 to help develop the fur trade (Shumway 1975). By 1650, New Amsterdam featured peoples speaking 18 languages:

> This broad-minded tolerance, which was the universal Hollandish custom, attracted from Europe bold adventurers bent upon making their fortune. In spite of the interruption of the change from Dutch to English rule, in spite of the constant warfare of the eighteenth century and the British occupation during the Revolution, New York's commerce grew steadily. By 1800, eleven years after the adoption of the Constitution...New York had outstripped its rivals...and had taken the foremost place as the seat of American commerce...(Bank of Manhattan Company 1915:5).

The fledgling colony was replaced by British rule when a naval squadron appeared in 1664 off New Amsterdam and demanded its surrender. Renamed "New York," the colony was taken back in 1673 but was returned to the British as terms of a treaty in 1674.

In 1683 there were three ships, three barks, 23 sloops, and 41 small boats noted as being at New York In 1696 there were 62 sloops, 40 square-rigged vessels, and 60 small boats. The single-masted sloop was the most extensively employed vessel type during the early years of the colony. Thought to have developed from the old Dutch yacht, the sloops had the broad beams and round, full bottoms that characterized seventeenth-century Dutch vessels. The universal boat for traveling and freighting on the river, the sloop's light draught was well suited to floating over the shallows of the Hudson River. By 1771, the Hudson River sloop was a large and powerful boat (Hall 1884:115).

The rise of New York commercial activity was slow, and while merchants traded to the West Indies, they neglected the trade of Europe until after the Revolutionary War. Prior to the war, privateering and the slave trade were practiced. The port was especially known for its privateering, and during the French War and prior to 1758, 48 privateers, 695 guns, and 5,660 men were sent out from the port until the advent of the Revolutionary War. Fast-sailing brigs and schooners had sharp floors and sat low in the water; these vessels were seldom captured. A few of this same class of vessel also participated in the slave trade (Hall 1884:115).

Part of the British strategy during the Revolution was taking control of New York Harbor, with their first landing on Staten Island. Although the major battles of the war were fought outside the state, the British continued to hold New York as a main naval base. The end of the war brought restrictions against trade with the West Indies; however, the trade was revived in 1793 when France and England went to war. Becoming the leading seaport in 1797, the port was idled for over a year with the passage of the Embargo Act of 1807. Just four months prior to the embargo, Robert Fulton successfully tested the steam-propelled *North River Steam Boat*, an event that signaled a revolution in marine transportation and waterborne commerce. Built in an East River yard and powered by an imported British steam engine, the vessel ran between New York and Albany in 1807. Although earlier steamboats had operated both in the United States and abroad, it was Fulton and his partner Robert Livingston whose success with the *North River Steam Boat* "marked the beginning of the unbroken development of steam navigation in America" (Ringwald 1965:1). In 1812, Fulton built the first "double-ended" ferryboat *Jersey*, which operated between Jersey City and Manhattan. In 1814, he established the first steam ferry between Brooklyn and Manhattan (Brouwer 1990:20-26).

The development of the steamboat was impeded by the monopoly awarded to Fulton (actually awarded to Livingston, a state political power) for steamboat operation in New York. Struck down in 1824 by the Supreme Court of the United States, the removal of the monopoly brought significant changes to the local waters both in vessel types employing steam propulsion and the engines themselves, as well as waterborne commerce affected by the introduction of these vessel types. A general type evolved that would come to typify the larger Hudson River steamboats (Ringwald 1965:2), as well as the Long Island Sound and Chesapeake Bay steamboats.

After the War of 1812 the Port of New York increased its role in the sailing packet industry, both in the construction and in the commercial aspects of the vessels. Like the *North River Steam Boat*, the packets were built in East River yards. Packets bound for Liverpool, London, and

Harve would make their eastbound crossing with cotton or grain and return with immigrants and European luxury goods. By 1850, New York was a center of clipper ship construction with between 50 and 100 vessels being built yearly. Mostly built for New York owners, the packets and clippers were launched for the packet, China tea, or California trades (Hall 1884:116).

After the Civil War, the American shipbuilding industry saw not only the final development of the American square-rigged ship but in New York, where builders specialized in expensive packets and clippers, a dramatic decrease in production. Production of New York-built boats dropped from 40 in 1855 to zero in 1862, averaging only four per year over the next decade (Hutchins 1948). The completion of the trans-continental railroad and the opening of the Suez Canal spelled doom for the fast sailing vessels by the 1870s (Brouwer 1990:46).

The industry also witnessed a change in the way it conducted business. Before the Civil War, shipbuilding usually consisted of a small group of shipwrights headed by a master shipwright. Shippers, on the other hand, had little to do with shipbuilding. After the war capitalists sought out the industry on a large scale. The master shipwright became an employee, this being the result of declining activity in the ship market and the increased cost of ship construction (e.g., decreased timber supply) (Hutchins 1948). By 1880 the economies associated with the free market system dramatically modified, if not replaced, the old apprenticeship system.

The opening of the Erie Canal in the fall of 1825 was perhaps the greatest stimulus to the growth and success of the Port in the early nineteenth century. Extending from Buffalo on Lake Erie to Albany on the Hudson River, the canal runs a distance of 365 miles. Reducing shipping times and costs of inland produce and commodities to the Port, the Erie Canal caused interior towns to thrive due to increased commerce, and ensured New York's leadership among eastern ports because of its access to markets and goods of the interior of the continent (Brouwer 1990:29-34; Hall 1884:224; Morrison 1958:539).

Soon other canals were being constructed throughout New York, with canals also constructed in Pennsylvania, Maryland, and Delaware. Navigation improvements in connecting inland waterways by canals in the 1820s and 1830s resulted in new commerce opportunities and increased maritime traffic. The Delaware & Raritan Canal, the company by the same name receiving its charter in 1830, was the conduit for Pennsylvania coal to New Brunswick, New Jersey on the Raritan River; the Morris Canal carried coal across New Jersey to Newark from the mouth of the Lehigh River (Albion 1939:134-137; Morrison 1958:172; Raber et al. 1995b:25). A crucial corridor around Staten Island for waterborne commerce in the early nineteenth century traveling between Upper New York Bay to Raritan Bay, the importance of the Kill Van Kull and the Arthur Kill increased throughout the nineteenth century with the construction of the Delaware and Raritan Canal and the attendant expansion of the coal trade. With later direct railroad connections from Elizabethport to Phillipsburg, New Jersey on the Delaware River, and a new coal terminal at Port Johnson, Bayonne on the Kill (constructed in 1865), shipments of coal on the kills increased dramatically in the 1850s and 1860s (Albion 1939:134-137; Morrison 1958:167-189; Raber et al. 1995b:25).

The construction of canals brought about an attendant boom in the construction and use of canal boats or barges, as well as a reduction in the number of schooners involved in the same trade. The importance of the canal use in the waters of New York Harbor is indicated by the frequency with which they appear in historic photographs of the area (see Johnson and Lightfoot 1980). Either decked or open, the canal barges were towed through the Erie and Champlain Canals by horse and mule walking along towpaths. Arriving at the Hudson River, they would require other means of propulsion. Coinciding with the construction of the canals and the canal barge, the advent of steam power produced the towing vessel, the predecessor of the modern day tugboat. The first vessel built for this general service appears to have been the *Hercules*, constructed in 1832 in New York by a company that ran a line of coastal packets (Morrison 1958:540).

At the same time steam propulsion was making inroads into maritime construction and commerce, it was also having a profound effect on land in the form of railroads. By the 1870s, the railroads would shape the way the Port area handled goods by effectively creating the lighterage system. Of the dozen major lines that serviced the port, only two directly serviced Manhattan Island. With the exception of the Baltimore & Ohio, which entered Staten Island, most railroads ended at the New Jersey shore of the Hudson River. These lines were forced to transport their cargoes of passengers and products over the last remaining leg of the journey by water. However, there remained a far greater tonnage of waterborne freight requiring discharge along piers and waterfront slips than land-conveyed freight (Harding 1912). Some freight cars crossed the waterways on long barges called car floats, while the contents of other cars were offloaded or transferred onto lighter barges in the form of sailing craft, deck scows, and hold and covered barges; steam lighters carried priority cargo such as mail.

Servicing the geographic and commercial needs of the harbor required a "railroad navy." Some 1,500 tugboats, car floats, covered lighters, express lighters, floating grain elevators, and other craft loaded and unloaded freight at specially designed rail-to-water transfer piers (Table 2). This transportation network offered (1) access to the water (slip) side of steamships, and (2) access to parts of the harbor not accessible by rail.

Table 2. Craft in New York by Class & Percent in Each Class, 1916*.

Vessel Class	Vessels		Tonnage		Value of	
	No.	%	Gross	%	$	%
Tugs/towboats	559	9.1	57,687	3.2	13,153,417	21.7
Ferryboats	125	2.0	115,363	6.4	11,406,584	18.9
municipal	16	0.3	15,471	0.9	2,107,199	3.5
railroad	59	1.0	68,881	3.8	6,779,130	11.2
other	50	0.8	31,011	1.7	2,520,255	4.2
Unrigged craft	5,433	88.8	1,641,694	90.4	35,938,792	59.4
Total	6,117	100.0	1,814,754	100.0	60,498,793	100.0

*adapted from Squire 1918

Historically, New York's leadership position in general cargo portage depended on its ability to move or "lighter" goods from ship to pier or ship to ship. The term "lighter" describes a small boat utilized as an intraport cargo carrier. These lighters, sail or steam propelled, handled all types of agricultural and commercial goods, including mail. The typical lighter transported between 500 and 800 tons of freight (Harding 1912).

In New York Harbor the term also applies to cargo ferrying via scow, barge, derrick, carfloat, or grain elevator, vis-à-vis waterfront terminals or anchored ocean vessels. The breadth of New York's lighterage activity "reflected America's full scale entry into the industrial age, with its ever increasing demand for imports of raw materials and foreign markets..." (Brouwer 1987:30).

The harbor's vast waterways and dense population initially hindered centralized railroad service. "In response to these challenges, many major railroads established inter-modal networks designed to meet and beat their competitors" (Dibner 1994:6). Of the dozen or so railroad lines built during the mid-1800s, only the New York Central provided direct freight service to Manhattan (Brouwer 1987). From 1835 to 1865 tracks progressively penetrated the harbor, terminating at the nearest navigable waterway; most came no closer to Manhattan than Jersey City.

In the 1870s railroads adopted the carfloat interchange system. Cars from southern areas reached New England-bound railroads by flotation barge. In Manhattan, around 1900, and later in

Brooklyn and the Bronx, float bridge stations (inland freight stations) provided mechanisms for freight marine/terrestrial interchange. Beginning around 1860 railroads delivered (at no charge) a carload or more of incoming freight to waterfront locations within a designated harbor boundary (free lighterage limits).

Waterfront destinations received the same rate "as though it were physically on the line of the railroad" (Flagg 1994:7). Railroad owners had no choice but to provide free lighterage since the free service directly competed with canal boat carriers who delivered goods directly to ships or terminals, and charging for the service would drive shippers to other East Coast ports. When later investments included port facilities, railroad owners "did not want New York to be placed at economic disadvantage in competition with East Coast ports where goods did not have to be lightered" (Brouwer 1987:31). By the 1920s railroads owned outright large lighterage fleets.

By 1885, New York Central Railroad maintained 92 lightering boats; the Pennsylvania Railroad maintained 104 vessels. In 1908 the Lehigh Valley Railroad had 250 craft, while the Baltimore and Ohio owned 142 (Harding 1912). Three other railroads had fleets numbering more than 200 (Brouwer 1987). In 1907 the New York Central fleet moved 304,372 cars on float, or about 1,000 per day, in addition to 1,402,358 lightered tons of bulk freight, or some 5,000 tons per day (Harding 1912). In 1917, all railroad freight shipped to or from Manhattan Island (apart from New York Central's track) arrived by lighter or carfloat (French 1917). Table 3 illustrates the tonnage of products moved by carfloats and lighters in 1914.

Table 3. Railroad Tonnage in 1914 by Commodity, Percentage, & Local Movement*.

Commodity	Carfloat		Lighter		Total	
	Tons	%	Tons	%	Tons	%
Grain and mill products	593,000	14.0	3,232,000	76.1	4,244,000	100
Foodstuffs	2, 714,000	42.1	1,195,000	18.6	6,442,000	100
Fuel and ores	568,000	1.6	31,903,000	90.9	35,101,000	100
Building material	829,000	17.0	2,323,000	47.8	4,865,000	100
Miscellaneous	6,100,000	49.0	2,607,000	20.9	12,463,000	100

*adapted from New York, New Jersey Port and Harbor Development Commission 1920

Expansion of the free lighterage system allowed waterfront industries to develop floating sidings. Terminal companies took advantage of the situation by developing ports within ports, providing steamship piers, loft buildings, and freight stations, all served by private rail networks connected by carfloat. Companies set up special terminals for bananas, coal, grain, and perishables. A Merchant's Association of New York representative described the waters of Manhattan as "an interior *belt line* employed in switching cars between the terminals on the New Jersey shore and the industries…in various parts of the harbor" (Squire 1918:3).

The water belt line or lighterage and carfloat system came under attack around 1910. Independent cost analysis suggested that the system suffered from cost overruns, particularly delay and damage to freight. These allegations, however, often originated from rival ports. Objections also came from urban planners, who complained about the disproportionate amount of waterfront occupied by railroad marine operations. Supporters recognized that if operations moved elsewhere in Manhattan, companies would occupy space even more valuable.

The New York Port Authority (est. 1923) tried to carry out a comprehensive plan of replacing marine operations with land-based belt lines. Railroad executives refused to cooperate with one another; despite studies showing increased revenue by unifying terminals and belt lines, rail companies preferred the traditional lighterage/carfloat system (Flagg n.d.). The Port Authority modernized pier and vehicular crossings, eventually substituting motor trucks for lighterage.

Modern containerization and trucking diminished the importance of the lighterage system by 1960. The demise of the lighterage system came about with the advent of the modern standardized freight container that is adapted for quick transference from and onto train, truck and specially adapted ships (Brouwer 1990:54). By 1976 railroads no longer provided lighterage service. Hundreds of abandoned wooden vessels associated with this industry now litter the port's shoreline. Flagg et al. (1992) accurately noted that steel barges contain valuable scrap and are less likely abandoned. Some derelicts served as storage units for a time, but eventually lost any useful function.

The lack of railroad initiative aided Manhattan's port decline. Marine business slowed to the point that railroads found it cheaper to transfer freight in New Jersey by truck rather than by lighter. By the early 1970s, most free railroad lighterage in New York's port ended. The last carfloat operation in Manhattan ended in 1976.

STATEN ISLAND

Relative to the New York-New Jersey metropolitan area, Staten Island is both water-bound and isolated. Historically the island's western border, the Arthur Kill channel, and its northwestern border, the Kill Van Kull, played vital roles connecting New York with New Jersey, Philadelphia, and Long Island Sound. Staten Island rests between New York Bay and New Jersey's northwestern shoreline, the Arthur Kill channel separating the Island from the latter. The Island's geographical center is situated 11 miles southwest of New York City. The Kill Van Kull extends from Newark Bay to New York Bay and separates Staten Island's northwestern shoreline from New Jersey at Bergen Point. Bayles (1887) states that the Island's name is an English rendering of the Dutch form *Staaten Eylandt*, meaning "Islands of the States."

The name "Kill Van Kull" (channel), historically known as the Kills, is apparently Dutch for the "Kill of the Cul" (*Het Kill van het Cul*) (Bayles 1887). *Kill* is a Dutch word for "creek," while *Cul* is possibly French for "bay," thus "the creek of the bay." *Achther Cul*, the Dutch rendering for Newark Bay, meant "Back Bay," the Dutch word *achter* meaning "after" or "behind" (Clute 1877).

De Vries (1655), as cited in Wacker (1975), comments on the immense numbers of water fowl on the Achter Cul, stating:

> There are great numbers...of geese, which stay here through the winter, by the thousands, and which afford fine sport with a gun...Land birds are also very numerous, such as wild turkeys...taken by the savages with their hands, who also shoot them with bows and arrows...There are different kinds of fine fish...haddock, plaice, flounders, herring, sole, and many more kinds...There are fine oysters, large and small, in great abundance. In the summer time crabs come on the flat shores, of very good taste [Wacker 1975:23-24].

The description offered by De Vries is a far cry from the fouled and polluted waters of the modern Arthur Kill and Kill Van Kull channels.

Initially, Native American conflict hampered European development of Staten Island. As part of the Province of New Netherland, the Island fell under the jurisdiction of the Dutch West India Company (1621 to 1664) (Black 1982). In 1661 French Waldenses and Huguenots established a modest village near South Beach, apparently the Island's first permanent European settlement (Steinmeyer 1950).

The Dutch surrendered its Island claim to England in 1664. Native American conflict culminated in the "Peach War" of 1655, which depopulated the Island where "settlement had to be recommenced" (Bayles 1887; Black 1982). Staten Island became part of the shire of Yorkshire. Francis Lovelace, who purchased Native American land rights to the island in 1670, laid out lots on the Island's north, south, and west sides. In 1675 the Island obtained separate jurisdiction, and in 1683 a separate county, Richmond.

Demographically, seventeenth-century Staten Island mirrored early Dutch and subsequent English settlements. Under English domain the Island witnessed the arrival of fugitive French Huguenots in significant numbers. By the mid-1700s Staten Island included Dutch, French, Belgian, and English populations (Bayles 1887).

Between 1790 and 1810 the Island featured a rural population subsisting on farming, fishing, and maritime commerce. The population (5,347) increased more than 39 percent by 1810 (Sachs and Waters 1988). Agriculture (beef, pork, wheat, rye, apples) and seafood (fish, clams, oysters) sustained the Island's population (Cotz et al. 1985). The community also harvested salt hay from the extensive salt meadows in Northfield, Southfield, and Westfield townships.

Commercial oystering dates from the earliest Dutch settlements. The industry even advertised in early Dutch journals (Powell 1976). Considered a staple in the eighteenth century, oysters were shipped locally and abroad. Beds thrived in the Arthur Kill's deeper waters, Prince's Bay, the mouth of the Raritan River, and the Kill Van Kull (Hine and Davis 1925; Sachs and Waters 1988).

Extensive marshes north of later Rossville, coupled with the Island's remoteness (relative to the New York City and Philadelphia markets), slowed coastal development. Furthermore, large land grants encompassing the Island's southern end restricted settlement. Mark Dusachoy, described in a seventeenth-century deed transaction as a "planter," held some 823 acres in the Smoking Point area (Schneider 1977). Christopher Billopp received about 1,600 acres on the Island's southwest corner. Begun circa 1709-1716 and running between Perth Amboy and the end of Amboy Road, the earliest ferry across the Arthur Kill was included in Billop's grant. Besides local ferry service, given opportunity, the Billopp ferry probably served as a link between New York City and Philadelphia. The ferry operated intermittently from the Amboy Road site until the beginning of the Civil War, when the landing moved a half mile north (Raber et al. 1995a:24).

By the end of the colonial period subdivided Billopp grants, together with other smaller grants, led to increased farming near the Arthur Kill south of Fresh Kills. Eventually smaller communities emerged north of the Billopp grant boundaries as New York/Philadelphia markets expanded. The initial franchise, Old Blazing Star (now Rossville), is located in an area north along the south side of what is now Arthur Kill Road (prehistoric Smoking Point). The name "Blazing Star" apparently originated from taverns at each ferry site. Old Blazing Star remained the project area's principal settlement until after the American Revolution. The New Blazing Star Ferry at Tompkinsville (Linoleumville) opened around 1757 and by 1764 featured a stagecoach connection.

One of the earliest ferries to cross the Kill Van Kull, the Port Richmond-Bergen Point ferry, dates to the 1690s. Jacob Corsen petitioned the New York Governor's Council in 1750 for a patent stating that he had operated a ferry between Staten Island and Bergen Point for some 60 years. His request, to "erect" his vessel into a public ferry, grew out of fear of competition as a result of increased population. Corsen received the patent, operating the ferry until 1764. New owners took over the operation the same year (Reed 1959).

The New Blazing Star route began in New York City, crossed the North River by ferry to Powle's Hook (Jersey City), to Bergen Neck (Jersey City and Bayonne), to Bergen Point, where the ferry carried passengers and freight across the Kill Van Kull (Reed 1961). The New Blazing Star differed from the Blazing Star Ferry, which ran from modern Rossville, Staten Island to the opposing New Jersey shoreline. The route did not operate during the Revolutionary War.

British forces occupied the island during the Revolutionary War. Up to 40,000 garrisoned British and Hessian troops occupied the island, many stationed near the western shore (Sachs and Waters 1988). This was perhaps due to the location of the Old Blazing Star ferry and its subsequent access to Philadelphia and New Jersey (Schneider 1977). After the war local officials confiscated and subdivided the grant's remaining acres. Development of the island's hamlets, villages, and industry depended, in part, on transportation networks, i.e., ferries, landings, and roads.

Ferry service provided early links with the mainland. By 1816 Daniel Tompkins' Richmond Turnpike Company opened a road connecting the northeast shore (Tompkinsville) with the New Blazing Star Ferry west in Linoleumville. Tompkins then offered steamboat service between Tompkinsville and Manhattan, establishing a direct route between New York and Philadelphia (Cotz et al. 1985). The ferry at Tottenville linked Staten Island with Perth Amboy, and the one at Holland or Howland Hook with Elizabeth, New Jersey. Another ferry ran across the narrows to Brooklyn. Kill Van Kull service ran between Bergen Point and Port Richmond (Leng and Davis 1930). In the 1830s, a horseboat ferry operated across the Kill Van Kull. The vessel, known as Coyles horseboat, ran during the late 1830s and early 1840s. The project lasted only a few years, the service replaced by rowboats or scows (Reed 1959).

Despite New York Harbor expansion, the Arthur Kill's marshy shoreline prevented large-scale commercial development. In 1810 the Island's primary industries included two textile carding machines, two tanneries, three distilleries, and 59 looms producing some 23,100 yards of flaxen fabric, 12,000 yards of woolen fabric, and 7,000 yards of blended cloth (Sachs and Waters 1988). Even as the channel itself became an increasingly important commercial route, communities along the Arthur Kill remained largely agrarian.

In the early nineteenth century Manhattan's new middle class sought refuge on the Island's underdeveloped southern shore. The earliest resorts appeared in Tompkinsville (1821) and later north in New Brighton (1837). The grand shoreline became a favorite local retreat. In the 1880s South Beach, later Midland, had 100,000 tourists during peak season. Several large institutions, public and private, medical and non-medical, established expansive residences along the northern shoreline. Settlements gradually developed around these institutions. The wealthy, meanwhile, established their own Island estates.

Early industrial development began on the north shore at Factoryville, now West New Brighton. In 1819 Barrett, Tileston, and Company established a dyeing and printing house there (Leng and Delavan 1924). Port Richmond served as the location for the Staten Island Whaling Company and later the Jewett White Lead Works (1842).

The Island's rich clay and kaolin deposits on the southwest shore along the Fresh Kills and lesser deposits on the north shore led to an emerging brick-manufacturing industry (Sachs and Waters 1988). German immigrant Balthazar Kreischer, knowledgeable in the construction trades, built a Manhattan brickworks in 1845, and in 1852 built the International Ultramarine Works on the Arthur Kill south of Smoking Point.

In 1854 Kreischer established a clay and firebrick works on the Island that operated in several locations, the earliest and largest located along the Arthur Kill south of Rossville (Sachs and Waters 1988). In 1873-1874, he moved the entire manufacturing operation to a three-acre site just north of the Outerbridge Crossing. In the 1880s the family-owned plant produced an estimated 3.5 million bricks annually. Kreischerville became an industrial community. The plant shipped all products by water, building a steam lighter in 1880 (Raber et al. 1995a).

Transportation improvements during the last half of the nineteenth century accelerated Staten Island's industrial growth. The first railroad linked Clifton with Tottenville in 1869 (Leng and

Delavan 1924). Small communities developed around the rail stations. Immediately after the Civil War heavy industry expanded, especially after the 1880s. The emerging transportation industries and the subsequent communities built near their local hubs brought new occupations and services, providing opportunities for blacksmiths, coopers, wheelwrights, grocers, bakers, and printers (Sachs and Waters 1988).

The Staten Island Rapid Transit Railway Company opened a train bridge over the Arthur Kill in 1889. Coaches and horse cars linked north and east shores with Richmond and Linoleumville to the west (Leng and Delavan 1924). By 1880 Staten Island's population totaled approximately 40,000, ninety percent clustering in villages along the northern and eastern shorelines. The rest of the island remained rural farmland, swamp, salt meadow, or beach. The Island featured 100 manufacturing plants employing some 1,550 people, mostly young men, though the plants employed 88 females over 15, and 30 children (Sachs and Waters 1988).

By the mid-1900s agricultural chemical production facilities, metallurgic industry plants, clay and brick production facilities, building material factories, copper refineries, shipyards, and emerging petroleum industries lined the Arthur Kill's western shoreline. At Staten Island only a few small industries appeared: the American Linoleum Manufacturing Company, Atlantic Terra Cotta Company, Kreisher Brick Works, and Tottenville Copper.

During the early part of the twentieth century New York's port handled 40% of all U.S. foreign trade. The average annual value of imports and exports for the port during 1911-1913 totaled $1,809,358,239, or 46.2 percent of that for the United States (Squire 1918). In 1920 nearly half of all foreign commerce for the United States entered through the Port of New York. Some eight million people lived within a 25-mile radius of the Statue of Liberty (New York, New Jersey Port and Harbor Development Commission [PHDC] 1920). Yet Staten Island's Arthur Kill waterfront remained underdeveloped.

Local economic fallout following World War I, limited access, and pollution governed the Island's future. When the Department of Health traced typhoid fever to Staten Island oysters, the department condemned the industry (Bureau of Curriculum Research ca. 1980s). Water pollution destroyed oyster beds, and by the early twentieth century, the local fishing business little resembled its admirable past.

Chemical and copper refineries along the Jersey shoreline released gaseous contaminants into the atmosphere. Prevailing westerly winds, in turn, pushed contaminants across the island, ruining agricultural production. Industrial waste eventually made Staten Island's real estate less than desirable. New York City started dumping garbage on the Island in 1916. Initial operations failed in 1918, but in 1946 dumping resumed. Following a series of land transfers, the present Fresh Kills Landfill on Staten Island is considered the largest landfill in the world.

The disposal of garbage, particularly during the nineteenth century, created special problems for local residents. Until 1934, ocean dumping was commonplace. Shoreline residents from Long Island to New Jersey complained of nasty beaches and shorelines. Dead cats, dogs, and chickens, and putrid fruits and vegetables lined the area shoreline. The problem, recognized by local officials, proved difficult to correct (Corey 1991).

The garbage scow, a barge filled with garbage, became commonplace on the rivers and channels. An article in the *New York Times* (*NYT* 1880) noted that the amount of garbage dumped in the harbor actually filled certain channels (as presented in Corey 1991). In 1871 the New York legislature enacted laws prohibiting the dumping of garbage into the waters of the North (Hudson) and East Rivers, Upper New York Bay, and parts of Raritan Bay (Corey 1991). As a result, legal dumping moved to southeastern Staten Island.

STATEN ISLAND SHIPYARDS

The scarcity of timber following the American Revolution somewhat diminished the Staten Island shipbuilding trade. After the war the U.S. shipbuilding industry thrived because of low-cost construction made possible by cheap timber (Hutchins 1948). The growth of the fishing and oystering industries following the War of 1812, and later the expansion of recreational boating industries, brought a revival in wooden boat/ship construction and repair.

By 1855 shipwrights in Tottenville (particularly in an area called Unionville), many of Scandinavian descent, produced sloops, schooners, propeller yachts, and coal barges. At one time stores stocked Norwegian newspapers because Staten Island had so many Scandinavian ship carpenters (John Noble Collection 1973). The William H. and James M. Rutan Shipyard built nearly 100 sloops and schooners (manuscript on file, Staten Island Institute of Arts and Sciences). Jacob Ellis operated a shipyard near the foot of Tottenville's Main Street. At the south side of the Ellis yard stood a blacksmith shop (A.E. Rolles) where Ellis's vessel fittings were probably wrought. Before mid-century sailing lofts, which later manufactured building awnings, established services on the north shore. Rope walks appeared in Rossville and Richmond in the late 1850s (Sachs and Waters 1988).

One of Ellis' shipwrights, Chris Brown, eventually opened a business at the foot of Amboy Road, later building the oceangoing tug *Cyclops*, renowned for towing huge rafts of lumber from Nova Scotia to New York (*Advance* March 24, 1968). By 1880 Staten Island had seventeen shipbuilding firms, eight of them in Tottenville. These latter eight yards included eight marine railways. Described by Henry Hall in 1880, "this is a fishing locality, with coal depots in New Jersey, and the work is largely for smacks (fishing), tugs, and coal barges" (Hall 1884:119).

From the middle to late nineteenth century, shipbuilding industries played a major role in Staten Island's maritime economy. Staten Island shipbuilding dramatically increased during World War I. Stephen Cossey operated a 20-acre plant that during its 22-year history constructed 1,149 boats. The $30,000,000 industry produced lighters, tugs, dredges, coastwise vessels, and dry docks. More than anything else, Tottenville celebrated its shipyards and the quality and quantity of work done in them. The yards planned and built tugs, schooners, oyster boats, sloops, yachts, and all conceivable craft of ordinary tonnage, besides the work of overhauling, rebuilding, refitting, altering, etc. that was always ongoing. Competent mechanical work gave Tottenville shipyards an excellent reputation all along the coast.

Staten Island's shipbuilding tradition continued into the twentieth century. The Staten Island Shipbuilding Company (est. 1895) is historically known for its steel hulls and diverse designs. The early hulls built by the yard included tugs, carfloats, scows, barges (oil and coal), yachts, schooners, ferryboats, steam and derrick lighters, dredges, drill boats, and in recent years, mine sweepers, cargo freighters, and tankers (Allen 1922). There is a distinct probability that some of the derelict sites associated with the project area are vessels built by the Staten Island Shipbuilding Company.

4. VESSEL TYPES

This chapter presents the types of vessels potentially located within the project area. Sections to follow include information on scows, barges, lighters, pile drivers, tugboats, floating dry docks, water boats, menhaden trawlers, and floating grain elevators.

Scows

The wooden scow was the most ubiquitous barge type in the waters of the New York port, and played a crucial role in various industries within the project area. A non-self-propelled vessel, the scow was rectangular in shape. It was generally decked, with a flat bottom and vertical sides, and its ends were raked or angled upward in the common scow end. A small cabin with its door to the stern was often set on one end to provide living accommodations for the barge captain. To support the weight of the cargo, the hull contained an elaborate system of bulkheads, pillars, trusses, or braces, some possibly designed or adapted for a particular type of cargo.

Flat, flatboat, coal float, coal barge, *chalan* (Spanish) and *chaland* (French) are all historical terms for the type of watercraft employed in inland waters (e.g., bays, harbors, rivers) that have flat-bottomed hulls and square or raked ends. Vessels with these hull characteristics are called scows, a word derived from the Dutch word for this vessel type, *schouw*. A word that did not enter use in English until the late eighteenth century, it refers to a freight-carrying vessel. "Attributes of the scow hull include a flat bottom, a right-angle chine (the chine is the line of intersection between the side and bottom of a boat.), straight sides (both horizontally and vertically), and squared ends that may be vertical or raked (i.e., slanted out)" (Saltus et al. 1995:2-45).

The wooden scow hull, with its many sizes, was adapted for numerous uses in the waters of New York. But while differing in use, the hulls were often identical from the deck down. The basic open-deck scow was generally used for non-bulk, non-perishable commodities requiring little or no protection (i.e., brick, stone), with the main open deck providing storage. Based on cargo type, the scow might feature bulkheads forward and aft to avoid spillage. Other scow barges employed to carry perishable products were covered with protective structures. Many hulls were also employed as various types of floating work plants, such as crane barges or derrick lighters.

Figure 4 presents a labeled plan of a scow constructed for the New York City Department of Street Cleaning in 1921. The plan shows a standard scow hull with raked bow and stern. The dimensions for the barge were 134 feet length, 37 feet breadth, with a depth of hull 13 feet 8 inches. The cabin crew, 7 by 12 feet, is on deck, aft. From illustrations such as that presented in Figure 5, we know that the scow hull shape was present in New York waters as early as 1717. While the evolution of this vessel type is little understood, by the late nineteenth century there was very little design variation in the hull shape. From a study of ferries, flats, and barges of the South Carolina lowlands (Newell 1996), we do know that the basic vessel form, a rectangular body and raked ends, was present throughout the eastern seaboard by the early 1800s, and it may have been introduced earlier. Thought to be a vessel reflecting the ethnic origins of its colonists, like its New York area counterpart, the scow type vessel found in South Carolina also appears to have become uniform in design by the mid to late 1800s (Newell 1996).

Further clouding the question of origin and vessel evolution, the early use of the scow was not confined to the coast; it was also a vessel type employed extensively on inland rivers. Flatboats employed to carry coal down the Ohio River from Pittsburgh area mines as early as 1829 became known as coal boats. Illustrated in Figure 6, these early flatboats had scow characteristics and, by the mid-nineteenth century, varied in length from 160 to 175 feet, and were 24 feet wide and 8 feet deep (Saltus et al. 1995:2-53).

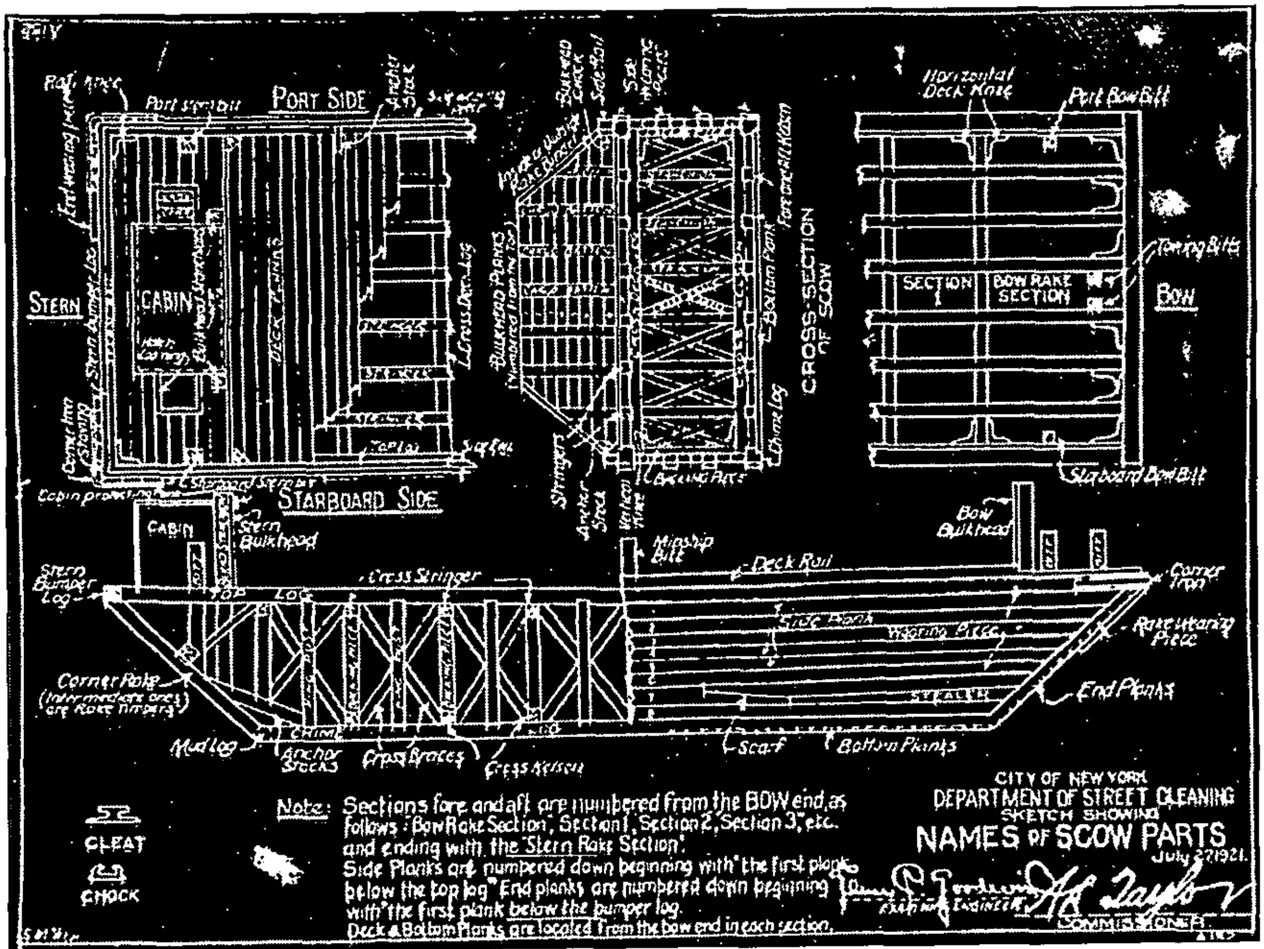

Figure 4. Plan of a 1921 street-cleaning scow (NYC Department of Street Cleaning 1921).

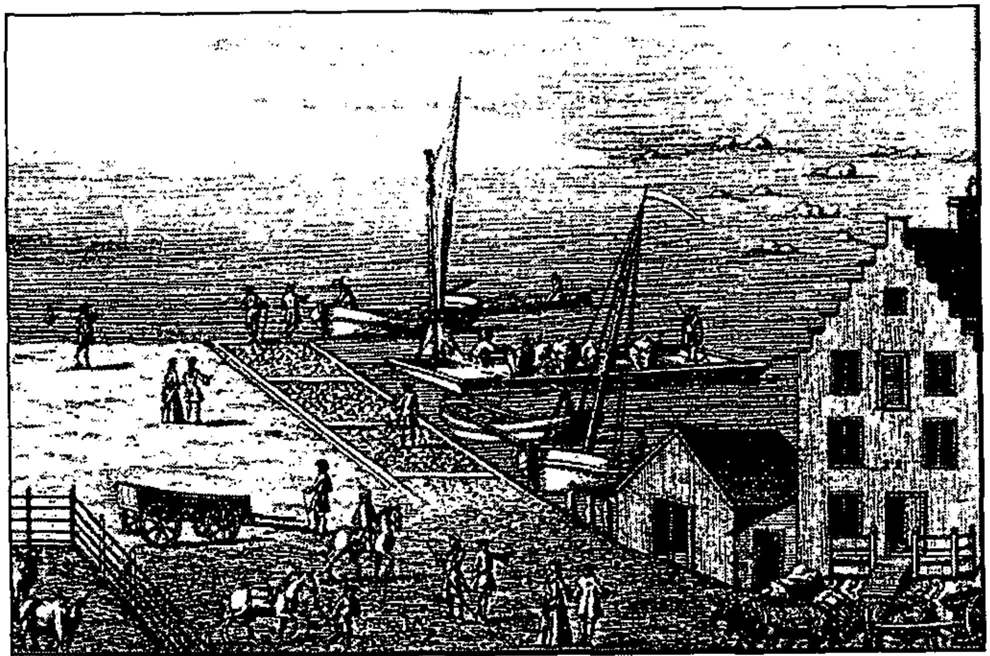
Figure 5. Vessel with a scow-shaped hull plying the waters of New York in 1717 (as presented in Brouwer 1981a).

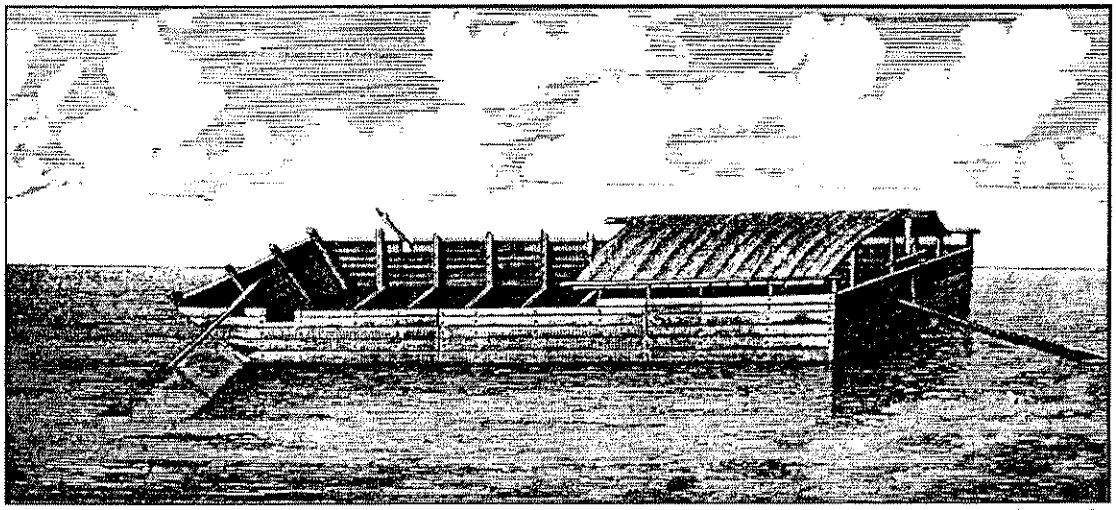

Figure 6. Drawing of a typical nineteenth-century inland rivers flatboat illustrating the early dissemination of this vessel type throughout the country (as presented in Bragg 1977:60).

OPEN-DECK SCOW

As a vessel type, the wooden-hulled, open-deck scow or flat scow is not well documented. We do know from plans that the deck scow had three or more longitudinal bulkheads, effectively dividing the hull into evenly spaced sections; access to the holds was provided by small manholes, most likely as access for pumping and repair. However, scows were built with both bulkhead and stanchion-type internal construction. A small cabin with its door to the stern was often set on one end to provide living accommodations for the barge captain. The open-deck scow was employed to transfer all manner of nonperishable goods.

ROCK SCOW (BULKHEAD SCOW)

These vessels were named for their specific cargo in the late nineteenth century, when quarries along the lower Hudson produced large quantities of crushed stone and sand for construction use at locations within the port area. Employed to ship other cargoes as well, companies delivered the building material on scows with the same hull configuration as the deck scow (e.g., triple bulkheads), but the rock scow included the addition of timber bulkheads for the retention of cargo, one located on deck at either end.

Termed the "Hudson River Rock Scow," the "bulkhead" scow type was an adaptation of the deck scow. Added high deck-end bulkheads were the distinctive features of this vessel. The bulkheads situated at the bow and forward of the deckhouse at the stern measured some 10 feet high in the center but angled downward 45 degrees at either side (Figure 7). Since the cargo peaked in a mound, the retaining bulkheads could measure as low as two feet. Vertical timbers supported the bulkheads, horizontally planked and smooth on the side facing the cargo (Brouwer 1996). Companies still transport crushed stone on the Hudson River. The scows are generally of the same configuration as earlier scows, but are steel built. The loading deck is usually sunk into the hull and not part of the main deck. Newer scows do not have steel cabins (Brouwer 1996).

It should be mentioned that the South Street Seaport Museum has a complete set of plans for a New York Trap Rock Corporation scow, dated 1951; the 1950s were the last decade in which companies built wooden barges and scows (Brouwer 1996).

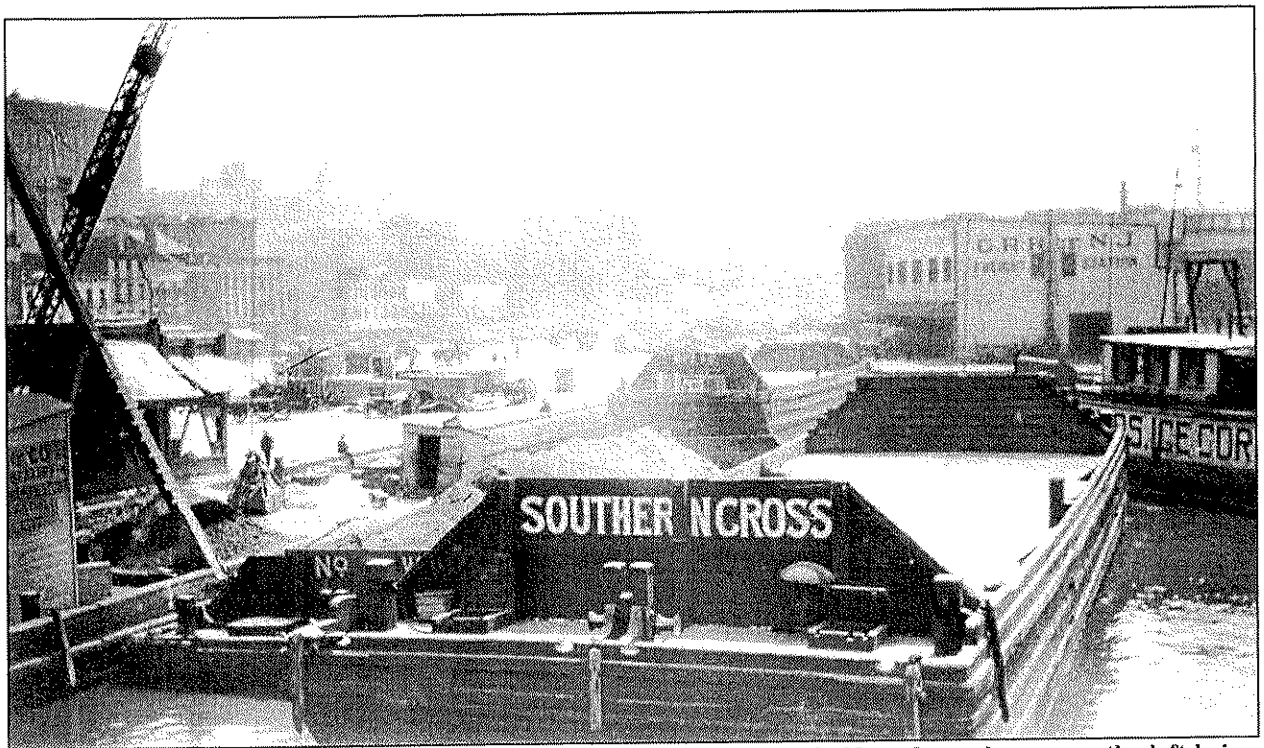

Figure 7. View of three rock scows in a turn-of-the-century photograph. Note the rock scow on the left being loaded with sand and rock by the crane barge. Also note how low in the water it sits compared to the two unloaded rock scows (courtesy of the South Street Seaport Museum).

Wooden Covered and Converted Covered Barges

Covered barges were employed in the port area to lighter (i.e., load, transport, and offload) non-bulk, perishable cargoes from and to ship or shore. By the mid-nineteenth century, covered barges with boat-shaped hulls were present in the port area. There is uncertainty regarding the evolution of this craft, but similar to other barge types, by the late nineteenth century the covered lighter barge was predominantly scow-hulled (Brouwer 1996:128-129). As was the case with many of the later barge types, the employment of the scow hull may have been associated with the economic practicality in building this hull type (i.e., less boatbuilding craftsmanship, fewer curved timbers), as well as its proven functional aspects. Replaced by steel-covered barges, the last wooden-hulled covered barges were built in the 1950s (Brouwer 1985:3-4).

Basically scow-built with either a stanchion or bulkhead hull system, the barge featured a one-story structure or shed covering most of the deck, with all cargo carried on deck. Often barn-sided, two large sliding doors opened port and starboard when cargo was handled over the gangway. A hatch at the margin of the roof allowed for vertical hoisting of goods when the barges were moored to the high side of an oceangoing vessel. Vents positioned at each end of the shed (attached to large ice bins) provided refrigeration for perishable items. Filled with ice through hatches in the roof, the vents circulated cool air top and bottom. When necessary a stove, installed in the center of the shed, circulated warm, dry air (Brouwer 1996:132).

Some companies preferred centered penthouse cabins over the usual stern counterpart. The higher elevation permitted a 360° view of surroundings and perhaps more importantly, wasted no cargo space. Some covered barges featured hoisting gear. A single mast with booms rose above the center of the deck house. Part of the rooftop cabin accommodated a steam-, or later, oil- or gasoline-powered winch (Brouwer 1996).

The presence of small cabins used as living quarters on this and other types of barges is illuminated by a 1918 document that stated for insurance reasons all non-self-propelled harbor boats must feature cabins (Squire 1918). The standard insurance policy of the Atlantic Inland Association, which many companies used, required a man on board. Many captains lived on board with their families; the size of the cabin varied from a shed to a permanent residence. Besides providing extra security, night-time operations (towing, moving, loading, etc.) required the captain's presence.

Of 208 unrigged boats owned by one company, 89 housed families with children ages one through ten, 71 had captains and their wives, and 48 had captains living alone on the boat (Squire 1918). Living conditions on board no doubt varied, but general descriptions mention crowded, damp, foul-smelling rooms: "The general impression given is that of dirt and disorder" (Squire 1918:16). Some companies tried to accommodate their employees if possible, providing stoves, furniture, etc., while others provided nothing at all. One company (200 unrigged boats) provided nothing for its employees (Squire 1918).

As a vessel type, the wooden-hulled, covered barge is well documented; numerous plans exist, several examples along waterfronts have been extensively recorded, and a restored example serves as a traveling museum. The Hudson River Waterfront Museum, located at various New York Harbor slips, is a restored wooden covered harbor barge. The barge's physical condition is in stark contrast to the physical remains of the covered barges in the project area, which are all deteriorated. Two detailed covered barge plans are shown in Figures 8 and 9.

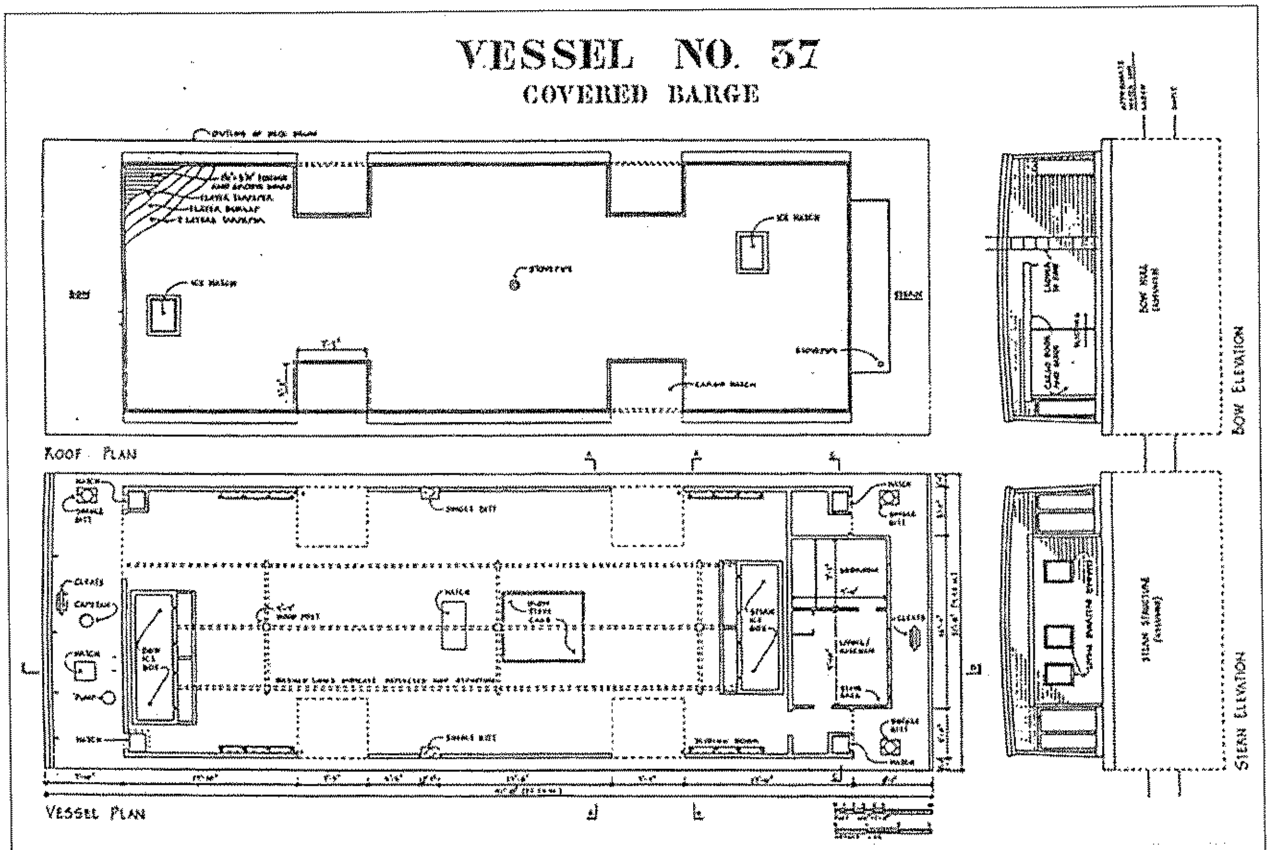

Figure 8. Plan view of deck house of covered barge at Shooters Island recorded to HABS/HAER standards (as presented in Kardas and Larrabee 1985:109).

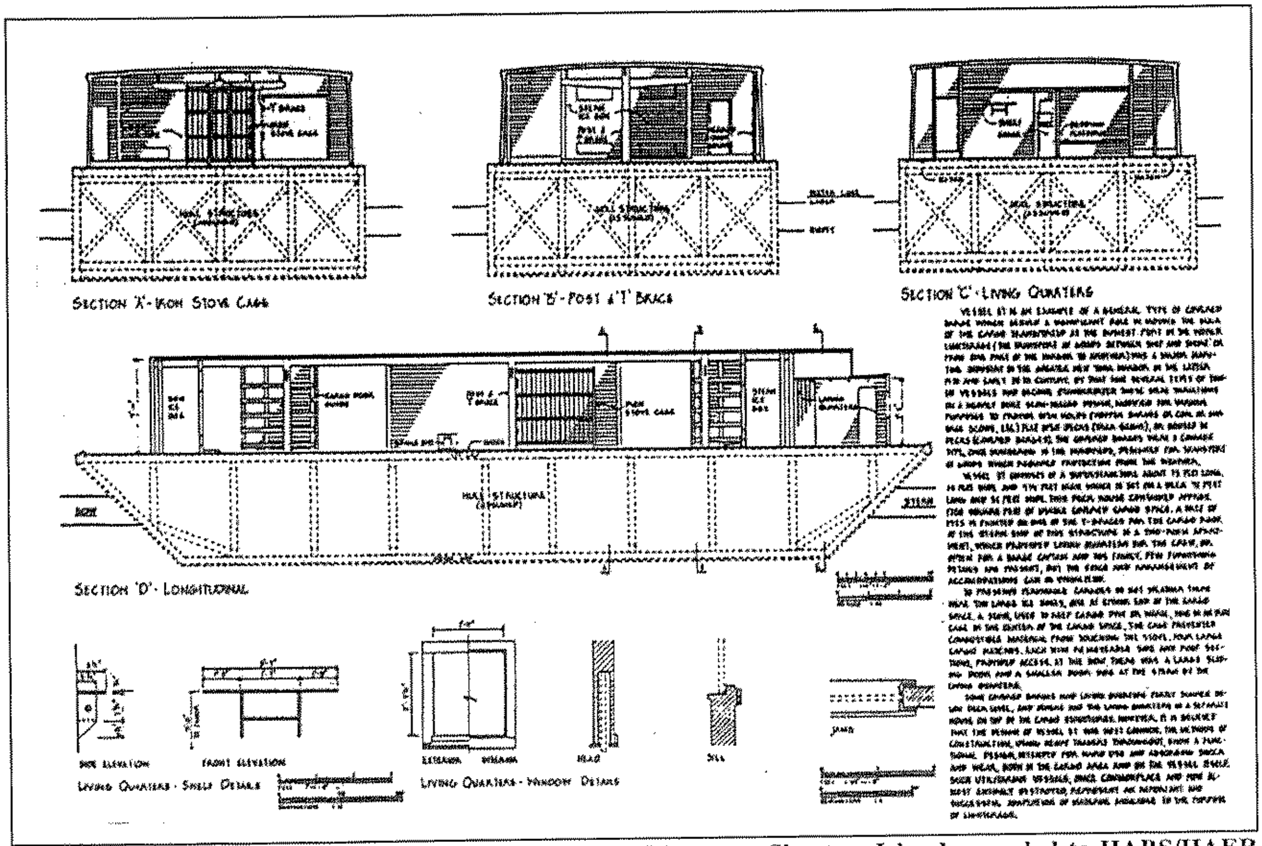

Figure 9. Side and end views of deck house of covered barge at Shooters Island recorded to HABS/HAER standards. Note absence of hull recordation (as presented in Kardas and Larrabee 1985:110).

A-Frame Crane Barges

Most likely adapted from mid- to late nineteenth-century shore-based lifting equipment such as the stiff leg, these towed cranes would have been employed in ship salvage, dock and pier construction, and cargo transfers. The cranes and hoisting machinery are situated atop scow hulls that appear to represent the variety seen in scow construction.

Two A-frame crane barges in an apparent salvage operation are illustrated in Figure 10. The photograph reveals numerous aspects of these scow-hulled work barges, including the characteristic A-frame stays and chain plates found on this vessel type.

Derrick or Stick Lighter

Open-decked derrick lighters were employed in the port area to lighter various cargoes to and from ship or shore. Early stick lighters, as they became popularly known, likely because of prominent timber masts and cargo booms, had boat-shaped hulls, pointed bows, and elliptical sterns (Brouwer 1996:133). There is uncertainty regarding an association between this configuration and lighters or sailing craft, but by the late nineteenth century derrick lighters were predominantly scow-hulled. We do know that the advent of the steam tow was a significant impetus in the use, acceptance, and profusion of this vessel type, the combination of the steam tow and barges making the sailing lighter uneconomical and thus contributing to its demise. The use of the scow hull for this vessel type, as seen on many of the later barges and work platforms, may have been associated with the economic practicality in building this hull type (i.e., less boatbuilding craftsmanship, fewer curved timbers), as well as its proven functional aspects.

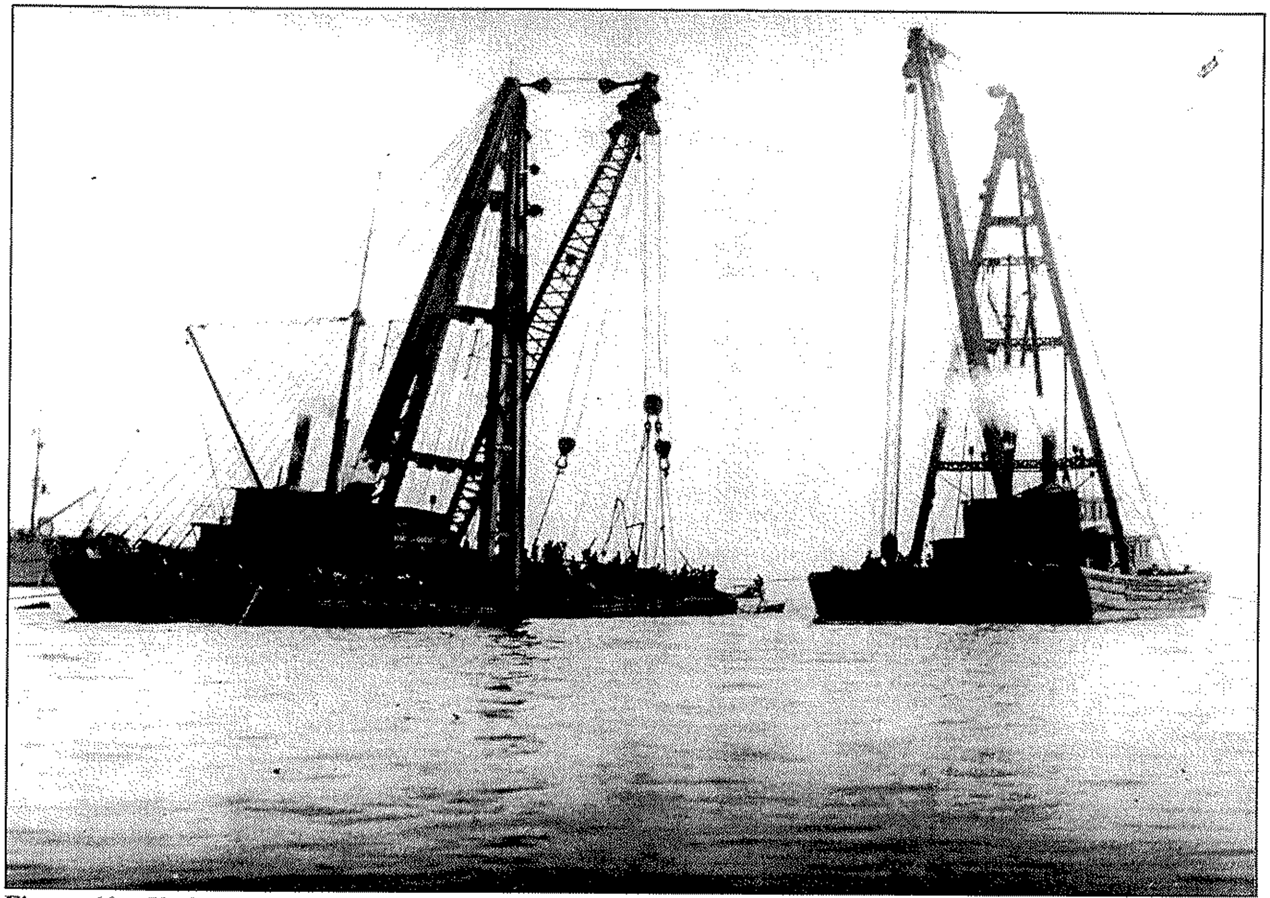

Figure 10. Undated photograph of two A-frame crane barges involved in what appears to be a salvage operation. Note scow hulls, the machinery cabin, as well as the numerous crane stays on the barge to the left. These stays and their corresponding chain plates where they attach to the hull are a distinguishing characteristic of this vessel type (courtesy of the South Street Seaport Museum).

As shown in Figure 11, the derrick lighter had a single sturdy timber mast stepped in one of two locations, either in the center of the deck or at the stern just in front of a small crew cabin. If the mast rested aft, only one cargo boom pointed forward. In the former case, there would be two cargo booms, one pointing forward and one pointing aft, and usually rigged like a sailing ship's fixed gaff in the central mast configuration. Fitted with wooden jaws to allow lateral swinging, and held at a constant angle by fixed wire topping lifts, they would be positioned about three-quarters of the way up the mast. The masts measured around 50 feet in height. In the central mast arrangement, the boat had two lighter masts at the bow and stern just forward of the cabin. Three masts around 20 feet high had sheaves mounted near their tops for lines used in hoisting the ends of a tarpaulin used in the protection of cargo (Brouwer 1990:134-135).

In 1985 Norman Brouwer recorded the intact derrick lighter L.V.R.R. No. 462, grounded at Edgewater, New Jersey. The boat, built at Mariner's Harbor, Staten Island in 1926, measured 104.5 feet in length, 32 feet in breadth, 7.8 feet depth of hull. A large winch house stood on deck aft, with mast and boom positioned directly in front of the house. The largest openings in the deck, small rectangular hatches, provided access and ventilation. A system of longitudinal bulkheads and timber pillars linked by crossed diagonal timber braces supported the deck. The derrick barge had more diagonal braces at the side rather than natural knees. A continuous row of windows spanned the front of the deck house. The cabin measured 6 feet 2 inches across the windows, 14 feet 9 inches at the side of the deckhouse. Interior cabin construction featured tongue-and-groove details (Brouwer 1985:8-12, 1990:135-137).

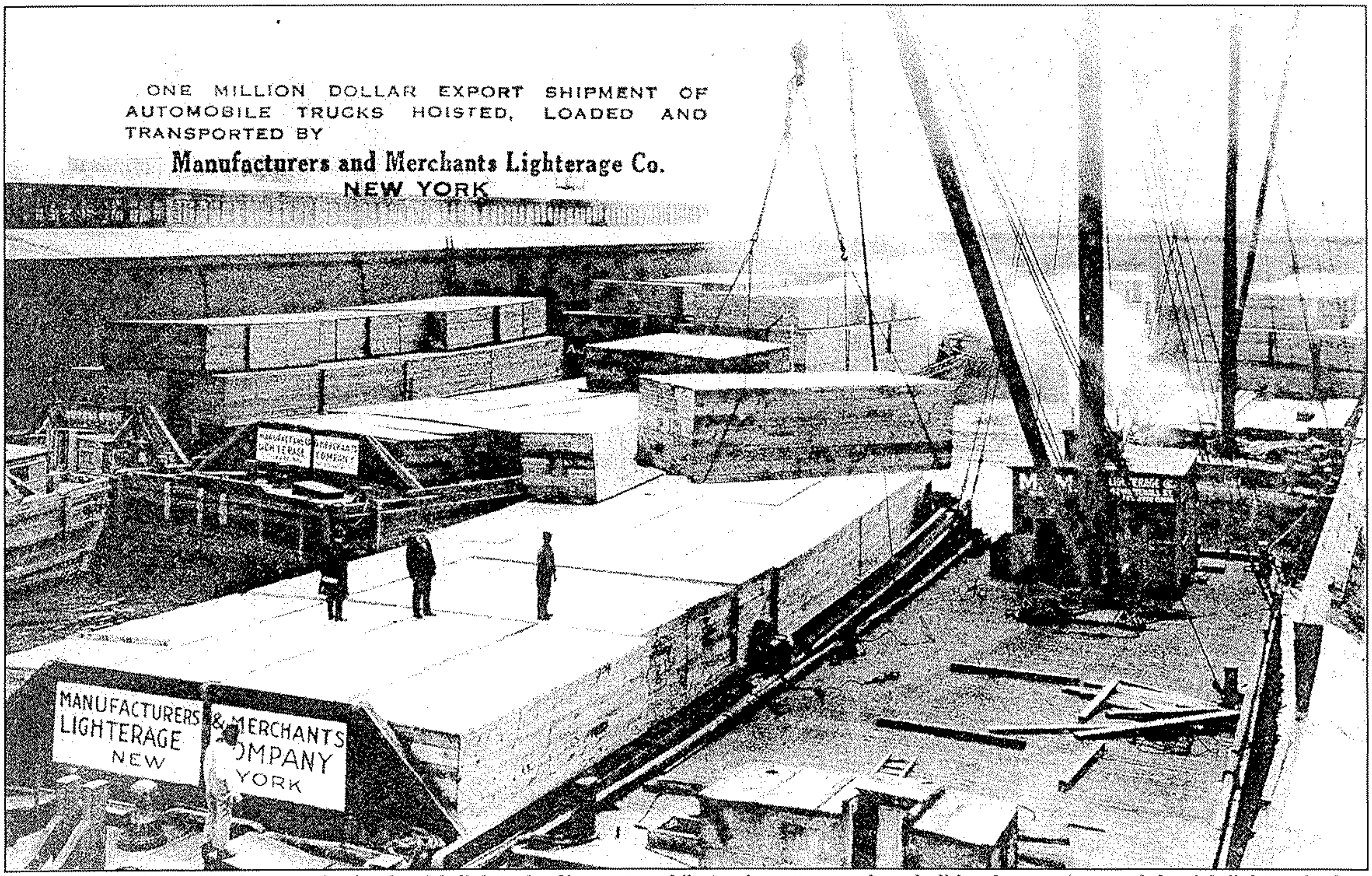

Figure 11. A 1930s (?) photograph of a derrick lighter loading automobile trucks onto a rock or bulkhead scow. A second derrick lighter sits just behind the first (courtesy of the South Street Seaport Museum).

Later derrick lighters were fitted with steel A-frames and steel booms in place of their wooden counterparts. The wooden scow hull was eventually replaced with a steel barge hull, retaining its steel A-frame (Brouwer 1990:137).

As a vessel type, the wooden-hulled derrick lighter is somewhat documented. But as seen above there are differences, some unrecorded.

Pile Drivers

As stated in Raber et al., "the first steam-powered pile driver in the United States was a direct-acting type patented in 1841 and used in construction of Drydock No. 1 at the Brooklyn Navy Yard" (1995b:106). Virtually unchanged since the latter half of the nineteenth century, steam pile drivers played a crucial role in the construction of area piers, bulkheads, bridges, and numerous other in-water construction projects such as lighthouses (i.e., the U.S. Dike).

The hulls are basically rectangular scows. The guides for the weight employed to drive the piles are supported on a tall timber framework, the distinct and defining characteristic of this vessel type. The steam winch, for hoisting the weight, and the steam boiler are located in a wooden deck house or cabin. The boiler is the vertical type, using oil for fuel, the stack projecting through the deck house roof. In the nineteenth century, coal probably fueled the boiler.

There is little wasted space on the vessel. The open decks around the house are wide enough only for the walkways and for handling mooring lines. There are winch heads on the outside of the house used by the pile driver to winch itself into position.

Although today the majority of extant pile drivers are steel-hulled and diesel-powered, steam is still employed for driving piles in the maintenance of the slips for the Staten Island and Governors Island ferries. And while an important floating work plant vessel type, the wooden-hulled steam-driven pile driver remains undocumented with the exception of the Feeney Collection plans and historic photographs. These, however, do not indicate if specific hull construction features were a requirement of the scow hull employed as a pile driver.

Dredges

One of the earliest accounts of dredging in the present-day United States refers to attempts by the French in the eighteenth century to deepen the mouth of the Mississippi River. In 1718 the Company of the Indies, the French enterprise then in control of the colony of Louisiana, sent several iron harrows from France. These were dragged across river bars to help remove them. These harrows were unloaded and lost in Mobile and the plan was never implemented. Several years later, in 1729, a scraper or harrow-like implement was finally built and dragged across the bar at Belize Pass, successfully deepening the channel by loosening the sediment and allowing it to be carried away by the current. In Philadelphia in the 1770s a grab dredge, consisting of two moveable jaws or shovels, was used to clear slips, and in 1784 a man-powered treadmill machine fitted with dippers was used to remove sediment. By the end of the eighteenth century other similar types of crude dredging devices were in use in North America (Bastian 1980:1-3).

In the early nineteenth century, improvements began to appear in dredging technology and several patents were issued for mechanical dredging machines. Among the earliest was one issued in 1804 to Oliver Evans of Philadelphia for his machine called the *Orukter Amphibulos*. Apparently the first self-propelled wheeled vehicle in America, the *Amphibulos* was described as a "large flat, or scow, with a steam engine of the power of five horses on board to work machinery to raise the mud into flats" (Bastian 1980:3). Little is know about Evan's machine, but Oliver Evans himself became one of the most important figures in the development of steam engine technology and steam navigation in the United States. With the continued development of steam power, a variety of technological improvements in dredging machines appeared. However, Bastian (1980:5) suggests that the real impetus to dredging and the corresponding advancements in dredging machines in the United States resulted from the passage of the General Survey Act of 1824 and the fact that the Army Engineers were given the responsibility for its implementation. Under the authority of the Act, the Engineers began to acquire, develop and build dredges for use on a variety of harbor and inland river projects. John Grant of Baltimore built a steam-powered ladder bucket dredge for the Army Engineers in 1827 for use at Sacketts Harbor, New York (Bastian 1980:1-3). Illustrated in Figure 12, an 1830s ladder bucket dredge, though employed at Ocracoke Inlet, North Carolina, is thought to be similar to the one employed in New York.

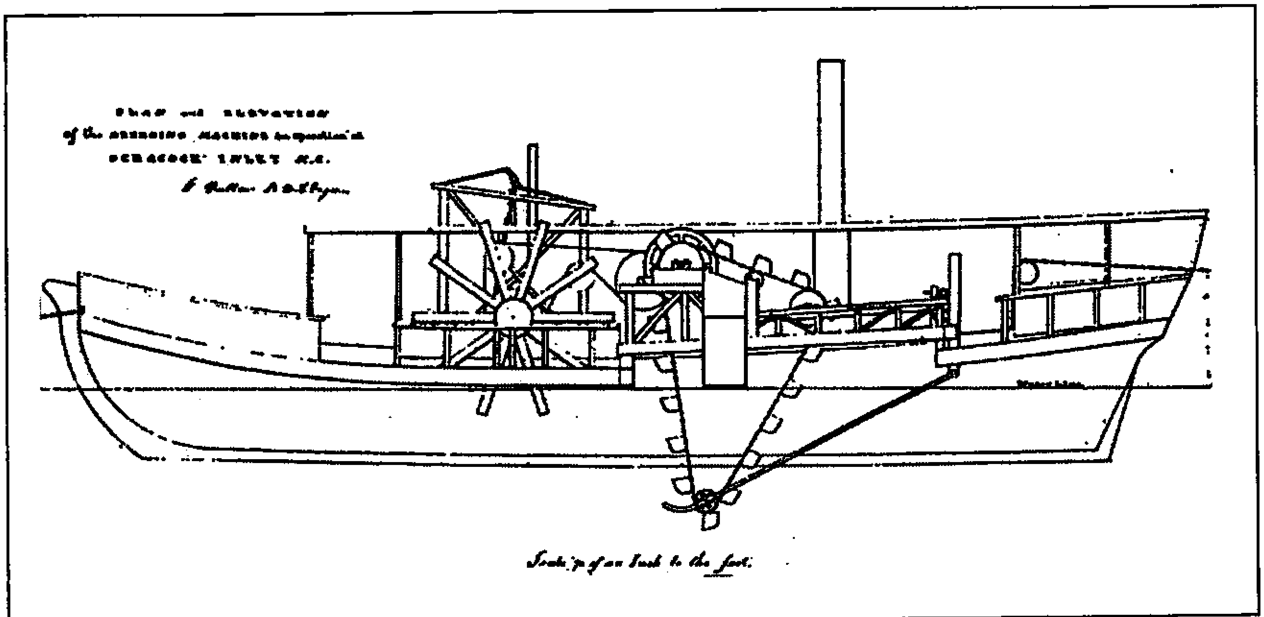

Figure 12. An 1830s ladder bucket dredge (as presented in Bastian 1980:Figure 2).

By the early 1900s the bucket and hydraulic cutter head dredges were the most common and extensively employed types in the dredging of harbors and navigation channels, and these are the two types represented within our project area. The bucket dredge, historically related to the spoon dredge, a simple scoop design, typically had a boom extending from its bow (Figure 13). The boom was supported by an A-frame or an H- or gallows-type frame. Another boom, equipped with a large bucket at its pivot end, rested near the midpoint of the first boom. The first boom had a cable running through a sheaf at its head. At the head of this boom was a bucket used as a scoop. In 1990 the Great Lakes Dredging Corporation used a bucket dredge in the channel at Newark Bay, off Staten Island, New York (Brouwer 1990; Mavor 1937:43).

The cutter head dredge differed from the bucket dredge in that it suctioned sediments through a pipe, the sediments having been loosened or cut by the cutter head. The boom was usually lowered by a lift rig supported by an A-frame. The hollow boom contained a pipe leading to a large hydraulic suction pump. A rotating cutter head, complete with a series of blades, was attached to the end of the boom. The cutter head loosened bottom material, which was subsequently sucked into the pipe. The bottom sediment was then discharged into a barge or floating pipeline (Brouwer 1990:150). Dredge material was either pumped into a waiting scow or was pumped to shore by a series of connected pipes.

International Marine Engineering (IMS 1912) published data on a 20-inch Morris hydraulic suction cutter head dredge owned by the American Pipe and Construction Company and used on the New York State Canal Barge system. The hull was wooden, with two heavy steel girders running fore and aft. Powered by a triple-expansion Morris engine (750 hp. @ 225 revolutions/minute), the main hydraulic dredge pump, steel constructed, had a 20-inch diameter suction/discharge. The power plants utilized a surface condenser, with vertical air pumps and centrifugal circulating pumps, boiler feed pumps, and service pumps. The cutter shaft measured 8.5 inches in diameter. The cutter-drive engine (12-by-12-inch double-cylinder horizontal engine) sat on deck.

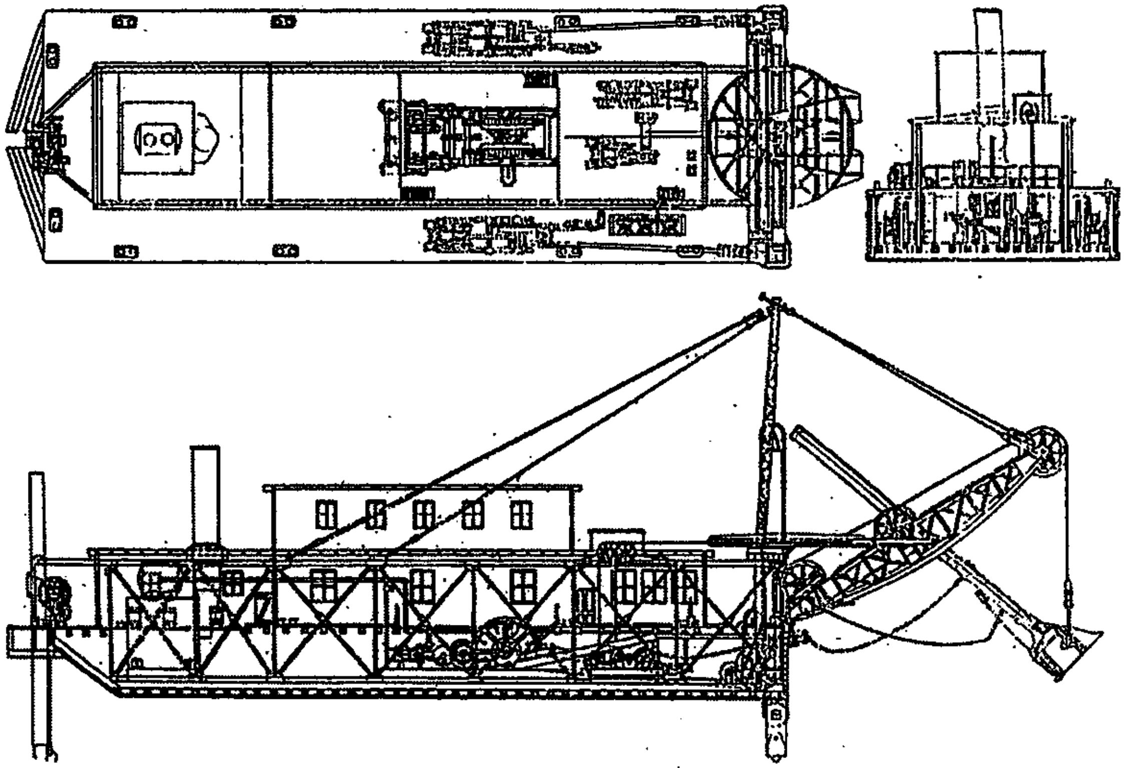

Figure 13. Inboard profile, deck plan, and cross section of the *Toledo*, a wooden-hulled bucket dredge. Note the spuds, the large legs that raise and lower and anchor the dredge in place (as presented in International Marine Engineering 1910).

Hydraulic dredges used early this century worked extensively during construction of the New York State Barge Canal System. Stationary vessels, these dredges had no propulsion systems; they reached their destinations by tug (Brouwer 1990). As depicted in the above figure, many dredges used vertical timbers termed "spuds" to anchor themselves in place. Raised and lowered by winches, the spud legs traveled through vertical guides called spud boxes that were built through or on the exterior of the hull.

Hopper Barges

Builders developed several types of scows capable of dumping garbage and dredge spoil at sea, or depositing breakwater/shoreline extension fill. Of the types that were developed, including the hopper barge, the side-dumping scow, and the hinged scow, the hopper barge was the most common, possibly due to its functional design. Although the most common, its origins are not understood, and the type remains undocumented. Plans of a 1927 six-pocket (hopper) dump scow (hopper barge) indicate that instead of a raked bow and stern seen on the scow, the hopper barge has:

> curved ends forming one-quarter of a circle from the keel to deck. The pockets measure 28 feet from side to side at the top and 16 feet 5 inches fore and aft. There is a 3 foot 4 inch coaming rising above the deck. At deck level, the sides of the pockets begin sloping inward. The sides ending at the hatch in the bottom measure 9 feet 6 inches wide. The hatch is closed by a pair of timber doors. The doors are closed by chain bridles attached to single chains passing over sheaves on forward and aft bulkheads. These chains are in turn attached to cables on moving sheaves. The cables are taken in or released by turning a continuous shaft running along the top of the hatch coaming on one side. The shaft, probably operated by hand, closed the doors once the contents of the hopper had been dumped. In the middle of the barge is a seventh bay only eight feet 10 inches in the fore and aft dimension [Brouwer 1996:140-141].

Although not represented in the investigated vessels, another dump scow type was the side-dump scow. Similar in hull configuration to the basic scow, it had bulkheads like those of the rock scow. It differed from both in that its deck was not level, but sloped downward 45 degrees on either side of the longitudinal centerline between the end bulkheads. This sloped deck was divided into sections by additional transverse bulkheads, with the "cargo" held in place and later released by bay doors at the base of the sloped deck (Brouwer 1996:141). A plan view of this type, found in the Feeney Collection but not pictured here, shows the general interior layout of the vessel and illustrates its similarity with the deck and rock scows, but does not illustrate the slanted deck or additional deck pockets.

DOUBLE-ENDED FERRIES

Indigenous to the port area of New York, the double-ended ferry was a quick adaptation of steam power, which itself was the result of several developments associated with the Industrial Revolution. The invention of malleable iron by Cort in 1784 certainly provided the means of shaping iron for power-plant production, as did the work of machinist Samuel Wilkinson and others. In the late eighteenth century, Boulton Watts (Soho) established an engine manufacturing plant that eventually provided an opportunity for European and American engineers to experiment with steam-power propulsion (Hutchins 1948).

In the U.S., John Fitch experimented with marine steam power on the Delaware River near Philadelphia, while John Stevens and Robert Fulton worked between New York and Hoboken, New Jersey. Colonel Stevens operated a steam launch at Hoboken in 1804 (Whittier 1987). When Robert Fulton built the world's first commercially successful steamboat, *North River Steam Boat,* in 1807 (Figure 14), he had little idea what the appropriate hull form should be. The vessel seems to have had a shape similar to a large canal boat (Brouwer 1996), though Dayton (1939) suggests lines similar to a sailing ship. In describing the boat, enrollment records state "she is a square-sterned boat, has a square tuck: no quarter galleries and no figurehead" (Morrison 1958:21). The vessel, built at the Charles Brown Shipyard on the East River near Manhattan, originally measured 140 feet in length by 16 feet in breadth, a ratio of almost 1 to 10 (Morrison 1958). The copper boiler (low-pressure) measured 20 feet long by 8 feet wide (Dayton 1939).

Rebuilt after its first season, the steamboat measured 149 feet. Peter A. Schenck, surveyor of the Port, certified that the boat had one deck and two masts, a breadth of 17 feet 11 inches, and a 7-foot depth (Morrison 1958:21). A contemporary drawing of the boat, later named *North River,* shows a stern similar to those on sailing ships of the period, though with a proportionately wider transom. The paddlebox extended out from the hull with no additional structure forward or aft. There are two masts, one forward and one aft, with yards for square sails, which are furled.

Jean Marestier's study of American steamboats *Memoir on Steamboats of the United States of America,* published in Paris in 1824, includes an outboard profile of Fulton's steamboat *Paragon,* built for the Hudson River in 1811 (Figure 15). It is very similar to the print described above. The sails are shown set with a very deep square sail on the foremast, a small square topsail above, and a fore-and-aft sail from a gaff and boom on the second mast set. It has a plain bow with a convex curve to the stem, and a bowsprit house on deck from which is set a single jib. The main difference from the first steamboat is the apparent addition of "guards," protective mouldings faired out around the paddlebox.

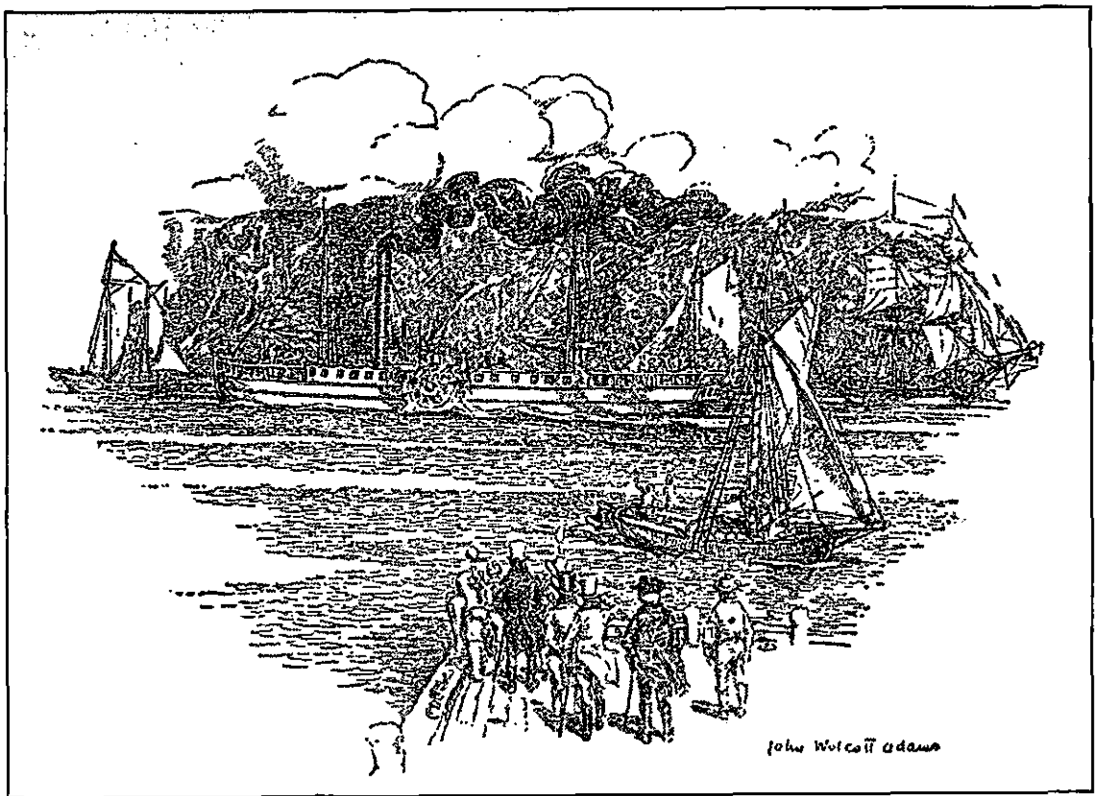

Figure 14. John Wolcott Adams's lithograph of *Clermont* (Dayton 1939).

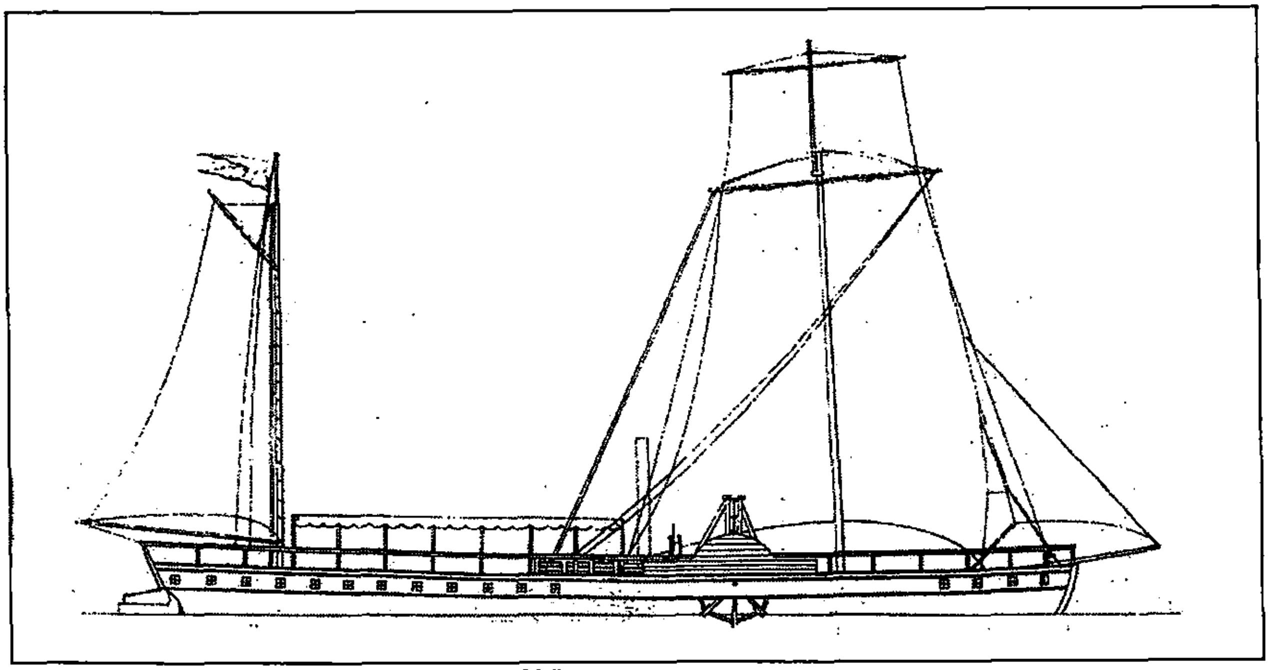

Figure 15. Side view of *Paragon* (Marestier 1824).

Ship paddlewheels, called waterwheels at the time, had the same basic design as waterwheels used in powder mills. These wheels, easily modified for marine use, "ideally suited...the conditions which existed on American waterways in Fulton's time" (Whittier 1987:7). To generate enough thrust from a relatively slow-turning steam engine, screw propellers had appreciable draft, creating problems for a shallow-draft vessel. On a shallow-draft hull, a pair of paddlewheels generated ample thrust without projecting below the keel line.

The 1820s witnessed two major changes in steamboat design. Sails disappeared within a few years, and length-to-breadth ratios declined (seven to one or less). Aside from these developments, boats of the early 1820s had most of the same features as the *Paragon*. The *Constitution*, built in New York, had a similar bow and a transom stern with six or seven windows. The guards around the paddleboxes did not extend very far forward or aft, but did create some additional space for storing boiler wood. The vessel included a second deck aft of the engine, sheltered by an awning (Brouwer 1996).

The *DeWitt Clinton,* built at Albany in 1828, measured 233 feet in length, 28 feet in beam, 64 feet over the guards, 10 feet depth of hold, and 4.6 feet draft (Dayton 1939). Freeboard reduction brought the main deck much closer to the water; little transom remained at the stern. The guards extended outboard around the paddleboxes in a continuous curve from bow to stern, supported at intervals by diagonal struts braced against the hull. In addition to providing more space, the guards afforded a practical place to put the boilers (Ringwald 1965). West Point Foundry built the engine, the largest at the time, with cylinders measuring 66 inches in diameter with a 10-foot stroke (Dayton 1939).

Marestier (1824) expressed concern over the stress engines and boilers placed on wooden hulls of this type once they exceeded a certain length. Several methods provided additional support. A heavy-timbered truss ran fore and aft on either side, with the highest point sometimes arching over the paddlewheels (Ringwald 1965). These trusses, called hogframes, were a distinctive feature on early wooden-hulled steamboats. The *DeWitt Clinton* also had three masts on the centerline supporting "hogging chains," iron rods extending to either side, offering additional support for the guards. These rods distributed the stress and provided support for the guards. Additionally, the wooden hulls were equipped with massive engine bed timbers because of the engine's great weight.

Crosshead engines powered early steamboats. Developed from Fulton's basic vertical-cylinder layout, this type of engine is named after the crosshead frame shown in Figure 16 (the small cylinder below the steam cylinder is the condenser). A long piston rod extended above the cylinder to form a T with the horizontal crosshead. The crosshead, a device forming a connection between the piston rod and connecting rod, is similar to the joints in the human body (Hawkins 1987[1904]). The engine, positioned athwartships, moved and up and down on vertical guides. The first guides were mounted on simple upright timbers. Later a pair of A-frames (linked together at the top) replaced these timbers. Some steamboaters called it the "gallows frame" because of its shape (Whittier 1987). Near the outer ends of the crosshead, two connecting rods attached together. These came down on either side of the cylinder to crank throws on the paddlewheel shafts. As the crosshead rose and fell, the connecting rods rotated the cranks, turning the wheels.

The vertical beam engine, known as the "walking beam," is a uniquely American technology. Developed around 1820, the engine's design was used as late as the 1950s. Its popularity revolved around its simplicity. However, despite the popularity of the walking beam engine, crosshead engine production continued sporadically through the 1830s. Introduced as a solution for space and balance problems associated with bigger engines, the walking beam engine also had a vertical cylinder (Whittier 1987). A piston rod attached to a crosshead above; however, above the crosshead, a second rod connected to one end of a diamond-shaped beam. The beam rotated at its center on a bearing mounted at the top of an A-frame, similar to the A-frame of earlier engines. A connecting rod to the single crank throw was attached to the other end of the diamond-shaped beam. In this way the beam, rocking back and forth, transferred the up-and-down motion of the piston to the crank, turning the paddlewheels.

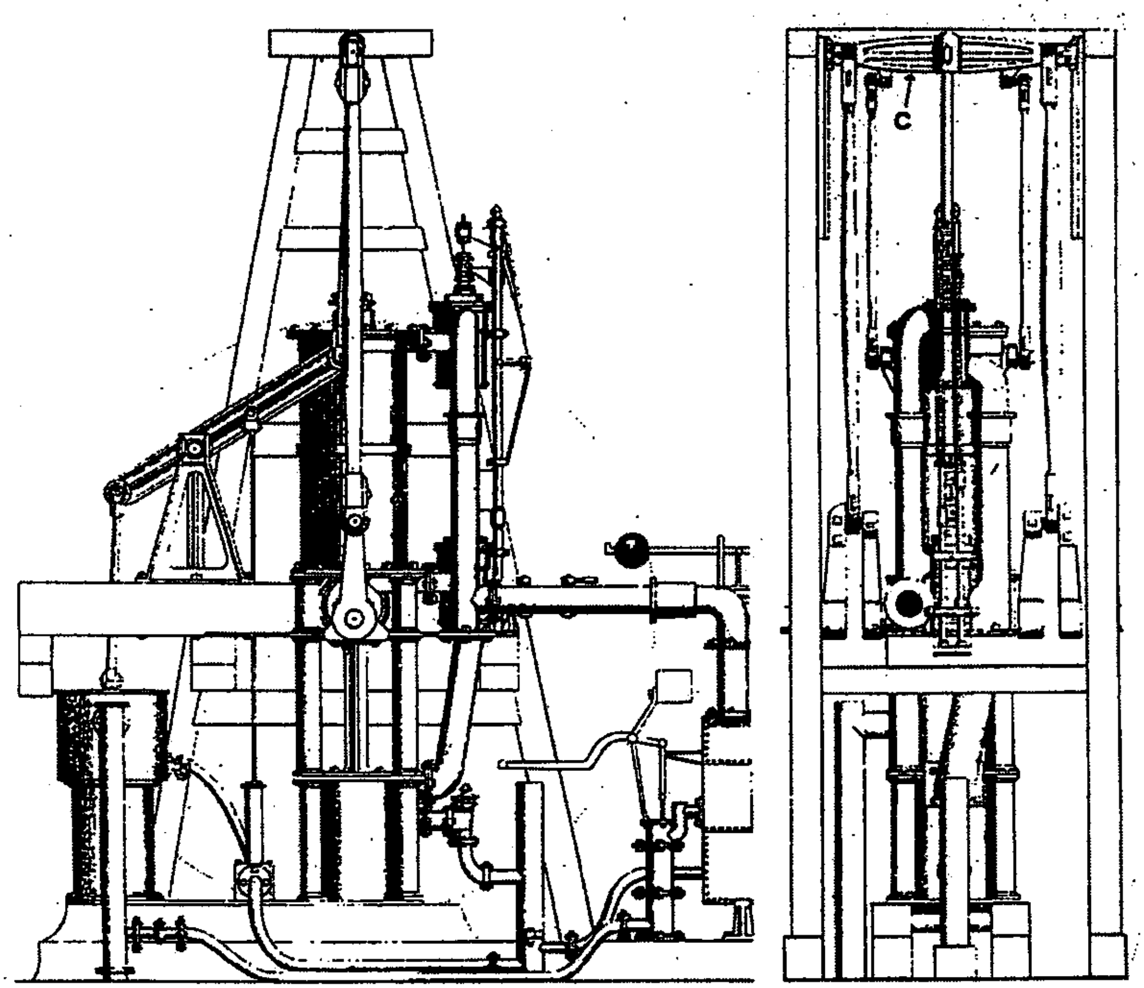

Figure 16. Vertical cylinder layout of a crosshead engine around 1850. The name comes from the sliding member marked "C" (Whittier 1987).

Figure 17 shows a walking beam engine built by T.F. Secor and Company, New York. A typical 1850 design, the long stroke piston and double poppet valves minimized the force needed to open them against steam pressure. Cold water passed through the injector pipe, then flowed through openings in a perforated plate into the condenser chamber. From there it mixed and condensed exhaust steam. The water/vapor mixture was withdrawn by air (Whittier 1987).

The walking beam apparently got its name from the rate at which it moved, usually in full view above the roof of the steamboat's uppermost deck. In a few later steamboats, it was enclosed in a small uppermost deck. Later still it was enclosed in a small, greenhouse-like structure (Brouwer 1996). By the mid-1800s wrought-iron straps over a cast-iron framework replaced heavy wooden timbers, though wooden frames appeared right up to the end of the walking beam era (Whittier

1987). In the 1880s A-frames consisted of iron and then steel angular plating. Three known examples of the walking beam engines survive, two in the United States: the ferry *Eureka*, preserved at San Francisco, and the lake steamer *Ticonderoga*, preserved at Shelburne, Vermont.

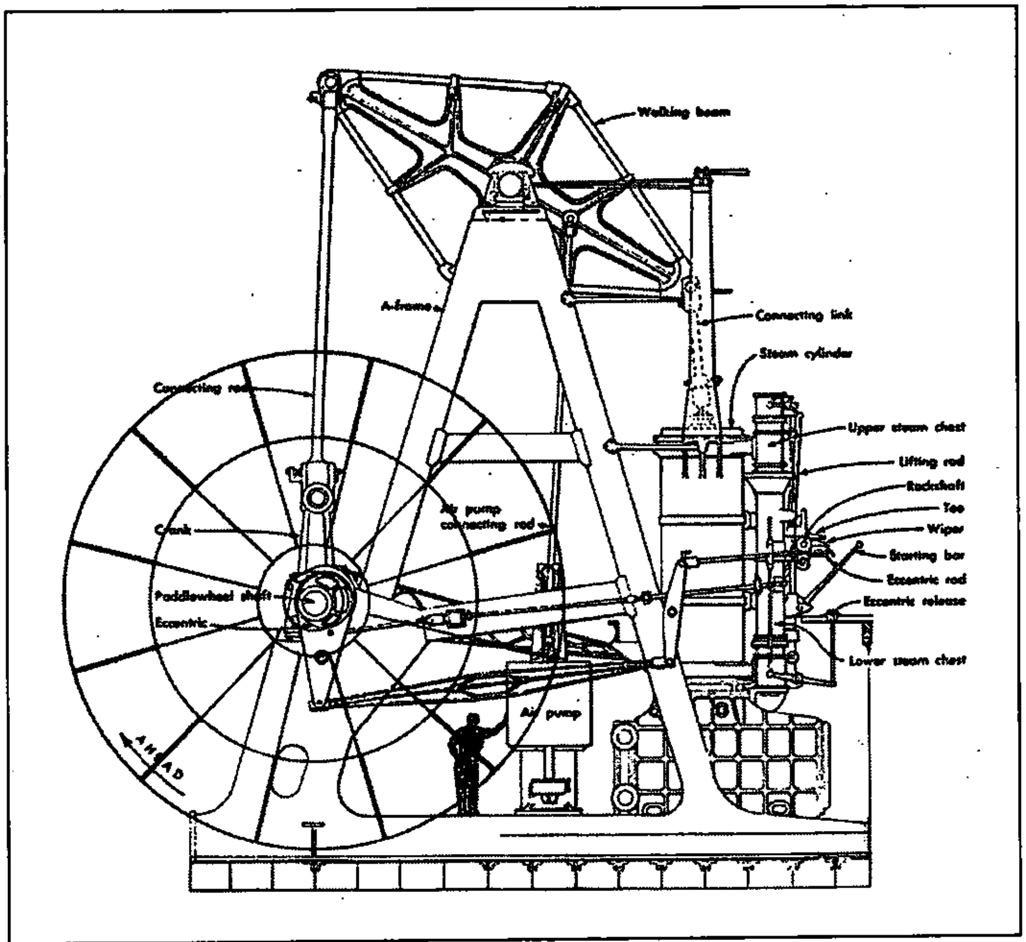

Figure 17. Labeled illustration of a walking beam engine of intermediate size (as presented in Whittier 1987:50).

Development of New York City Double-Ended Ferryboats: 1812-1860s

Until the advent of the steam ferryboat, regularly scheduled connections to and from New York City (via the harbor) occurred by sloops, periaugers, and rowboats (Cudahy 1990). After Robert Fulton's successful use of steam power with *Clermont*, innovators realized the potential steam power had for ferrying passengers, and steam service soon became a routine and expected feature of New York City life. Original designs and characteristics took place under the guidance of Fulton and John Stevens, who, along with other builders, designed the double-ended ferry.

Robert Fulton launched the first double-ended ferry in July 1812, with the construction of the twin-hulled *Jersey*. Built by New York City's Charles Brown Shipyard, the 80-foot-long ferryboat transported passengers over the Hudson River. Fulton's design featured a twin-hulled vessel equipped with a 5-foot draft and a 30-foot beam. The draft allowed easy maneuvering over water (Marestier 1957[1824]). A platform between hulls held machinery, passengers, and cargo. Fulton placed the paddlewheel between hulls, mainly to avoid direct contact with floating ice. He situated the rudders in the same space, one forward, one aft of the paddlewheel. Equipped with fore and aft rudders and a double-ended hull, the ferryboat could travel to and fro across the river without turning. This characteristic gave the vessel type its name, "double-ender," and differentiated the class from other sidewheel vessel types such as the Hudson River and Long Island Sound vessels. These sidewheelers, also ferrying people and freight and powered by the same engine types, had different hull and deck configurations, and had only the single stern rudder.

The *Nassau*, also built by the Charles Brown Yard (1814), retained the twin-hull configuration begun by Fulton, but featured a passenger cabin on the main deck (Cudahy 1990). *Jersey* and *Nassau* remained the only two ferryboats operated by Fulton. After Fulton's death former associates added another twin-hulled ferryboat, *William Cutting*, to the fleet in 1827.

Following visits to the United States in the 1820s, Frenchman Jean Baptiste Marestier wrote an eyewitness account of the Fulton-type ferryboat. The boats, according to Marestier, had platforms between 72 and 79 feet long. The engines rested on the platform center. The paddlewheel rested in front of the engine. The paddlewheel contained eight buckets eight feet in length, two feet in height. Boiler dimensions averaged 18 feet long, 7 feet wide, and 7 feet high. At the end of each platform sat a cabin (Marestier 1957[1824]).

Because ice had a tendency to disrupt the twin-hulled paddlewheel's motion, the Union Ferry Company, "an outgrowth of the original Fulton ferry line interest, finally dispensed with its twin-hulled ferryboats" in 1833 (Spirek 1993:29). The company opted for a single-hulled configuration, which effortlessly sliced through ice. Latter-day New York City ferryboats retained two Fulton designs: a sloping main deck amidships to each end (caused by the paddlewheel shaft's placement above the sheerstrake of the hull) and the characteristic double end (Hall 1884).

John Stevens is credited for the prototype of the single-hulled New York City ferryboat. He launched *Hoboken*, a 98-foot steam-powered double-ender, on May 1, 1822. The ferryboat ran between Hoboken and Manhattan on the Hudson River. Keeping two characteristics of Fulton's early design, the characteristic double-end, and a sloping main deck from amidships to each end, the boat featured a single hull and a sidewheel port and starboard. To protect the sidewheels, Stevens extended the main deck. The addition, including paddlewheel sponsons, provided additional room and loading capacity to the boat. Not intended for oceanic passage, the vessel's design was adapted to the interior waters of New York Harbor (Cudahy 1990).

The demand for ferryboats increased as the boat proved its reliability. The corresponding economic growth in Manhattan and surrounding areas (New Jersey, Brooklyn, and Staten Island) further increased ferryboat demand. New York City's population in the 1800s numbered around 100,000. By 1824, six ferryboats serviced the City's population of 200,000. By 1860, 70 ferry-boats serviced nearly 1,176,000 New Yorkers. Some ferryboat companies carried up to 5,000 passengers a day (Spirek 1993).

Into the 1830s, overall ferryboat size increased. Stevens's ferryboat line built *Fairy Queen* in 1826. One hundred forty-nine feet long, the boat measured 26 feet wide with a 6-foot draft. The boat featured a vertical walking beam engine with two paddlewheels. *Fairy Queen* had cabins in the hull, accommodating up to 100 passengers. The boat had a bar on board, and during the summer crewmen stretched an awning over the boat from end to end. A helmsman operated a rudder tiller, steering with the help of a pilot who stood at the forward end of the vessel (Stevens 1893).

In 1836 the Union Ferry Company operated three new ferryboats. On heavily traveled routes, the company added the 304-ton, 155-foot-long *Brooklyn*, the 155-foot-long *New York* (23-foot beam, 9-foot draft), and the diminutive *Olive Branch* (89 feet long, 23-foot beam, and 8-foot draft). Besides these three boats, Union Ferry operated three other ferryboats ranging in size from 100 to 125 feet in length, 145 to 184 in tonnage (Cudahy 1990).

By the 1840s, shipbuilders all across New York City built double-enders. William H. Webb, noted builder of sailing ships, built three double-enders for the city. *Wallabout* and *New York*, sister ships, measured 94 feet long, 23 feet in beam, and 9 feet draft. The third ferry, *Williamsburg*, built in 1846, measured 115 feet long, 26 feet in beam, and 10 feet in depth. Each of the boats featured a vertical beam engine with a walking beam. These boats operated on the East River (Dunbaugh and Thomas 1989).

The Staten Island ferryboat *Hunchback*, built by Jeremiah Simonson (New York City) in 1852, featured an upper cabin, making it the first double-decked ferryboat in New York Harbor (Cotterell 1978). The wooden housing built to enclose the walking beam gave the boat a lumpish appearance, hence the name. Another Staten Island ferry was the *Southfield*, built in 1857 for the New York and Staten Island Ferry Company's route from Staten Island to Manhattan by way of New York Harbor. The wooden double-ender was 200 by 34 feet, with an overall deck length over guards of 210 by 50 feet. The first 30 feet of hull at each end consisted of solid timber for navigating through ice floes in winter. She was converted to a gunboat by the U.S. Navy during the Civil War (Spirek 1993).

The 700-ton *Atlantic*, 177 feet long with a overall deck length of 190 feet, had a beam of 32.5 feet. Built in 1857, the New York Times called *Atlantic* the "largest and most perfect ferryboat ever constructed" (*NYT* January 21, 1858). The *Atlantic* featured a hull designed to plow through ice (*NYT* August 12, 1857).

Another boat, *John S. Darcy*, also built in 1857, measured 191 feet in length, 33 feet in beam, and 11 feet in depth, and "became the largest ferryboat in the New York City area during this time" (Spirek 1993:33). Because some ferries serviced less-traveled locations, many were small. The ferryboats *Ethan Allen* and *Commodore Perry* (527 tons) measured 144 feet in length and 33 feet in beam (Franklin Institute 1859).

The New Jersey Railroad and Transportation Company operated *John P. Jackson* for ferry service between Jersey City and New York City. The 860-ton vessel, built by the Devine M. Burtiss Shipyard, measured 192 feet end to end, with its deck measuring 210 feet stem to stern. The ferry had a 36-foot beam, a 12-foot depth, and a draft of 5 feet 5 inches. The frame was of white oak, chestnut, and other hardwoods fastened together by copper spikes/bolts and treenails. Its single-cylinder, vertical-beam engine measured 46 inches with an 11-foot stroke. The paddlewheel had a 21-foot diameter and featured 18 buckets (Cudahy 1990; Franklin Institute 1860).

The archetypal ferryboat design established by Fulton and Stevens changed little over the years. Most builder concerns centered around keeping foot passengers separated from wagons and other cargo. Early configurations accommodated wagons near the center of the boat; enclosed cabins provided passenger room and space. Later ferryboat construction kept this configuration, but added a cabin above the main cabin (Grava 1986). An 1880 description of a double-ender states:

> The ferry-boats of New York are double-enders, sharp and swift, with side wheels, the deck highest amidships and dropping about 2 feet at the ends in a gradual curve. They are all of one general type, varying only in size. The machinery is stowed away in the hull as much as possible. The engine is low-pressure condensing, is often built with horizontal cylinder and piston, has a long stroke, and acts quickly. A narrow house rises in the center of the deck to shelter the machinery and cover the stairways to the hold, and on each side of this the deck is open for 10 feet, in order to allow horses and wagons to pass from end to end of the boat. The cabins for passengers are outside of the two gangways, one on each side of the boat, and extend two-thirds of the length, each cabin being in turn divided nearly in two by the wheel-house, which rises through it and leaves only a hallway 3 feet wide between the forward and after halves of each cabin. A roof covers the whole of the cabin, engine-house, and spaces between for teams, and the pilot-houses are on this roof, one at each end of the boat. A portion of the deck at each end is clear of structures of any kind, except the posts and chains needed to prevent the passengers and teams from crowding each other overboard while in the stream. These boats are an important feature of the business life of New York

city. They run across the North and East rivers at numerous points, and from the city to Staten Island, day and night, at intervals of from 5 to 30 minutes, according to the magnitude of the travel on each particular route. A large boat will carry 400 passengers and about 50 teams with wagons on a single trip. In construction of this class of boats the New York builders have attained special excellence. The hulls are strongly but lightly framed with oak and chestnut and planked with oak, yellow pine being used for the rest of the vessel except the houses and the decking, which are of white pine and spruce, with cherry, black walnut, etc., in the joiner work of the cabins. They cost from $50,000 to $90,000 each, according to the size of the hull and the luxury of the cabins. The Jersey ferry-boat *Princeton*, of 888 tons, built in the census year, was one of the large class. She was 192 feet long, 36.5 feet beam, and 12.5 feet deep in the hold, and to build her it required 52,000 feet of oak, and 10,000 fee of chestnut, 103,000 feet of white pine and spruce, and about 10,000 feet of yellow pine. Her machinery weighed 130 tons. Complete the boat cost $85,000 [Hall 1884:162].

Iron straps provided longitudinal support for most wooden-hulled, shallow-drafted ferries. Copper fasteners, commonplace by the 1860s, held strakes below the waterline together, while iron fasteners served the same purpose above. At either end of the hull was a rudder, and depending on the direction traveled, one rudder acted as a bow, locked in place with a lock-pin, while the other acted as the steering rudder and provided direction (Spirek 1993).

Winter ice created hazards for the pilot and his boat. Fulton and Stevens had some success with ice, each approaching the hazard differently. Fulton placed the paddlewheel in the center of the two hulls, but ice between the hulls created handling problems. Stevens' single-hull configuration pushed the ice out of the boat's path, and if caught between ice floes, compressed the ice downward, away from the hull. As a safety feature, Stevens placed cork inside the hull for buoyancy (*NYT* December 12, 1857).

Boats operating in the harbor faced another hazard: marine borers. Coppering, or sheathing, protected the hull from borer infestation. The combination of sheathing, pitch, horse hair, cloth, or other materials extended the life of the vessel's hull. Ferryboat coppering usually occurred several months after construction was completed, allowing for exterior strake expansion. "It is customary not to copper them [ferryboats] until they have been in service for six months" (Franklin Institute 1860:291). Sheathing could then occur without strain or tear by further expansion.

Vertical-beam engines powered most early double-ender ferries. But because space in the hold of a double-ender was of little value and deck room was critical, the inclined marine engine, which occupied the hold and left more deck room, was accepted by many ferry companies for later vessels. However, in the late nineteenth century the walking beam engine still remained the more usual type.

The inclined engine was designed in 1839 by Charles Copeland, its patent issued in 1841. The placement of the inclined engine in the hold affected the beam-to-width ratio of inclined versus walking beam engine vessels, with the former being much beamier (Hall 1888:64). The engine and frame of an inclined engine are presented in Figure 18. Describing this figure, Copeland's patent of one engine states:

The cylinders in this arrangement of the engine are inclined at an angle dependent upon the depth of the hold and the length of stroke, and they are fastened to inclined beams extending from the paddle-wheel shaft to the keelsons, said beams being connected with the keelsons along their whole length by other beams and by bolts, the whole constituting truss-frames, which may be of wood or iron, which sustain and divide the weight and jar of the engines [Hall 1888:38].

Boiler locations varied from boat to boat, some positioned deep in the hold, others located near the paddlewheels. Wood originally provided heat for steam, though coal replaced it as a primary heating source in the early 1830s (Cotterell 1978). As one would suspect with wooden vessels, fire proved an immediate danger during operation. The *Williamsburg* ferry, operating between

Manhattan and Williamsburg, Brooklyn, "adopted...every precaution...to guard against fire, the boilers being quickly felted, and the decks and wood-work around the boilers and chimneys protected by facings of zinc" (*NYT* January 21, 1858). Fire protection for most ferries probably mimicked the *Williamsburg* vessel.

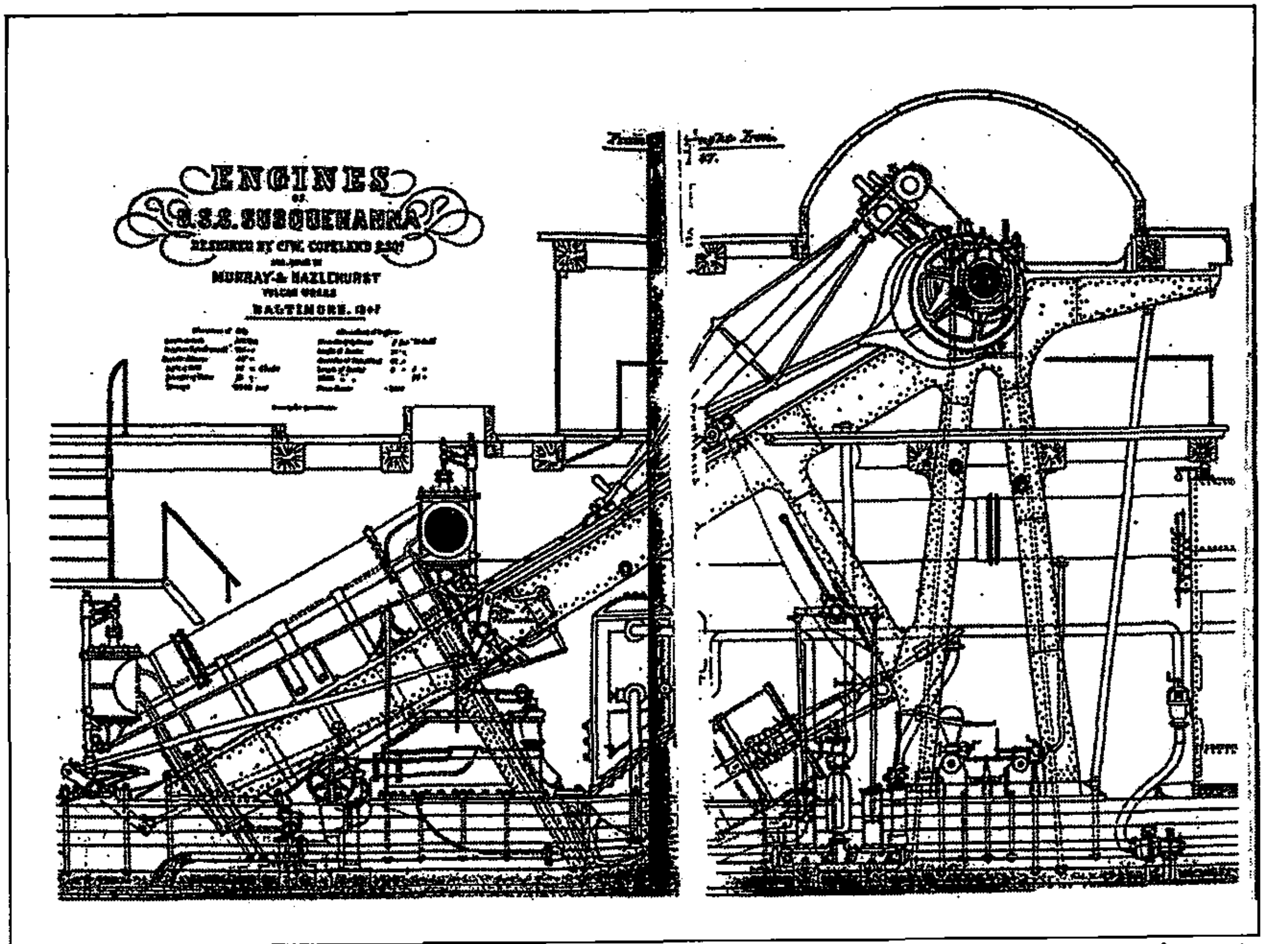

Figure 18. Inclined marine engine developed by Charles Copeland in 1839. The majority of the engine rests below the level of the main deck (as presented in Hall 1888:Figure 13).

As passenger traffic increased, builders in the 1850s included a second cabin above the main cabin. This addition commonly appeared on long-distance service, i.e., Staten Island ferryboats. The promenade, or upper deck, supported the upper cabin and the fore and aft pilot house, and provided additional passenger space. The hurricane deck sat atop the promenade deck cabin. Generally, three pilot house patterns appeared in New York City. A freestanding circular house and a freestanding square house usually appeared on single-decked ferries. A rectangle backed by an upper cabin is normally associated with double-decked boats (Spirek 1993).

The general configuration of New York City ferryboats remained the same for decades. Until the late nineteenth century, most were sidewheelers, the propeller models appearing in the 1880s (Delgado and Clifford 1991:37). Design evolution focused on increased size and space. Never as ornate as Hudson River or Long Island Sound steamers, these boats provided ferry service to thousands of commuters. The design is still visible in modern-day ferries.

Tugboats

The tugboat, as a distinct vessel type, dates back to Scotland with the construction of the *Charlotte Dundas* (1801) for towing barges on the Forth and Clyde Canal (Moran and Reid 1956:9). The Staten Island ferry *Nautilus* inaugurated the modern towing and tugboat industries in the United States on January 26, 1818, when she towed the sailing ship *Corsair* through the ice-choked lower harbor of New York from one mile below the Narrows to the quarantine dock. Other vessels quickly followed. In 1825 the woodburning sidewheeler *Henry Eckford* towed Hudson River barges from New York to Waterfront, the eastern terminus of the Erie Canal (Cleary 1956:44). In port, *Henry Eckford*'s crew docked and undocked sailing vessels. From that time on, towing became a part-time concern for many steamers operating in and around the harbors of the United States until it grew to be its own industry. By 1880 there were more than 1,800 tugboats operating in different parts of the country, chiefly in the seacoast harbors and northern lakes (Albion 1939:147).

Sidewheelers mobilized the towage service almost exclusively in the first half of the nineteenth century, guiding windbound whaling vessels, produce barges, and rafts of canal boats through or into the harbor. The forerunner to today's tug, the workhorse sidewheeler marked an evolution in steamboat design that significantly contributed to New York's lighterage system. Many of the first vessels employed in towing were converted passenger ferries. Illustrated in Figure 19, the *Norwich* was built in 1836 as a passenger vessel, and later was employed on the Chesapeake as a packet and between New York City and Rondout as a nightboat (passenger service). She ran as a towboat on the Hudson until 1917, and in 1923 was sold for scrap.

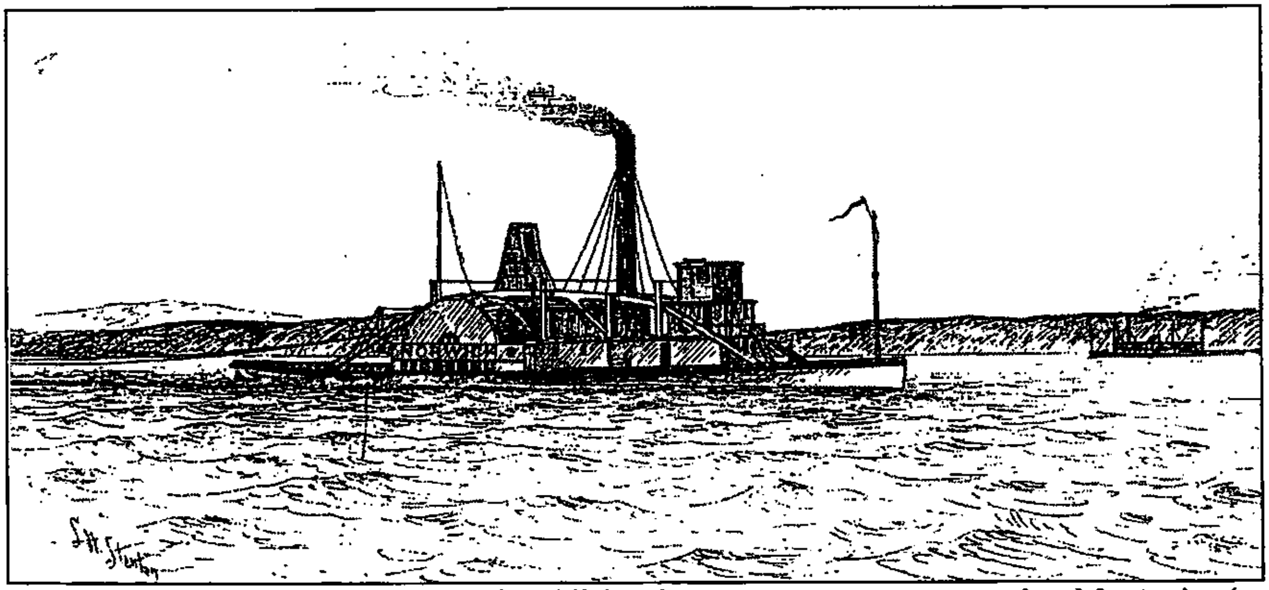

Figure 19. Representation of the *Norwich*, a 160-foot former passenger steamer employed for towing (as presented in Swanton n.d.). Note the vessel's crosshead engine.

In 1828 the New York Harbor Dry Dock Company built the first boat designed solely for towing in the Port of New York, the sidewheeler *Rufus B. King* (Cleary 1956). The hulls of these first towing vessels kept the lines of the passenger steamer, with its fine entrance and low freeboard. They also employed the same engine types with the walking beam becoming the predominant later type. With the first appearance of the propeller-driven vessel, the evolution of the towboat began. The unwieldy paddleboxes disappeared, and the hulls became shorter and narrower. A standard tugboat profile developed, featuring a long, narrow, one-story deckhouse. The wheelhouse appeared at the forward end, raised a few steps above the deck, or stacked on top of the deckhouse on smaller boats. Main decks developed a noticeable sheer, rising higher at the bow than the stern. Heavy moulding ran along the sides at deck level to withstand the constant buffeting by barges or car floats (Brouwer 1990:182-183).

Records suggest that the iron tug *R.B. Forbes*, of Ericsson design, appeared as early as 1845 (Hall 1884). The tug, twin-screwed, registered about 300 tons, its size apparently adapted for rough water work. Screw-type tugs later appeared in Philadelphia in 1849 (Hall 1884). Apparently an owner of two old paddlewheel towboats in the city saw the advantage of propeller tugs in the harbor. William Cramp of Philadelphia built the first propeller-type tug, *Samson*, on the Delaware River. The wooden-hulled vessel measured 80 feet in length, 17 feet in breadth, with a draft of 8 feet.

The success of the *Samson* drew a great deal of attention. Cramp departed from the idea of an entirely submerged screw, instead outfitting *Samson* with a 6-foot wheel, half of which remained below the hull, a 3-foot keel protecting the screw (Hall 1884). A number of boats featured this configuration. The need for a light-draft vessel led to the removal of the broad keel, the wheel placed entirely above the bottom of the vessel. "This boat proving to be as efficient as its predecessors and much more handy, a revolution was effected in the form of tugs" (Hall 1884:149).

By the late 1800s propeller boats replaced the big sidewheel towboats. The construction of these new vessels called for heavier scantlings, with bigger frames, closer frame spacing, heavier fasteners, and thicker planking. Hall describes an average steam screw propeller tug of the late nineteenth century:

> The tug of our American harbors is a little propeller varying from 30 to 120 tons register. A few of large size range from 130 to 170 tons register, but the average tug is of about 80 tons, and is about 90 feet long, 18 feet wide on the beam, and 9½ feet deep in the hold. One of 170 tons would be 120 feet long, 22 feet beam, and 12 feet deep in the hold. The hulls of the tugs are sharp and deep, but not long, and float at about 8 feet draught, drawing a foot or two more aft than forward. Those that go out into rough water are given a good deal sheer forward. The stems are perpendicular; the sterns are round and overhang from 6 to 10 feet. Although these little vessels sit low in the water, the deck being not more than 2 or 3 feet higher than the load-line, the bulwarks are always low. A house covers the machinery, which is placed amidships, and the pilot-house is either at the front of this cabin or on top of it at the forward end. Strong towing bitts are placed forward and aft of the house [Hall 1882:149].

By the 1920s and 1930s most of the old steam wooden tugs and towboats had been converted to diesel. In addition to technological improvements, diesel propulsion offered economic benefits. In 1923 for example, the Moran Company converted their steam-driven 107-ton tug *Eugenia M. Moran* to diesel. With her new self-contained 2-cycle, 4-cylinder diesel engine, the *Eugenia*'s fuel bill was reduced approximately 50 percent in just one month. Over the course of a few months the *Eugenia*'s monthly savings in operational expenses ranged from $490 to $825 per month (Moran and Reid 1956:1965).

The final technological development signaling the end of steam-driven wooden tugs was the introduction of the welded steel hull. Although riveted iron or steel tugs developed in the late 1800s, the welded steel hull did not achieve prominence until the 1930s.

Tugs are generally divided into two categories, harbor or short-haul tugs and oceangoing or long-haul tugs. These in turn have their own varieties.

CARFLOAT TUGS

Among the larger propeller-driven harbor tugs are those specifically designed for moving car floats across the Hudson River and the Upper Bay. The upper deck wheelhouse, elevated three or four feet by an additional crawl space underneath, gave pilots greater visibility over a car float loaded with standard freight cars. The *New York Central No. 27*, built in 1910, was a typical example, measuring 97.5 feet in length and 25.6 feet in breadth, with a depth of hold measuring 12.2 feet (Brouwer 1996).

The *Newark*, built at Elizabethport, New Jersey ca. 1916, served as a carfloat tug for the Central Railroad of New Jersey. The steel-hulled vessel measured 110 feet overall, with a molded beam of 26 feet and a depth of hold measuring 14 feet, 6½ inches. The lower, narrower after part of the deck house provided an unobstructed view of the stern from the pilot house (Figures 20 and 21).

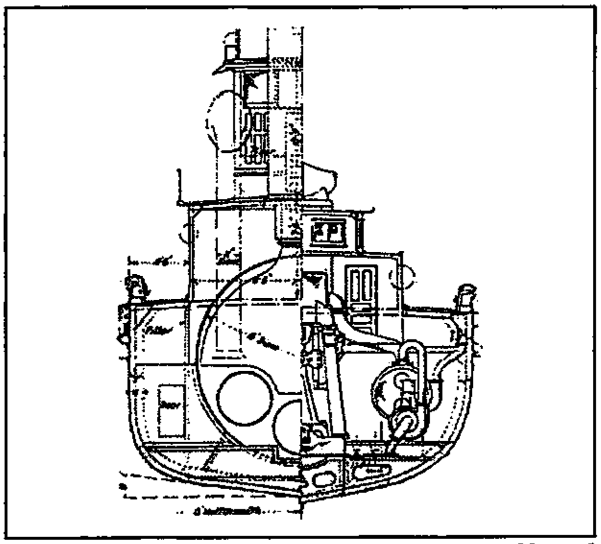

Figure 20. Midship section of the tug *Newark* (International Marine Engineering 1916).

Canal Tugs

After the completion of the New York State Barge Canal in 1921, goods were brought to the Port of New York from as far away as Buffalo in barges towed behind tugs. Because of height restrictions, the tugs used were long enough to accommodate the powerful engines required, but they also had a very low profile. Wheelhouses were again lowered to the main deck at the forward end of the deckhouse. Many canal tugs featured hydraulic systems for raising their pilothouse where heights were not restricted.

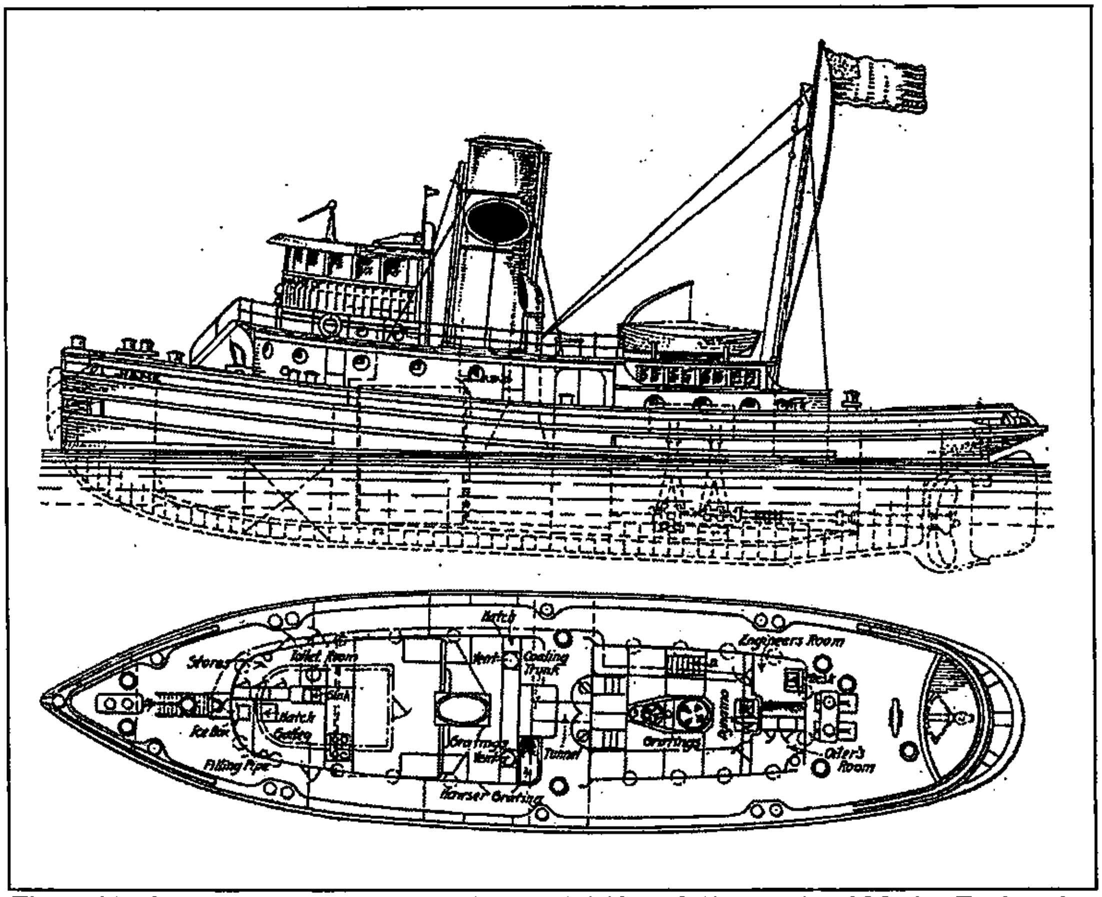

Figure 21. General arrangement of the iron-hulled *Newark* (International Marine Engineering 1916).

Offshore Tugs

The largest class of tugs moved coastwise barges, particularly the long strings of schooner barges that transported coal from New York and points south to ports in New England. Both wooden and steel-hulled, characteristics of this "seagoing" type are a series of steel-hulled boats built for the Reading Railroad around the turn of the century. One of these, *Catawissa* (1896), survives as a steam-cleaning plant based in Mariner's Harbor, Staten Island. The steel-hulled boat measures 158 feet by 29 feet breadth, with a depth of holding measuring 18 feet. Engines rated at 1,000 hp powered the boat. The seagoing tug featured a profile typical of tugs, but with two masts forward and aft (Brouwer 1996).

Often employed in the offshore towing of schooner barges, the size of the offshore tug and its horsepower determined the number of barges the pilot could tow. Bigger tugs, with a pulling capacity in excess of 400 hp, could tow three or more loaded schooner barges. Increased pulling power, larger loads, and stress on the bitts required a greater towing distance between barges. The greater the distance, the greater the probability for problems, particularly during bad weather.

Wooden Harbor Tugs

The Emergency Fleet Corporation and the Consolidated Shipbuilding Corporation, formerly the Gas Engine & Power Company, built four 100-foot wooden harbor tugs for the USSB at Morris Heights, New York. J. Murray Watts, naval architect, Philadelphia, Pennsylvania, designed the boats. With lines similar to usual harbor tugs (100 feet), the American Bureau of Shipping rules for wooden tugs presented the following specifications (International Marine Engineering 1919):

Keel:	white oak, sided 12 in. and molded 13 in.
Stem:	white oak, sided 11 in. and molded 14 in.
Stern post:	white oak, sided 11 in. and molded 14 in.
Frames:	white oak, sided 6 in. double
Keelson:	12-by-12-in. yellow pine in long lengths with scarfs not less than 6 ft. long
Shaft log:	white oak in halves, 10 by 24 in.
Deadwoods:	white oak, sided 18 in. and molded back to receive the frames
Bottom ceiling:	yellow pine 3 in. thick
Side ceiling:	ceiling between the bilge strakes and the clamps $3\frac{1}{4}$-in. yellow pine
Clamps:	yellow pine 6 by 10 in., three strakes on each side in long lengths, scarfed
Shelf:	yellow pine, two strakes 5 by 9 in., lock strake 5 by 10 in., in beam 1 in.
Deck beams:	main beams yellow pine sided 11 in. and regular beams sided $8\frac{1}{2}$ in.
Knees:	white oak or hackmatack
Outside planking:	side and bilge planking $3\frac{1}{4}$-by-8-in. yellow pine
Sheer strakes:	three sheer strakes 4-by-10-in. yellow pine, fastened with $\frac{7}{16}$-by-8in. galvanized spikes
Deck planking:	3-by-3-in. Douglas fir or yellow pine
Plank sheer:	white oak 4 by 14 in., let down over the stanchions and fastened with $\frac{7}{16}$-by-8-in. galvanized spikes
Rudder:	the rudder stock and main piece to be of the best steel casting; blade and balance made of oak
Shoe:	cast steel shoe for rudder
Water tanks:	either stock steel tanks or independent wooden tanks
Steel bunker bulkheads:	non-watertight steel bunker bulkheads; steel bulkhead forward of the boiler
Outboard joiner work:	the entire hull, decks, and rails well planed off smooth and fair
Wood deck house:	yellow pine; the top of the deck house made of Oregon pine, felted and covered with No. 6 canvas
Pilot house:	yellow pine

By 1920, 42 of these tugs were built according to Murray's design. Figures 22 and 23 show midship section and general arrangement plans of a typical 100-foot tug (Marine Engineering 1920). The boats were wooden built with oak frames (8 by 12 inches) and hard pine planking. The keels were oak, measuring 12 by 15 inches. The overall length of the tug was 100 feet 8 inches. The keelsons were built up of 11-by-12-inch hard pine.

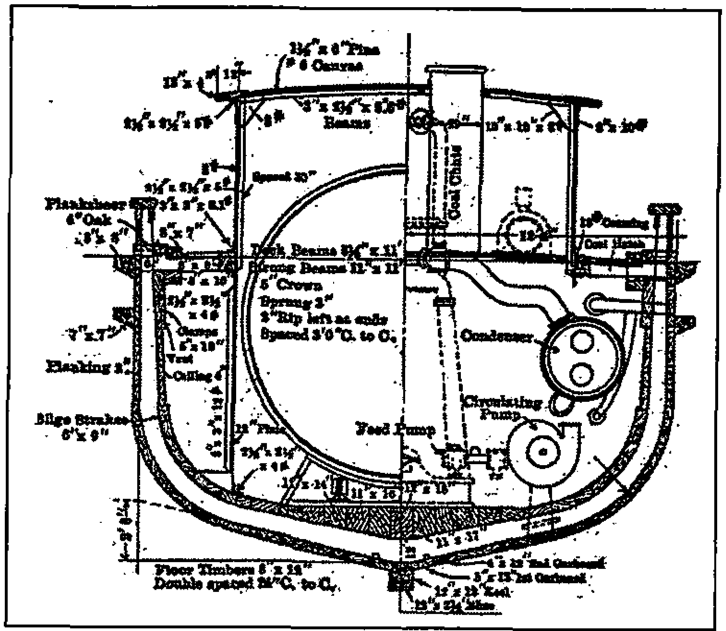

Figure 22. Midship section of a 100-foot wooden tug, circa 1920 (International Marine Engineering 1920).

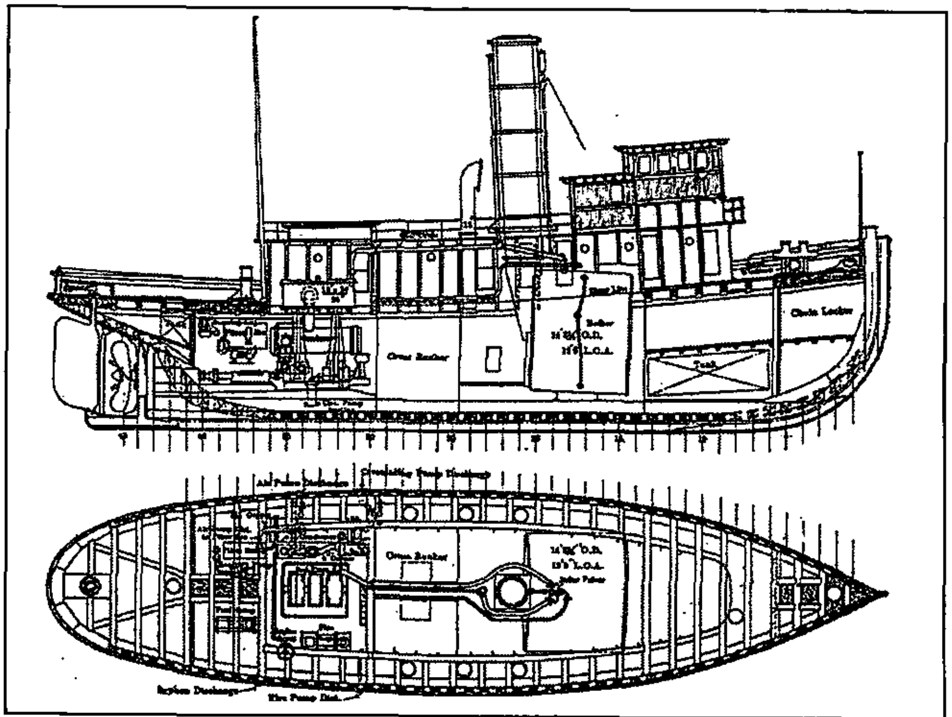

Figure 23. General plan and profile of a 100-foot wooden tug, circa 1920 (International Marine Engineering 1920).

Steel-Hulled Tugs

The Central Railroad of New Jersey had two tugs built "which embody new features and improvements which have been brought about through experience with former tugs..." (Norton 1916:56). Norton (1916:56) provides the following principal dimensions for the tug *Bethlehem*, built by Staten Island Shipbuilding Company for lighterage service:

Length of deck	98 ft. 0 in.
Beam, molded	24 ft. 0 in.
Depth, molded	12 ft. 7 in.
Draft, loaded	11 ft. 0 in.
Displacement	about 320 tons

Except for size, the general arrangement of the other tug, the steel-hulled *Newark*, remained the same. Used for the carfloat service, *Newark*'s dimensions measured as follows:

Length overall	110 ft. 0 in.
Length between perpendiculars	97 ft. 9 in.
Beam, molded	26 ft. 0 in.
Depth, molded	14 ft. 6.5 in.

In designing the tug, builders made sure of interior accessibility, primarily for painting and scraping. As witnessed in Figure 23, the forefoot and deadwood aft is cut away, enabling the tug to turn full circle within a short radius. The tug is fitted with a side-plate balanced rudder. Reverse frames, continuous athwartship, follow the top of the floor plates only. They are doubled in the engine room (Norton 1916).

The fitted keelson extends from the collision bulkhead to the after-end of the engine room. Longitudinal strength is provided by side keelsons and stringers, "the side stringer being deep and formed of intercoastal plates and clips, between frames, with a continuous angle along the outside of the frames" (Norton 1916:57).

The bulwark section aft is set in, cast steel protecting three fitted chocks. This sequence minimized the breaking of bulwarks. The space between the first and second fender guards is filled with solid wood from the stem to amidships, reducing damage to the hanging fenders. The deck is steel, covered with "litosilo" (Norton 1916:57). The after part of the deck house is narrowed and lowered to allow an unobstructed view of the stern from the pilot house.

World War II Tugs

The Army operated several thousand tugs during WWII. The tugs fit into four broad categories: (1) seagoing or large tugs designated as LTs (usually 92 feet or longer); (2) harbor or small tugs, designated STs (about 52 to 92 feet in length); (3) motor towing launches, known as MTLs (40 to 54 feet length); and (4) motor towboats or marine tractors, designated MTs (less than 40 feet) (Grover 1987). The measurements presented here are general. Several older vessels designated STs by the Army measured longer than 100 feet, while the MTL size often received ST designation.

Oceanic military operation and transportation during and after the Spanish-American War increased the need for tugs and towboats. By the turn of the century, Army tugs fell under the jurisdiction of the Quartermaster Corps. In 1909, the Army built four ship-class 98-foot tugs. Towboat construction preceded this class (Grover 1987). Early tugs featured War Department designations "Passenger, Auxiliary or Artillery, and Freight" vessels. These boats served in various capacities.

The Army operated a number of tugs in WWI (Grover 1987). These boats, built to various size specifications, included the oceangoing tug, which towed barges to Europe. During peacetime, the Army's tug fleet remained stagnant. However, WWII in Europe expedited U.S. naval construction. The pre-WWII buildup included tugboat construction, particularly harbor tugs. These workhorses assisted in the movement of ships and lighters at embarkation ports. The Army tried several designs, building one or two tugs in each class, finally deciding on the previously mentioned basic types in 1943 (Grover 1987).

As plans for European invasion and amphibious Pacific landings materialized, the Army ordered hundreds of tugs in each size. By the end of the war the Transportation Corps determined that 746 tugs operated under the designation LT or ST, 1,065 tow launches were designated MTL, and 1,113 were designated marine tractors or MTs. One hundred sixty-seven LTs or STs, 287 MTLs, and 295 MTs served in the European theater. In the Southwest Pacific, 171 STs and LTs, 260 MTLs, and 180 MTs served (Grover 1987).

The Harbor Boat Branch of the Transportation Corps usually operated the tugs, though late in the war some fell under jurisdiction of other departments, particularly oceangoing tugs. The Coast Guard provided crews for most of the live-aboard LTs. Civilians generally operated the STs. Both civilian and military personnel crewed smaller harbor boats, usually day boats (Grover 1987).

FLOATING DRY DOCKS

The floating dry dock is generally considered an American invention. It is basically a large floating structure, "so large that it can not only float itself, but the largest vessel for which it is designed" (Donnelly 1905:312). Donnelly (1905:316) suggests that the design (Figure 24) originated from "the wreck of an old hull laying on some slope beach, which was used by cutting out the stern and making gates to close the opening...similar to...a canal lock." The United States issued a floating dry dock patent to J. Adamson in 1816. In 1849, Abraham Lincoln invented a hollow structure designed to provide extra buoyancy for vessels in shallow water (Figure 25). The United States government issued a patent for the design, but apparently nothing ever came from it.

The Brooklyn Erie Basin dry dock, built 1845-1850, was in 1905 the oldest and largest known wooden dry dock (Donnelly 1905). Known as the old balanced or box dock, the structure (Figure 26) measured 330 feet long by 100 feet wide. Managing the combined weight of dock and vessel proved difficult. To compensate, builders connected smaller sectional docks together with locking logs.

The next development of dry dock construction, the early sectional dry dock (Figure 27), provided alignment stability while restricting the amount of motion between sections. The sway between sections required some means of flexible power from one section to another. For this purpose, designers invented a double universal joint, with a slip or extension joint between. The design, wrought with complications, proved popular. Built with three to seven 25-foot sections, the structure measured 200 feet in length.

The Dodge-Burgess sectional floating dock (Figure 28), patented in 1841, generally featured 10 pontoons. Connected by a locking log, the dock lost the wings typical of the earlier (and later) sectional dry docks. The framework's roof housed pumping machinery. The framework fastened to the central pontoon, lifting or lowering. Power was distributed along the top by a shaft with flexible couplings, in the same manner described for the sectional dock. Two of these docks were located for years near the Catherine Street Ferry (Donnelly 1905:320-321).

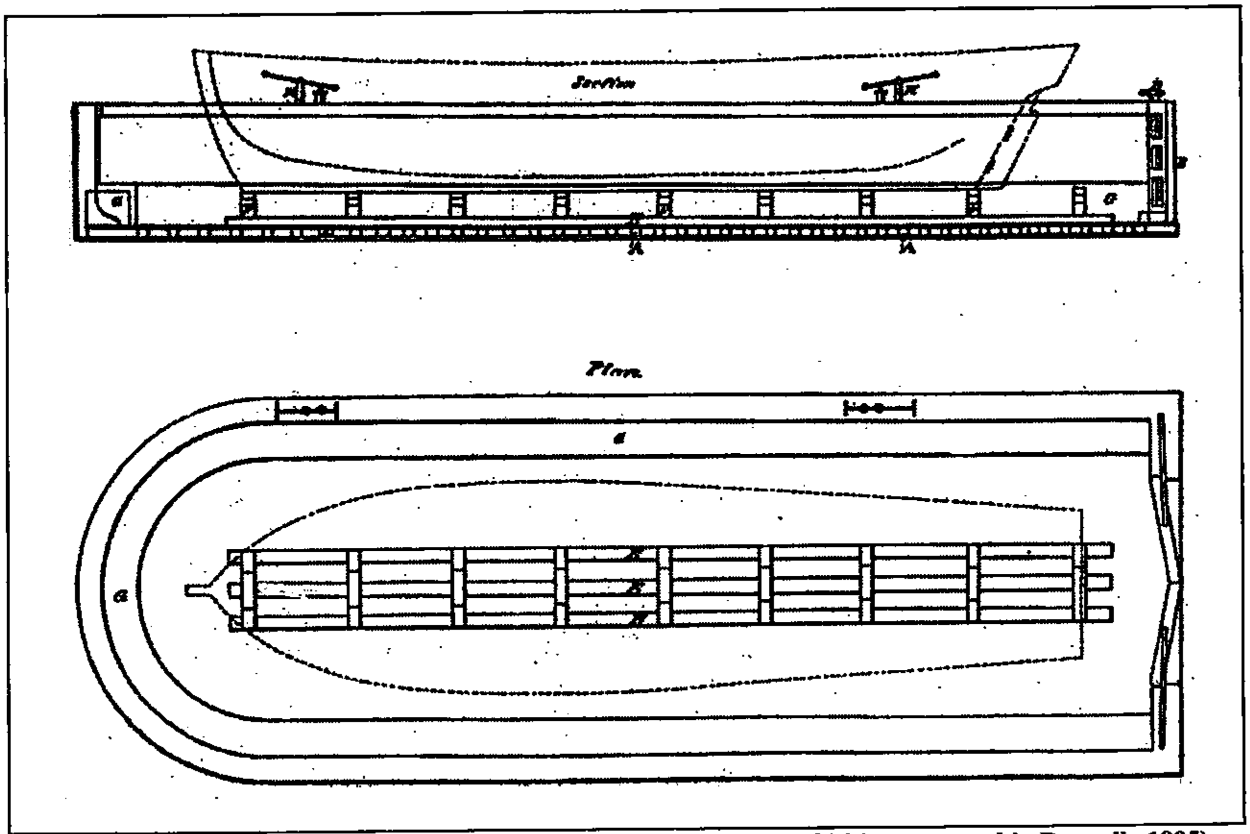

Figure 24. First U.S. floating dry dock patent issued to J. Adamson in 1816 (as presented in Donnelly 1905).

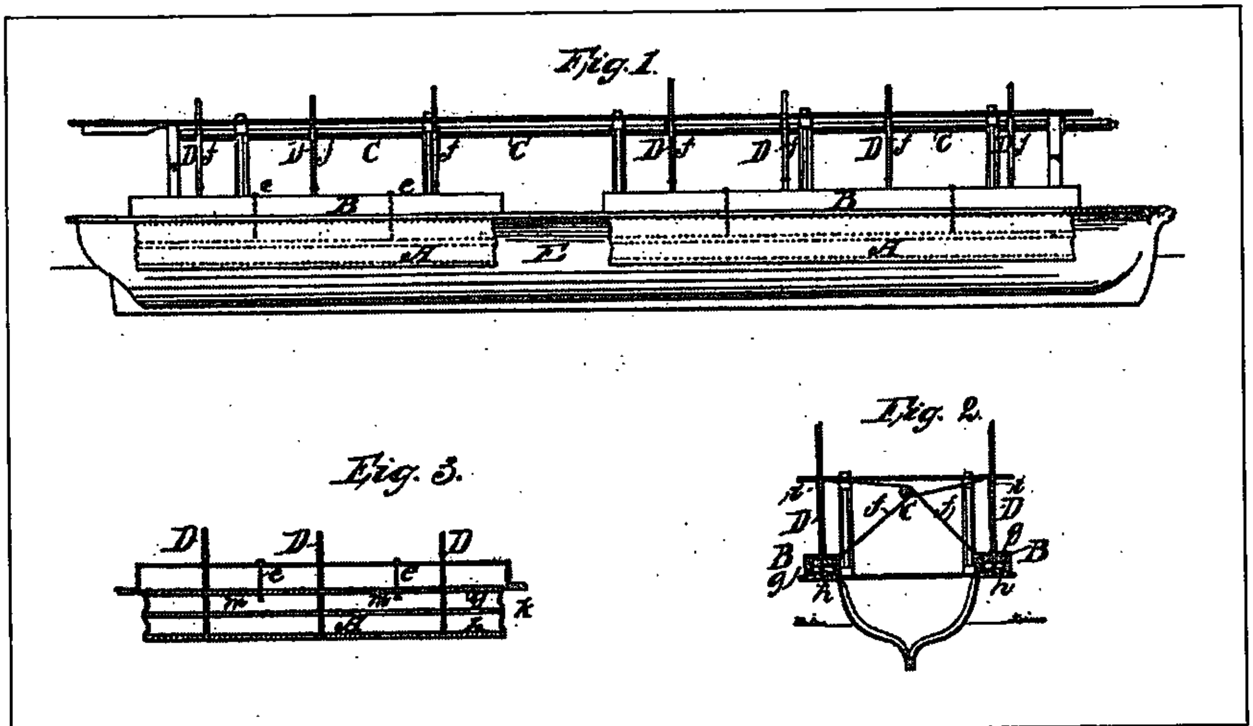

Figure 25. Floating dry dock patent issued to Abraham Lincoln (as presented in Donnelly 1905).

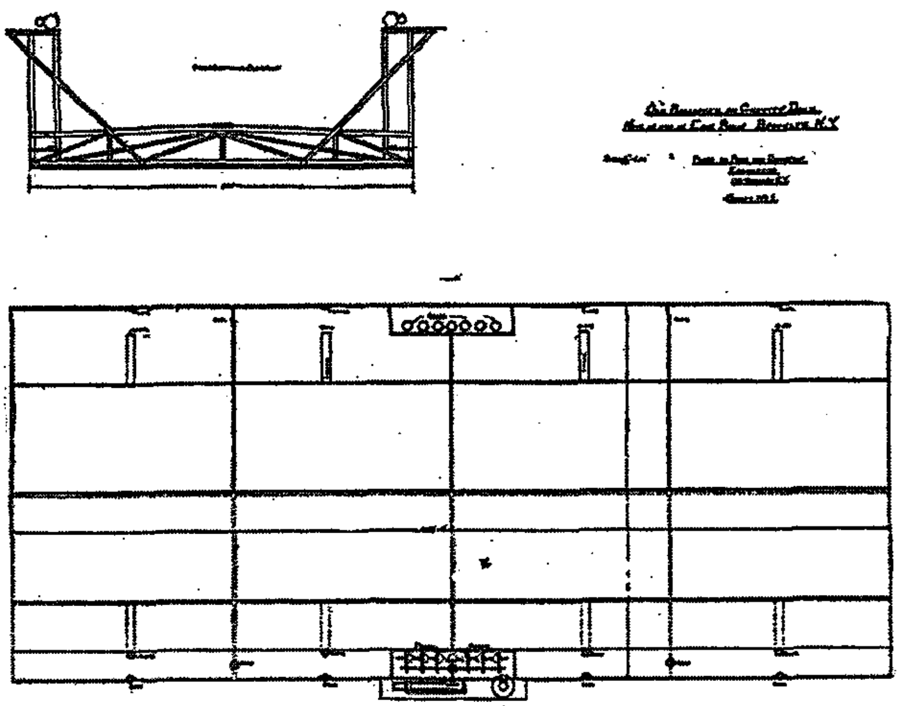

Fig. 4.—Old Balanced or Gravity Floating Drydock.

Figure 26. Old balanced or gravity floating dry dock (as presented in Donnelly 1905).

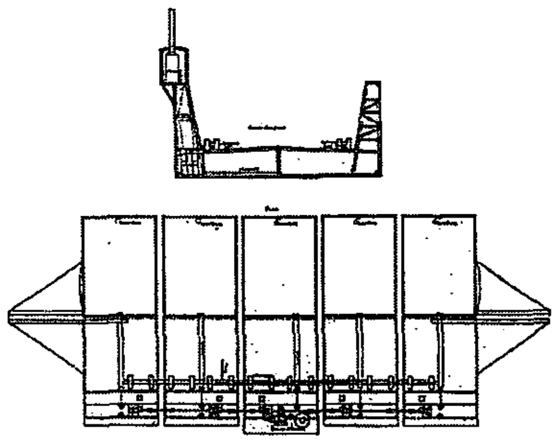

Figure 27. Old sectional dry dock style (as presented in Donnelly 1905).

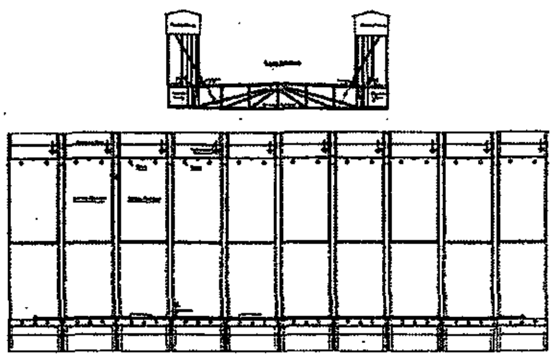

Figure 28. Dodge-Burgess sectional floating dry dock (as presented in Donnelly 1905).

Built in one piece, the box or balanced dry dock (Figure 29) represents the next phase in floating dry dock construction evolution. The dock was built as a single rigid structure, and to limit the flow of water from one end of the interior to another, builders added watertight bulkheads, a feature not seen until this point. These cross-bulkheads, "together with the center longitudinal bulkhead, divide the dock into…independent watertight compartments" (Donnelly 1905:322). The pumping machinery was located on one side only. Gates controlled the flow of water from compartments to the pumps, balancing the dock and vessel. The balanced dry dock design appeared near the end of the Civil War and was built through the turn of the century. The smaller sizes, with lifting capacities of 500 to 3,000 tons, were more prevalent.

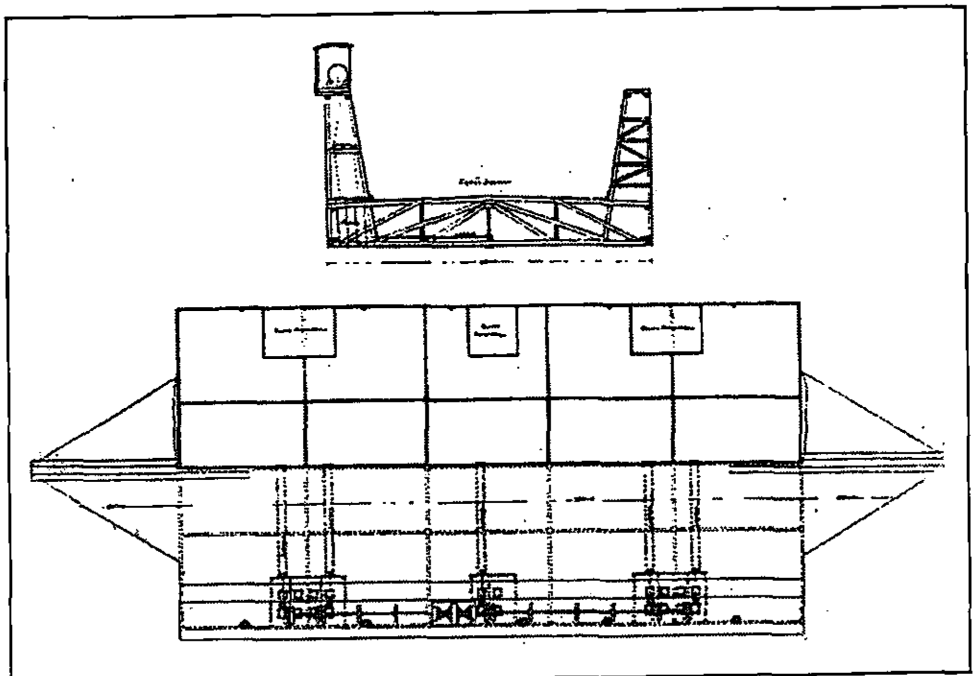

Figure 29. Cross section of the box or balanced dry dock, and a plan view of its pump layout (as presented in Donnelly 1905).

At the turn of the century, the balanced sectional floating dry dock represented the largest development in commercial dry docks. Illustrated in Figure 30, the five-section dock had an overall length of 468 feet, a width of 110 feet, and a lifting capacity of 10,000 tons; the height of the wings could allow vessels with draughts of up to 21 feet. Combining the best characteristics of the two dry dock types in use at the time, the balanced sectional floating dry dock possessed all the advantages of a balanced dry dock–with its cross and longitudinal bulkheads, separate gates, and independent means of admitting and removing water–and the sectional dock, with its freedom from both internal longitudinal strains and self docking. Differing from the balanced dry dock, machinery, in the form of a boiler and an engine, was placed on each side of the pontoon in the wings. Each of the five sections was divided into six compartments, and there were 60 pumps, 12 to a section (Donnelly 1905:322-323). This dock, patented to Frederic Lang in 1900, was significant in its lifting power, and it replaced the Dodge-Burgess Sectional Docks as the dry dock with the largest lifting capacity up to that time. However, the section dry dock would be contemporaneous with the newer balanced sectional type.

There was discussion as to constructing this dock with wood, steel, or a composite; wood was chosen because it was half the cost. In order to protect the below-water portions from the *Teredo navalis* (a wood-eating bivalve often called the Teredo worm), the bottom was coated with coal tar, sheathed with creosote-saturated hair felt, then covered with one-inch-thick boards (hemlock or spruce) treated with creosote and arsenic (Donnelly 1905).

The complete cross section presented in this illustration shows the identifiable features of the dry dock. It has two wings on either side of and rising above the main float or pontoon. The side wings, wider at the base than at the top, house the pumping machinery, with the pump wells at their base, and the engines and boilers on top. Also water- and air-tight in construction, the height of the wings gives an indication of the maximum ship draughts it could accommodate. The main float platform or water-tight pontoon hull, as stated, was divided into numerous watertight compartments on both the balanced and the balanced sectional dry docks.

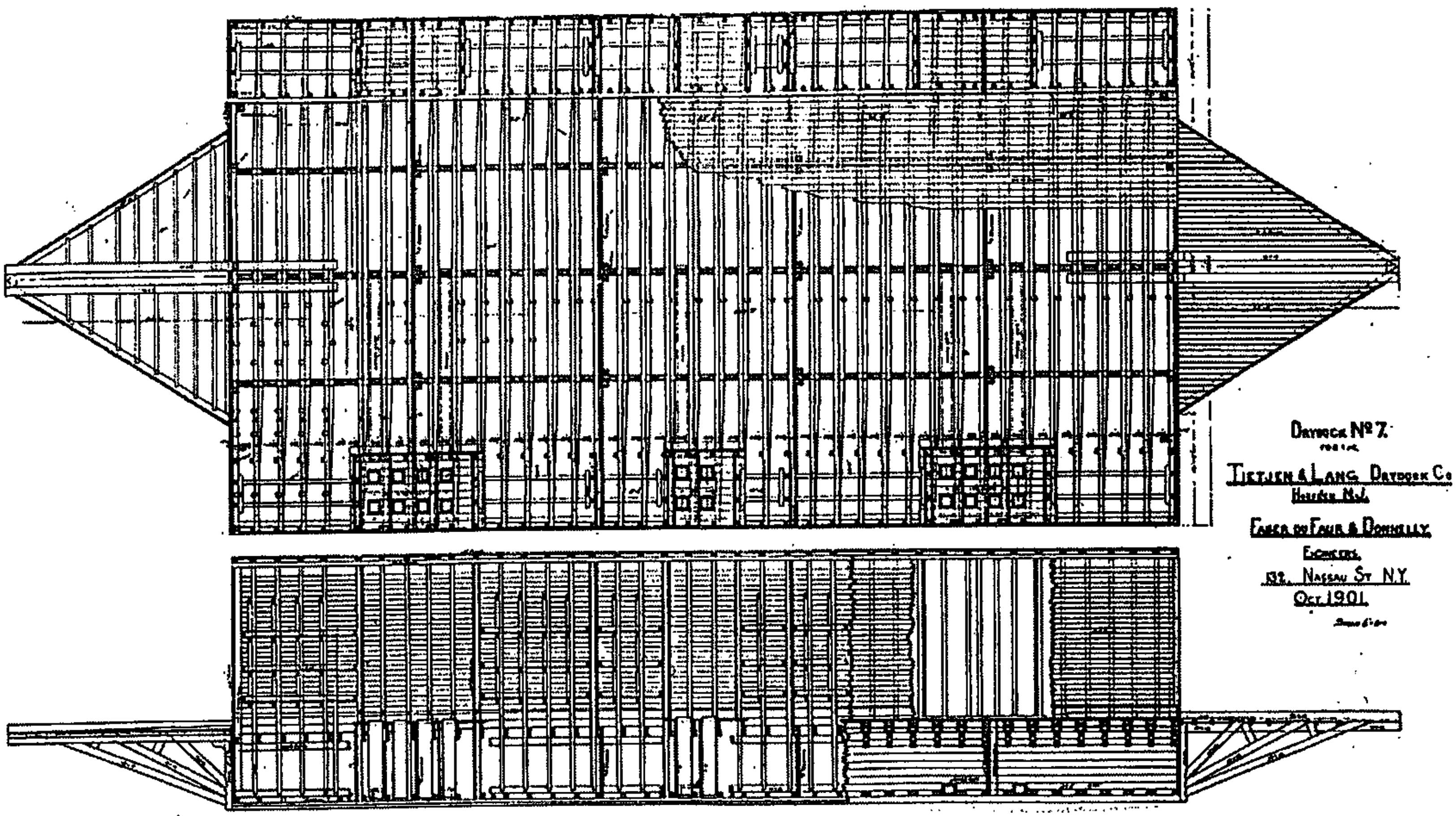

Figure 30. Plan and structural view of a box or balanced floating dry dock designed for the Tietjen and Lang Drydock Company in Hoboken, New Jersey, 1901 (as presented in Donnelly 1905).

In operation, keel and bilge blocks were prepared for the vessel to be docked, and water was let into the pontoon and eventually the wings through flood gates. The dry dock then slowly settled evenly down into the water, the deck of the pontoon (with its keel blocks) submerging to a depth that would allow the vessel to float freely atop the blocks (either motored or towed). At this point, only the wing tops with the machinery protruded from the water. Pumping machinery then slowly removed the water from the pontoon hull, floating both the dry dock and the vessel to be repaired.

WATER BOAT

The water boat supplied fresh and potable water to steamships and other facilities in the harbor. Very little is known about its history, though water boats, converted from steam lighters, served the port into the 1980s (Raber et al. 1996b). Some limited data is available on the water boat *Aqua I* at the South Street Seaport Museum in New York. There are no known construction details or historic documentation on wooden/steel water boats.

MENHADEN TRAWLER

At the turn of the century menhaden fish, or "pogie" as they are nicknamed, swam in large schools all along the Atlantic seaboard. Menhaden fishing in the Port of New York, as a profitable industry, began in the 1860s (Erismann 1912). However, initial efforts to develop menhaden as food failed because of its oiliness. Instead, processors derived profits from the fish for use in tanning, paint production, or fertilizer. The first steam-operated oil extraction plants occurred on Shelter Island around 1850 (Brouwer 1996).

A type of herring, the fish traveled at the surface in large schools. Lookouts posted on the mast of the fishing vessel sighted the schools. In describing trawling methods, Martin C. Erismann stated, "a purse seine is shot overboard from a seine boat, two usually carried, one on each quarter; the seine is brought along-side...the fish dipped out and transferred to the fish hold" (Erismann 1912:71). When full, the trawler made speed to the processing factory, where laborers extracted the oil. Once extracted, the remains of the fish became fertilizer. It became a substitute for German potash and bone phosphate.

Erismann (1912) described three boats, *Martin J. Marran*, *Rollan E. Mason*, and *Herbert N. Edwards*, built specifically as menhaden steamers under the direction of Capt. N.B. Church, who was manager of the fishing department, Atlantic Fertilizer & Oil Company. The Boston firm B.B. Crowninshield designed the boats, which were "of the usual type of vessel for this trade, except that they are larger and better equipped..." (Erismann 1912:71). The dimensions measured as follows:

Length overall	165 ft.
Breadth	23 ft.
Draft (loaded)	12 ft. 9 in.
Depth	13 ft.
Indicated horsepower	600
Speed	13 knots
Capacity of fish hold	4,000 barrels

The hulls are wooden; the keel, stem, stern post, and deadwood are made of oak. The framing is white oak; the planking and ceiling are made of hard pine some four inches thick. Bilge strakes are made of hard pine. A steel beam (with large gusset plates) tied the boat together near the boiler. The builders intended to strengthen the top member of the structure with a steel stringer, but "these were omitted owing to possible delay in the date of delivery" (Erismann 1912:71).

A two-story deck house sits forward, and a house is located aft on a raised poop (Figure 31). Part of the after house rests over the engine and boilers (Figure 32). A winch room is located in the forward end. Two large hatches "in the waist" provided access to the fish holds (Erismann 1912:71). Twenty-eight crewmen bunked in the forecastle below the main deck.

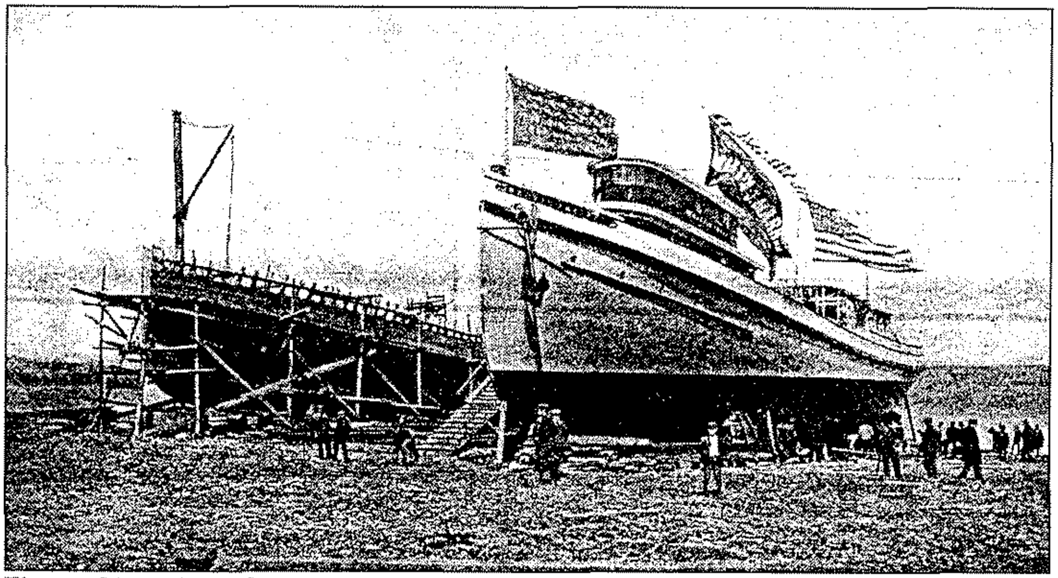

Figure 31. Menhaden steamer on the stocks (as presented in International Marine Engineering 1912:71).

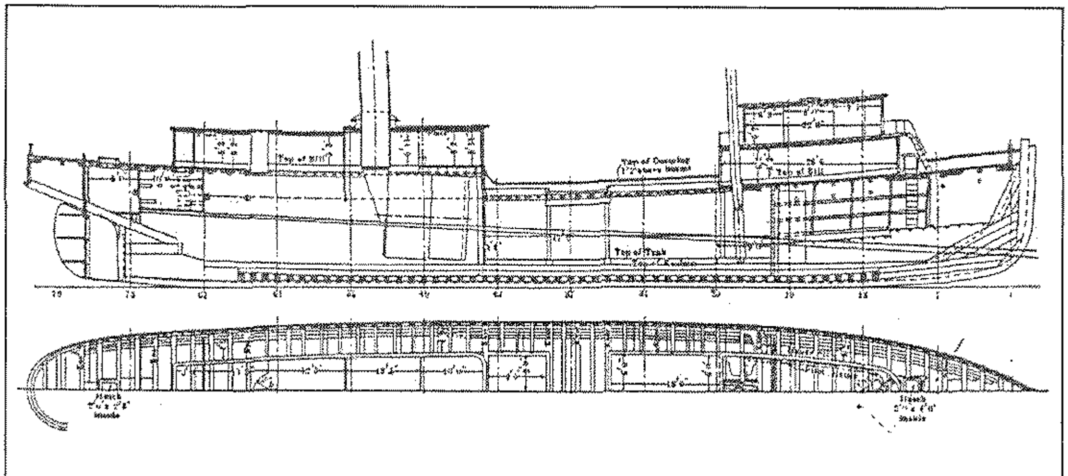

Figure 32. Inboard profile and deck plan of a 1912 menhaden steamer (as presented in International Marine Engineering 1912:72).

The early steamers had a wheelhouse on the main deck forward, with a tall mast for the lookout fitted high up with a boom for net handling. Crewman kept the central area of the deck open for loading fish. The forward end of the afterhouse housed dipping scoops, used to get fish from the seine to the fish hold (Erismann 1912). These boats usually had a sheer line rising to a fairly high bow (Brouwer 1996).

The menhaden steamer's basic design survived until quite recently. A plant handling menhaden was active on the New Jersey shore of Lower New York Bay and operated through the 1970s. Boats in the latter part of this century used diesel engines and had two-storied deckhouses forward. Menhaden fishing is still practiced today.

FLOATING GRAIN ELEVATOR

Floating grain elevators are original to New York. Without the influence of naval architects, elevator construction slowly evolved over the last century. Called "skyscrapers on tugboats," or a "naval architect's nightmare," these vessels proved quite stable in the protected waters of New York Harbor (Fuerst 1978:131).

In the 1840s gangs of men unloaded hundreds of bushel grain baskets by hand. Backbreaking work, the labor process proved time consuming and inefficient. Then in 1848 the nation's first grain elevator, known as "Pagan's Patent," appeared on the waterfront. The elevator resembled its Kansas cousin (Baab 1953). The elevator, basically a converted sailing ship equipped with a grain elevator, had an extendible leg and a conveyor belt with buckets. A loaded canal boat floated alongside the elevator, the extendible leg lowered into the hold, then the conveyor belt, set in motion, scooped up the grain, which was gravity-fed into the hold of a waiting vessel. The process could load up to 2,500 bushels per hour. Stevedores, keen to the situation, apparently destroyed the machine in 1852 (Fuerst 1978).

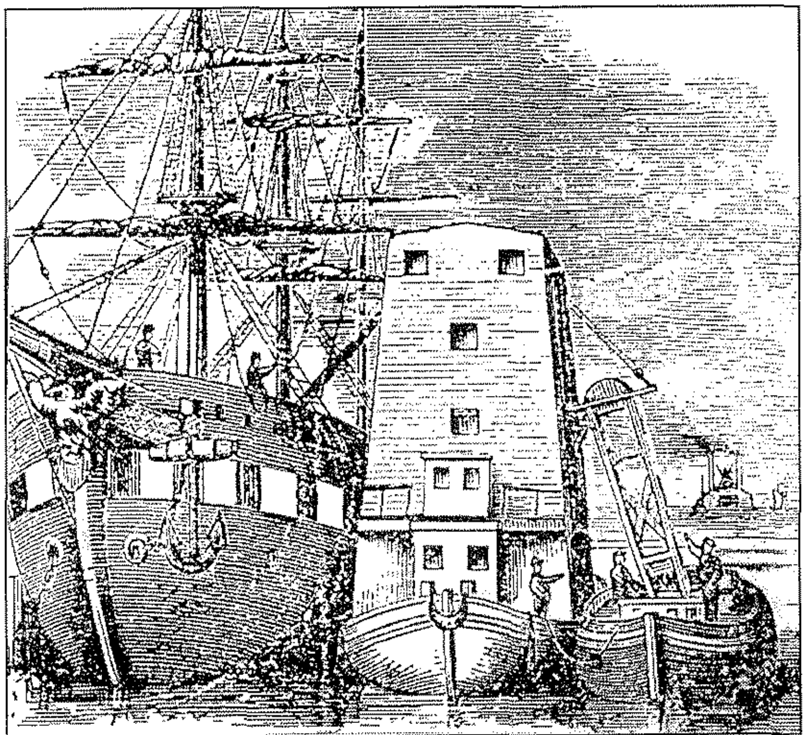

Figure 33. Illustration on a trade card of the International Board of Grain Measurers and Elevating Association, circa 1856 (Fuerst 1978).

Early elevators, so-called single leggers, sat on the gutted hulls of old scows, brigs, barks, or schooners (Figure 33 and 34). Eventually builders constructed vessels from the keel up. In the 1880s Phillip H. Gill and Edward G. Burgess received a patent on "two elevators adapted to elevate grain simultaneously from two boats, suitable devices for weighing the grain elevated from each boat separately..." (Fuerst 1978:133-134). As larger steamers replaced sailing vessels in the grain trade in the 1880s, the length or height of the elevator increased proportionally (Baab 1953). In the twentieth century, grain elevators featured two marine legs (Figure 35).

Initially, New York Harbor's free lighterage system provided companies with an incentive to use the city as their primary export port. However, under sanctions issued from the Interstate Commerce Commission in 1905, railroads serving the Atlantic seaboard planned to use other seaboard cities. By establishing "a freight rate differential for inland goods coming to the East Coast for export," goods shipped to Philadelphia or Baltimore cost less (Baab 1953:2). Grain transported to Buffalo east from the Great Lakes also featured a rate differential. Granaries on the Lakes also competed with iron ore suppliers for cargo space. Grain rates eventually increased. Canada stopped shipping grain to New York in 1932 when it issued a 6-cent-per-bushel tax on all exported grain (Baab 1953). New York Harbor's subsequent decline as a primary grain port precipitated the decline of the grain elevator. By 1953 there were only seven remaining, and their unofficial demise occurred in the early 1960s (Baab 1953:2; Fuerst 1978).

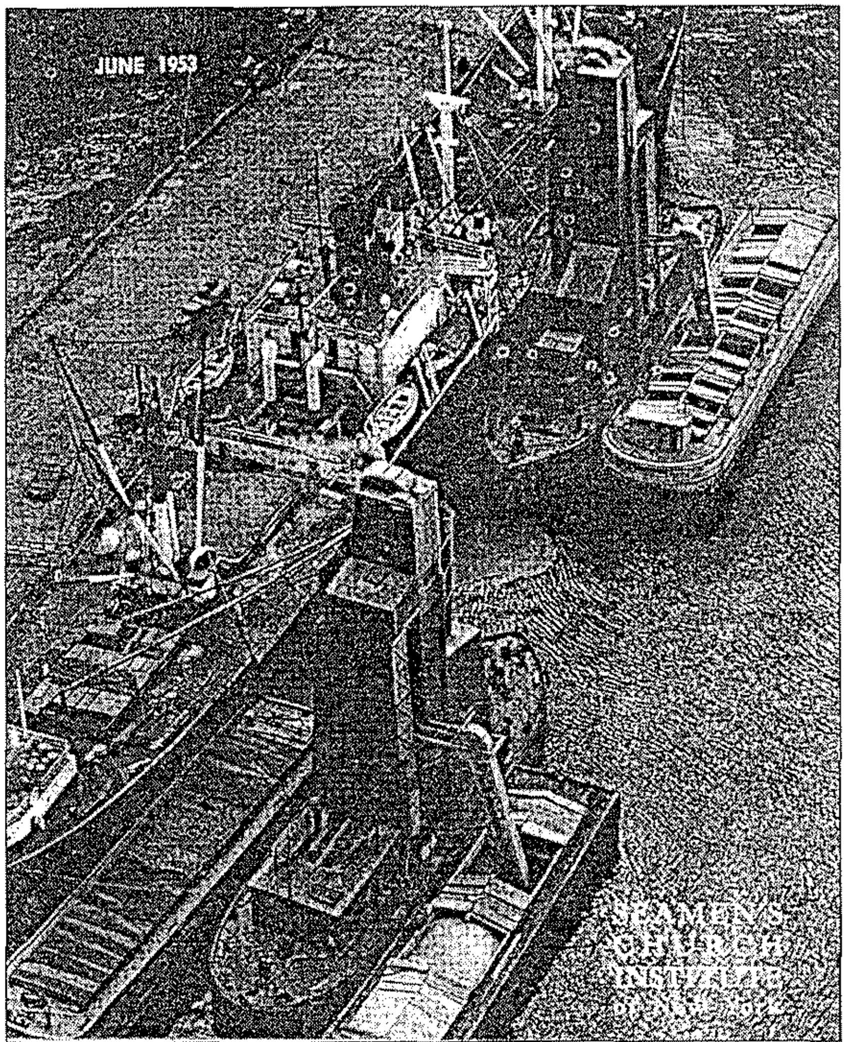

Figure 35. Early 1950s photograph showing two-legged elevators. Note the "skyscraper on a tugboat" look of these vessels, as well as the canal boats and hold barges offloading their cargos of grain (as presented in Baab 1953).

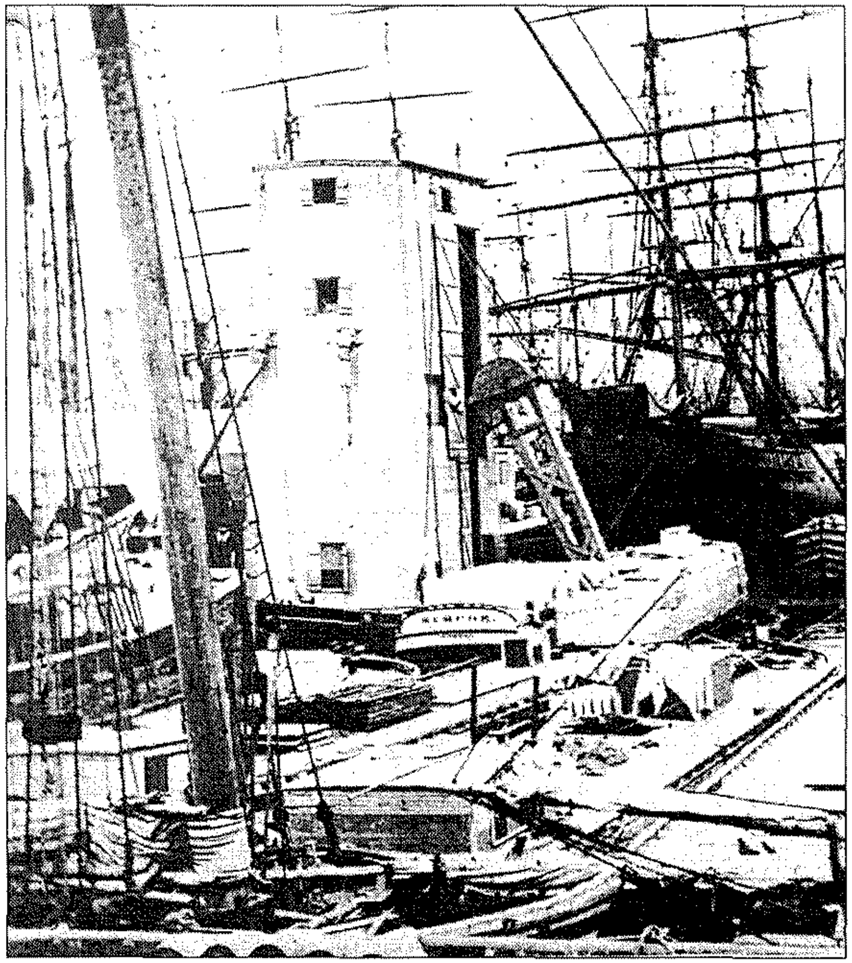

Figure 34. Nineteenth-century Anthony photograph of a floating grain elevator offloading grain from the *Simcoe*, a canal boat from Oswego, New York (courtesy of the South Street Seaport Museum).

BARGE TYPES OF THE ARTHUR KILL/KILL VAN KULL REACH

A barge is best described as a non-self-propelled watercraft used for hauling commodities. The modern use of simple boxlike vessels, similar in design to barges of the project area, can be traced historically to sixteenth- and seventeenth-century Europe. There the lines of the Thames sailing barge are remarkably similar to barge designs associated with the project area.

The lines of an English chalk barge, published in Chapman's *Architectura Navalis* (1768, as presented in Carr 1989), indicate a boxlike hull 56 feet in length, 15 feet in beam, with a depth of hold 5 feet amidships. The boat had lines very similar to the Thames punt, a small pleasure craft. The barge described by Chapman had a flat bottom and no external keel, and was steered by a large rudder and wooden tiller. In that regard, the barge design is similar to the river flatboat.

A forerunner of the modern American barge, the gondola was used during the American Revolution for harbor defense. This boat measured 40 to 60 feet and featured a flat bottom, double ends, and long, cutter, sloop, or hoy rigging. As a rule gondolas had no deadrise or rocker in the bottom and "sometimes had flat sides in sections; at other times the sides had a little curvature" (Chapelle 1935:54). The Revolutionary War-era "radeau," basically a square-ended scow, represented another box-shaped vessel similar in design to the barges in the study area.

Most barges employed on the Hudson River, or within New York's harbor area, can be categorized into five major types: (1) canal barges (boats), (2) hold barges, (3) deck scows, (4) covered barges, and (5) schooner barges, with numerous variations of each type designed for every conceivable use. The canal barge or boat is a case in point with at least four subtypes: the laker, the bullhead, the deck scow, and the steam canal boat. The next three types are described in literature as "lighter barges" or "lighters," though the term "lighter" also refers to various types of smaller self-propelled craft. However, there is no agreed-upon definition of a lighter or barge, and no accepted authority to rely upon (Harding 1912).

CANAL BOATS/BARGES

The opening of the Erie Canal in the fall of 1825 was perhaps the greatest stimulus to the growth and success of the Port in the early nineteenth century. Reducing time and cost of shipping inland produce and commodities to the Port, the Erie Canal caused interior towns to thrive due to increased commerce. It also ensured New York's leadership among eastern ports because of its access to markets and goods from the country's interior (Brouwer 1990:29-34; Hall 1884:224; Morrison 1958:539). Soon other canals were being constructed throughout New York, and also in Pennsylvania, Maryland, and Delaware. Navigation improvements in connecting inland waterways by canals in the 1820s and 1830s resulted in new commerce opportunities and increased maritime traffic. The construction of canals brought about an attendant boom in the construction and use of canal boats or barges, a vessel type that apparently originated in Europe, as well as a reduction in the number of schooners involved in the same trade. As illustrated in Figure 36, the importance of the canal boat/barge in the waters of New York Harbor is indicated by the frequency with which they appear in historic photographs of the area (also see Johnson and Lightfoot 1980).

The Erie Canal as originally constructed was 4 feet deep and 40 feet wide, with locks measuring 15 feet wide and 90 feet long. Between 1836 and 1862, the state enlarged the canal to 7 feet deep by 70 feet wide and the locks to 18 feet wide and 110 feet long (Shaw 1966:87, 96, 241). "This permitted boats of much greater size on the Erie, Champlain, Cayuga-Seneca, and Oswego canals, and further diminished the importance of the smaller lateral canals" (Canal Museum 1981:5). Dimensions given for New York's state repair scows in the 1880s are 98 feet long, 17⅔ feet wide, and 9 to 10 feet draft (Canal Museum 1981). The 1908 Barge Canal Bulletin for the State of New York gives the following dimensions: 18 feet wide, 98 feet long, and 6 feet draft. A contract giving the dimensions for a state scow for the Erie Canal (1875) states:

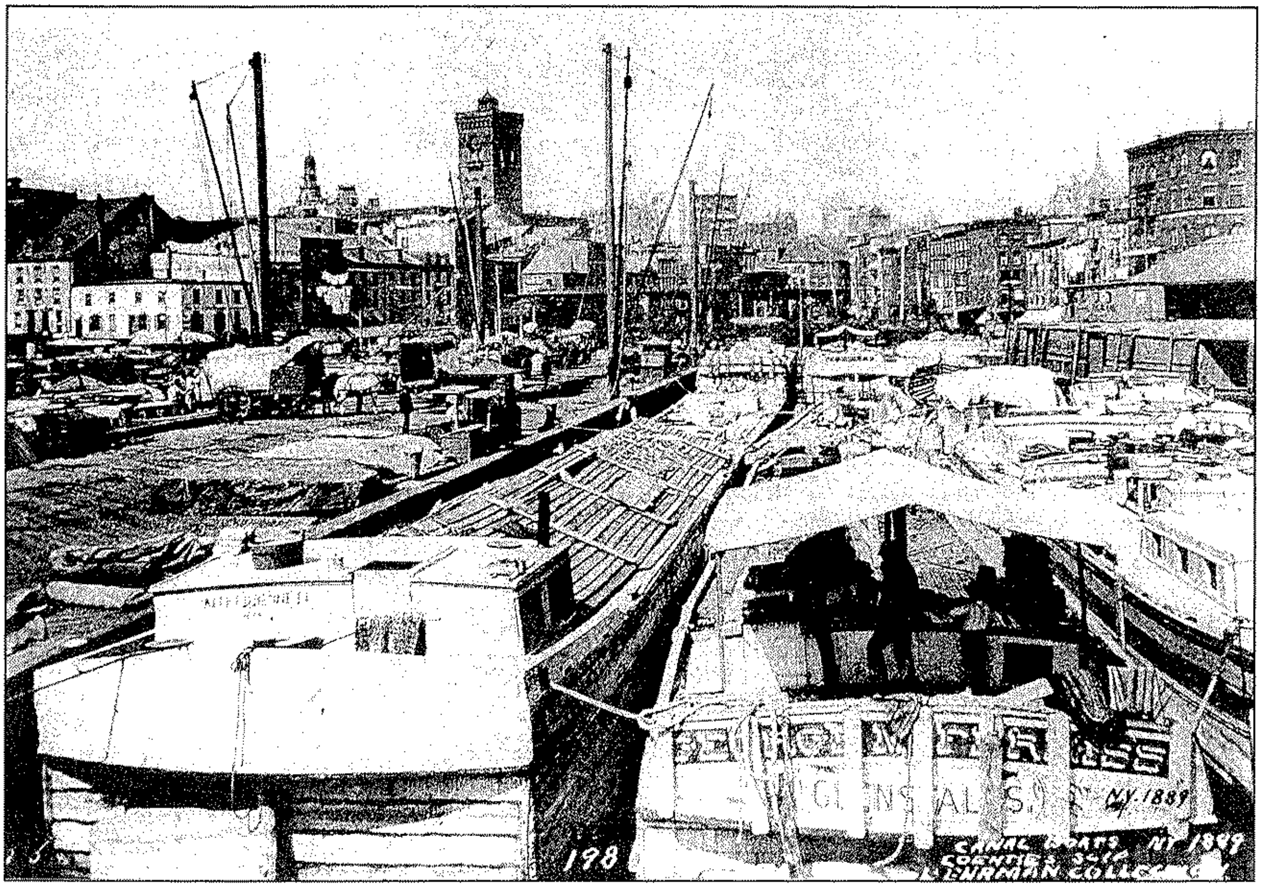

Figure 36. An 1889 photograph of canal boats/barges docked at New York City's Coenties Slip (courtesy of the South Street Seaport Museum).

> The Scow to be seventy feet long; fourteen and one half feet wide on top, and thirteen and one half feet wide on bottom, eleven feet top breadth of ends, four and one half feet height of sides; six feet rake, flooring to be one foot below top of sides; Stern deck to be six feet in length, and raise of bow and stern to be six inches. The cabin is to be twelve feet long and four and one half feet running above running board. The sides are to be seasoned white Pine, four inches in thickness and well jointed and doweled with 5/8 inch bolts to be placed not exceeding ten inches apart in each course. Floor timbers are to be well seasoned white oak three inches thick and eight inches deep. The long bow and stern timbers also the bow and stern Ricks are to be well seasoned white oak. The latter two inches in thickness. The Scow to be thoroughly caulked with the best quality oakum and the bottom to be well pitched. The Cabins to be made of thoroughly seasoned matched white pine, and to be painted with two coats of best Brooklyn lead and boiled linseed oil. All the bolts, fastenings and necessary iron to be of the best American iron [New York State Archives, Comptroller's Records. Canals. Collection 13. Package 2777].

Two major changes in New York canal boat-building occurred in the 1860s. Bigger boats and increased traffic provoked the state in 1862 to mandate rounded bows on the vessels employed in the canal system; the law prohibited square-bow boats. In a collision, a square-ended barge could shear off an entire section of boat "dumping a whole cargo and making a major blockage in the canal" (Canal Museum 1981:13). The mandate required better boat-building skills, but exploitation depleted local timber supplies, which was the second change. The boat-building industry developed along timber supply routes in Buffalo, Tonawanda, and Lockport. Canadian and northern New York timberlands supplied yards in Rochester, along the Oswego Canal to Phoenix and Fulton. Boatyards in Ithaca, supplied by southern timbermen, developed the slab side scow in the 1860s. The design made use of pine and hemlock 6-by-12-inch side timbers. The timbers were mounted edge to edge by steel drift pins. The use of cheap softwoods minimized framing and planking, reducing production cost and labor (Canal Museum 1981).

Growth in steam power and steel boat production led to the State Barge Canal System, a state-funded project featuring cast concrete construction and electronic locks. The System opened in 1918 and utilized canalized waterways and sections of the Old Erie Canal. The enlarged canal system had locks 45 feet wide, 310 feet long, and 12 feet deep. The ability of the canals to accommodate larger boats precipitated different towing methods, vessel types, and construction. "Whereas on the old system, mule-towed boats traveled separately, the steam-towed barges are propelled in fleets consisting of the 'steamer' and several, usually five or six, barges called consorts" (Springer and Hahn 1977:27). Figure 37 illustrates a tug towing both "transitional" barges and bulkheaded deck scows. While at first boat builders were uncertain of what shapes and sizes could be accommodated, the new canal boats/barges were much larger and were pulled by steam or diesel.

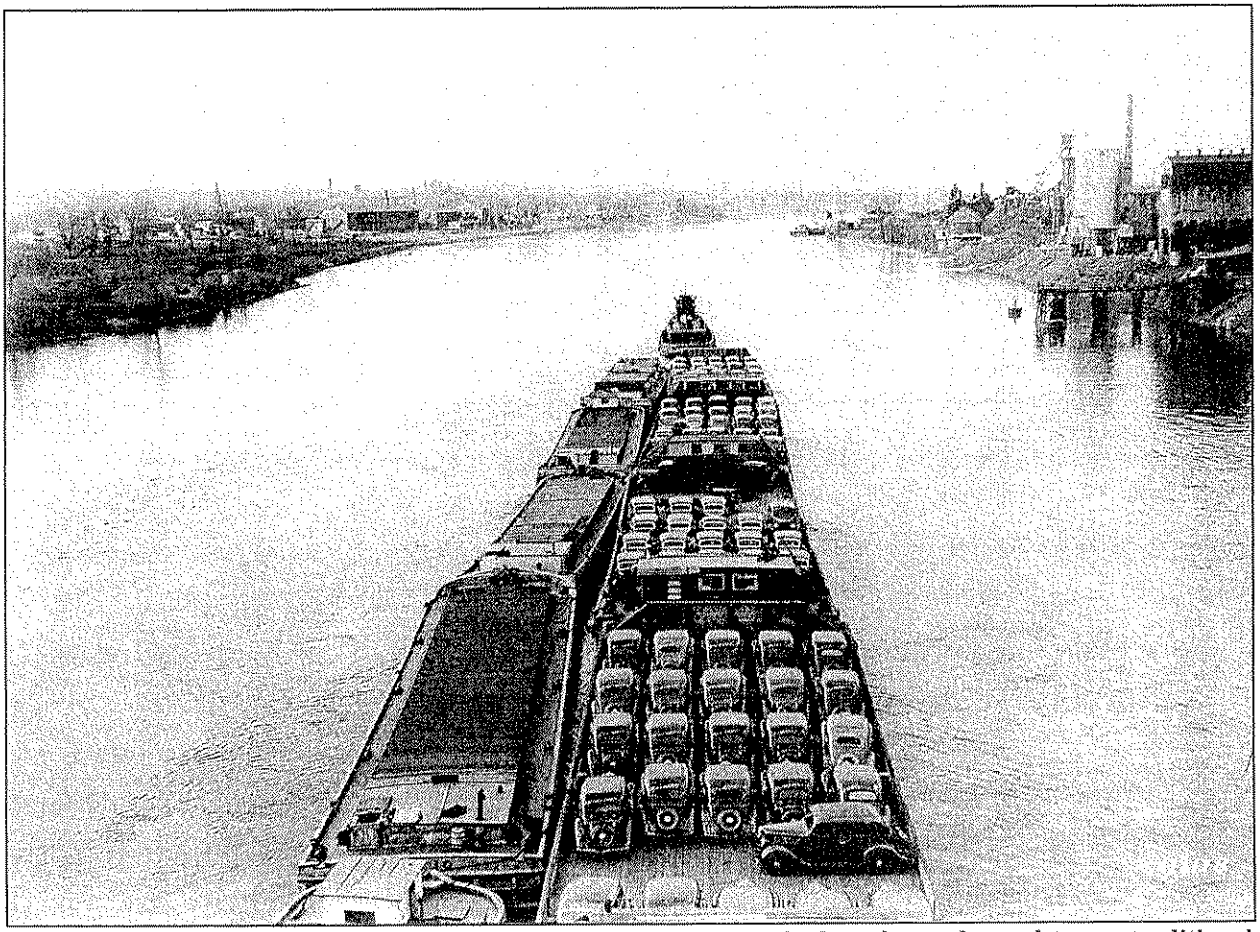

Figure 37. Late 1930s photograph showing changes in towing methods and towed vessel types; traditional shapes are at left, bulkhead scows are at right (courtesy of the South Street Seaport Museum).

Typological Issues. As stated in Raber et al. (1995a:98), "boats used on regional canals or contiguous waterways pose several identification problems." Boats used for canal service sometimes worked in a non-canal capacity, as in service on the Arthur Kill channel. Other times, these boat types served strictly in a non-canal capacity. These non-canal services included harbor freight traffic via creek and stream systems (including the Hudson River), and the movement of Woodbridge/Perth Amboy clay products.

The criteria adopted by Raber et al. for canal boat typology is based on width and form. They state that boats identified in the project area are long enough for offshore/coastal service, but are narrower (20 to 25 feet), with pointed or rounded bows, occasionally featuring rounded sterns.

Raber et al. state that these boats are "transitional" types "between traditional moulded hulls with curved floors and frames requiring bent or curved fabricated members, and barge forms with few if any members" (1995a:98). However, our investigation suggests that half of the group appear to represent traditional forms. Furthermore, the statement that traditional forms had moulded hulls with curved floors and frames appears to be at odds with some mid nineteenth-century plans for these vessels (presented below).

The use of the term "transitional" is based in part on the fact that all boats identified as canal boats supposedly featured measurements applicable only for the New York State Barge Canal. The boat measurements (20 to 25 feet wide) presented by Raber et al. (1995a:98) are not precise, but the authors state that the examples previously investigated exceed maximum 17.5-foot widths necessary for use on late nineteenth-century New York State Canals and the 10.5- to 14-foot boat widths witnessed on the Delaware and Hudson, Morris, and Delaware and Raritan canals (Raber et al 1995:58, 1995a:98-99). Our investigation indicates, however, that at least one and possibly two of the vessels represent pre-State Barge Canal measurements. Additionally, the similarity of these vessels to those with larger measurements suggests that the use of traditional hull shapes postdates at least the beginning years of the State Canal. Furthermore, by the mid-1850s the locks on the Lehigh Canal were 22 feet wide, and a number of the locks on the Delaware Canal were rebuilt to correspond to those on the Lehigh. By 1847 similar locks were introduced to give access to the Delaware and Raritan Canal (Yoder 1972:85-87). This suggests the possibility that even some of the larger vessels in our group may be early or traditional vessels.

Raber et al. (1995:58, 1995a:98-99) also categorized project-area canal boats into two types: (1) probable transitional/smaller barge canal boats, and (2) large wooden barge canal or harbor hold barges. The probable transitional/smaller barge canal boats are stated as apparently slightly larger versions of nineteenth-century forms, built circa 1905-191. The second type, large harbor hold barges, according to Raber et al. (1995, 1995a) apparently corresponds to twentieth-century drawings of vessels generally 22-34 feet wide and 108 feet long labeled barge, barge canal boats, canal box, lake work barge, Box O'Donnell type, big grain boat/box, and deep barge. Plans of several of these vessels from the Feeney Collection (1920-1922) housed at the Hudson River Maritime Museum, Kingston, New York, are presented below in the discussion on hold barges. Raber et al. (1995:58) state that these boats are wider, though they retain pre-barge canal boat features (i.e., low set cabins), and may represent a thorough redesign of earlier forms for use on the Barge Canal after 1915-1920.

Adding to the problem of type distinction and transition/evolution is the Raber et al. vessel type, the "wooden coastwise hold barge" (1995:63). Noted as probably of early twentieth-century origin, the vessels were employed in the shipment of coal and grain. Defined as larger versions of the harbor hold barge, some with heavier internal framing, the report states that full distinctions between these two barge types remain undefined. We know through historic photographs that hold barges with low set cabins were employed on the New York Barge Canal, towed in fleets by steam and diesel tugs (see Garrity 1977 or Springer and Hahn 1977). However, barges that reflect both the "large wooden barge canal or harbor hold barge" and the "wooden coastwise hold barge" types predate the State Barge Canal. Barges with the same above characteristics had been built at Perth Amboy since 1860 for sending coal up to the city and points accessible from the harbor. A description of one barge being constructed in 1880 states that "this barge was perfectly flat on the floor amidships and square on the bilge, the floor being carried well forward and aft. The bow and stern were sharp, the stem perpendicular. This boat was 125 feet long, 28 feet broad and 11 deep amidships, with 2¾feet sheer...and a house for the boatman and his family" (Hall 1884:121).

Although Raber et al. (1995) identify the two hold barge types, it may be that they represent variations of a single type or category, or that the two are not related at all and are typed incorrectly. While the large "coastwise" hold barges, either for canal or coastwise use, do appear to reflect a type, the canal/harbor hold barges identified in the previous studies either appear to be grouped incorrectly or do not represent a type. It is also possible that this scow-shaped type, contemporaneous with canal boats at least from 1860 onward, does not represent a reworking of the canal boat/barge for use on the State Barge Canal as previously theorized. Rather, their employment on the State Barge Canal may not be a function of a vessel redesign, but the employment of an extant vessel type on an enlarged canal. These vessels appear to have more in common with scow barges than canal boats. However, similarities between some hold barges and some types of canal boat/barge components, such as the curved stern construction (from the bottom to the top as opposed from the sides to the stem), suggest a common tie or relationship between these vessels. Whether this tie represents a common building method or builder, or a transition or evolution, can be answered only by archaeological data from these vessels and further archival research. Because of this understanding, the "large wooden barge canal or harbor hold barge" and the "wooden coastwise hold barge" will be discussed separately after the transitional barge canal boat type.

Hold Barges

Hold barges moved bulk commodities, especially grain and coal. These boats had construction designs similar to canal boats, i.e., large, accessible deck hatches with deep holds. Not restricted by canal or lock dimensions, these boats measured between 25 and 35 feet in breadth, 90 to over 100 feet in length. Box designs (except for a short upturn of the bottom) led to the vernacular box barge (Figure 38). Sometimes known as a coal or grain box, the boat usually had a cabin, hatch boards, or a canvas tarpaulin covering cargo, particularly grain (Brouwer 1996).

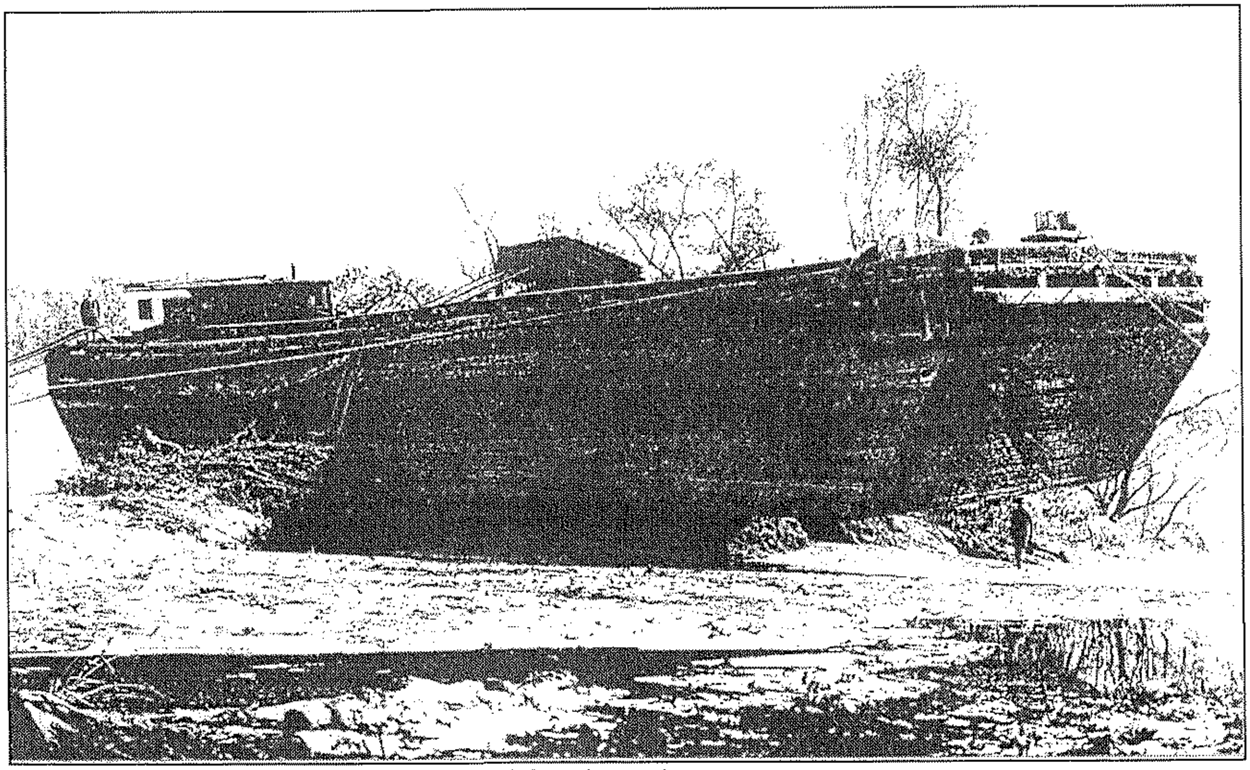

Figure 38. Typical scow-built box design (origin unknown).

Dimensions for the hold barge *Quincy Adams*, built in 1917 at South Rondout, New York, provide data typical for project-area hold barges. The vessel measured 122.7 feet long, 28.4 feet in breadth, with a depth of hold measuring 13.4 feet (Government Printing Office [GPO] 1937). A photograph of the vessel from the Steamship Historical Society of America is pictured in an article on the Port of New York by Norman Brouwer (Brouwer 1987). The depth is almost double that of a scow hull. As with scows, there is usually a crew cabin at the stern, either built on deck or sunk into it about four feet. A large, open hatch (with low coamings) took up most open main deck space. For transverse strength, the hatch opening usually featured three or more permanent beams.

To protect cargo from the elements, fitted longitudinal strongbacks were installed on the centerline to form a peaked roof. The side planking consisted of single timbers laid over vertical frames. The frames were joined to the underside of the deck on either side of the hatch and to the floors with natural hanging or standard knees. The frame and knees were exposed at the sides of the hold, but the floors running across the bottom of the hold were protected by planked decking (Brouwer 1996).

Large Wooden Barge Canal/Harbor Hold Barges
As stated above, this vessel type was possibly employed both on and off the canals. Predating the State Barge Canal and contemporaneous with earlier canals, it is believed that this vessel type does not represent a reworking of the canal boat/barge as previously theorized. Rather, their use on the State Barge Canal was not a function of a vessel redesign, but the employment of an extant vessel type on an enlarged canal, albeit a vessel type with some similarities to the traditional canal boat.

Wooden Coastwise Hold Barge
Figures 39 and 40 display plans of a 1903 coastwise hold barge. According to the *Nautical Gazette* (*NG* October 8, 1903) the barge is of average size, about 100 feet long by 26 feet in beam. Longitudinal logs form the bottom framing. The planked sides serve as heavy girders. Heavy beams are connected by wooden knees. The transverse connections on the bottom are comparatively light, consisting of the outside transverse planks 3 by 12 inches. The center keel/keelson is a single log 12 by 12 inches. The corner keelsons are the same dimensions; the intermediate sister keelsons are 8 by 12 inches. The side planks are 6 by 12 inches, while the garboards are 8 by 12 inches. The wales are composed of two pieces, each 8 by 12 inches.

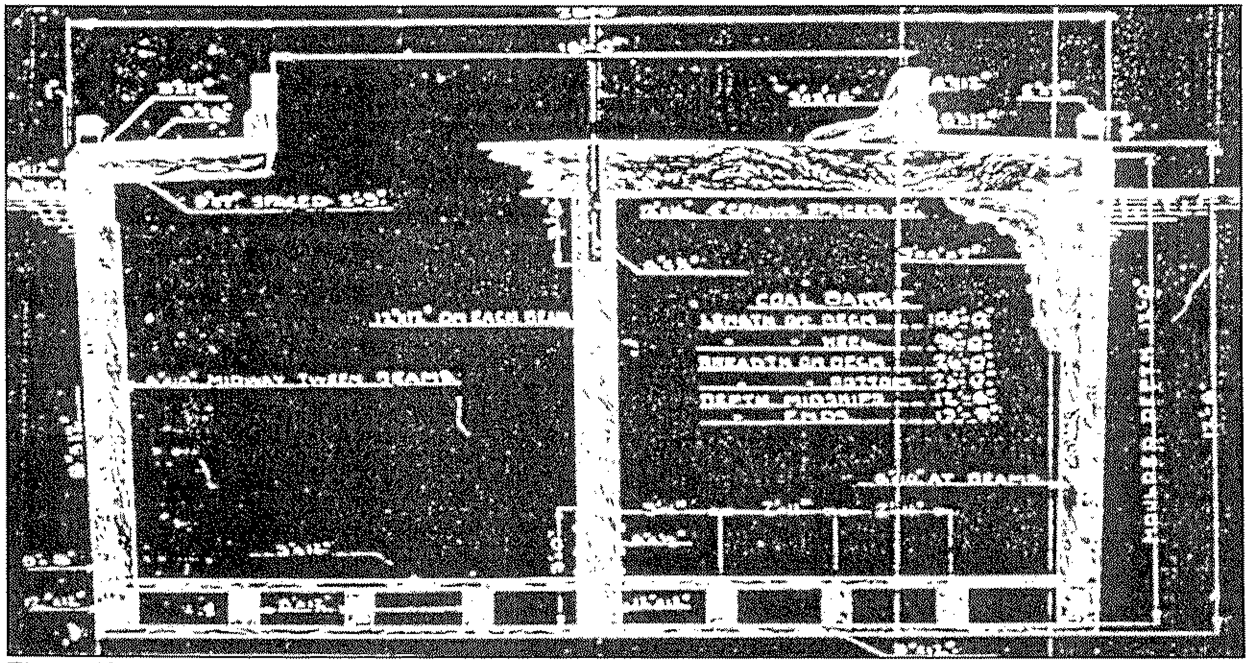

Figure 39. Midship profile of a turn-of-the-century coal barge (as presented in *Nautical Gazette*, October 8, 1903).

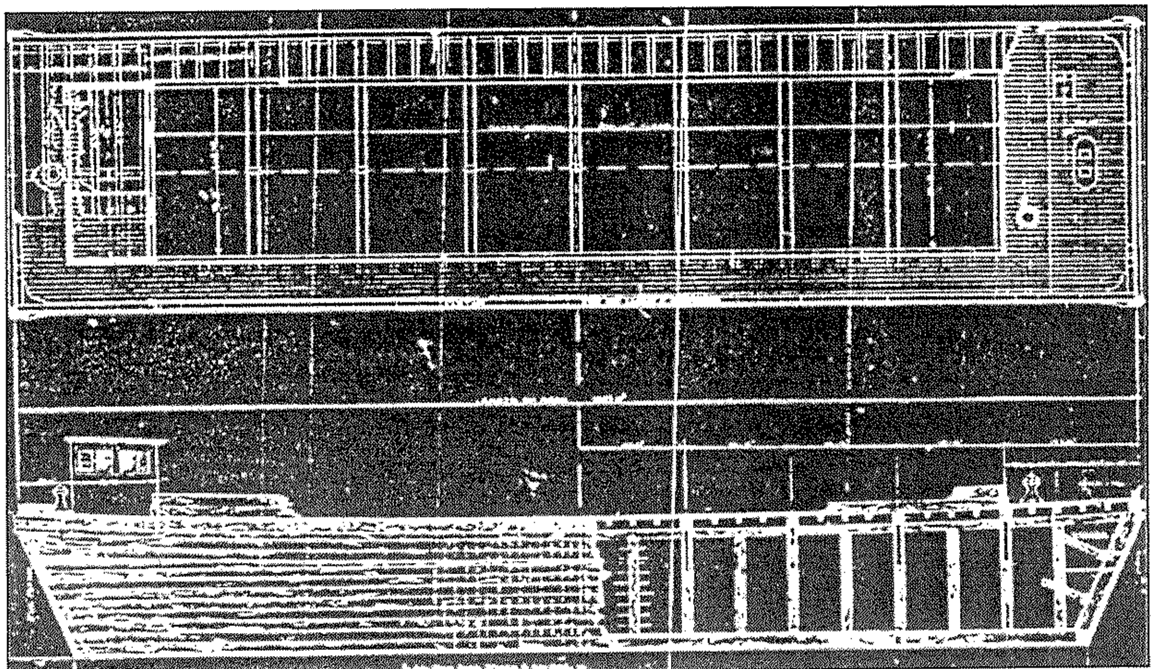

Figure 40. Deck and side plan of a turn-of-the-century coal barge (as presented in *Nautical Gazette*, October 8, 1903).

The deck planking measures 6 by 3 inches. The plank sheer is 3 by 12 inches with a rail 5 by 7 inches along the sides of the barge, lifted off the deck by distance pieces. The heavy hatch coaming is made of a lower strake 8 by 12 inches and an upper strake 6 by 12 inches, all around the hatch. The deck beams are 12 by 6 inches with a crown of 4 inches in their length and 10-foot spacing. At the center of each beam is a strong stanchion, 12 by 12 inches, connected by an iron strap ½ by 6 inches. The knees connecting the deck beams to the sides are 7 inches thick by 3 feet long on the beam and 4 feet long on the side vertical stanchion. These side stanchions are 6 by 10 feet with 5-foot spacing. Additional 5-by-7 inch half beams are between the main beam spaced at 2 feet 3 inches for more efficient support of the deck planking (*NG* 1903).

The fastenings are particularly strong in the side planking, where heavy bolting unites the members into one rigid girder. Galvanized iron rods ⅞ inch in diameter are driven edgewise through the planks at a spacing of 2 inches. The knees also show the demand of strong fastenings at this junction. The center stanchions are connected with strong bolts to the iron straps that form the tie to the beams on top and for the main keelson on the bottom (*NG* October 8, 1903).

Defined as larger versions of the harbor hold barge, some with heavier internal framing, full distinctions between these two hold barge types remain undefined. However, as stated above in the *Typological Issues* section, barges of this size were extant by 1860.

Steam Lighters

Operated by major railroads and private lighterage firms, there were two types of wooden-hulled steam lighters: open-decked or covered (Figure 41). Brouwer states that the open-deck lighters "were either single-ended or double-ended, meaning they either had one mast and a single open deck forward, or two masts and open decks forward and aft" (1990:178). The open-decked lighters stored most of their cargo on deck, while the deck on the covered lighters was fully enclosed. With beamier hulls than tugs, the wooden-hulled, propeller-driven models may have appeared by the turn of the century, to be replaced by steel versions prior to WWII (Raber et al. 1995:65).

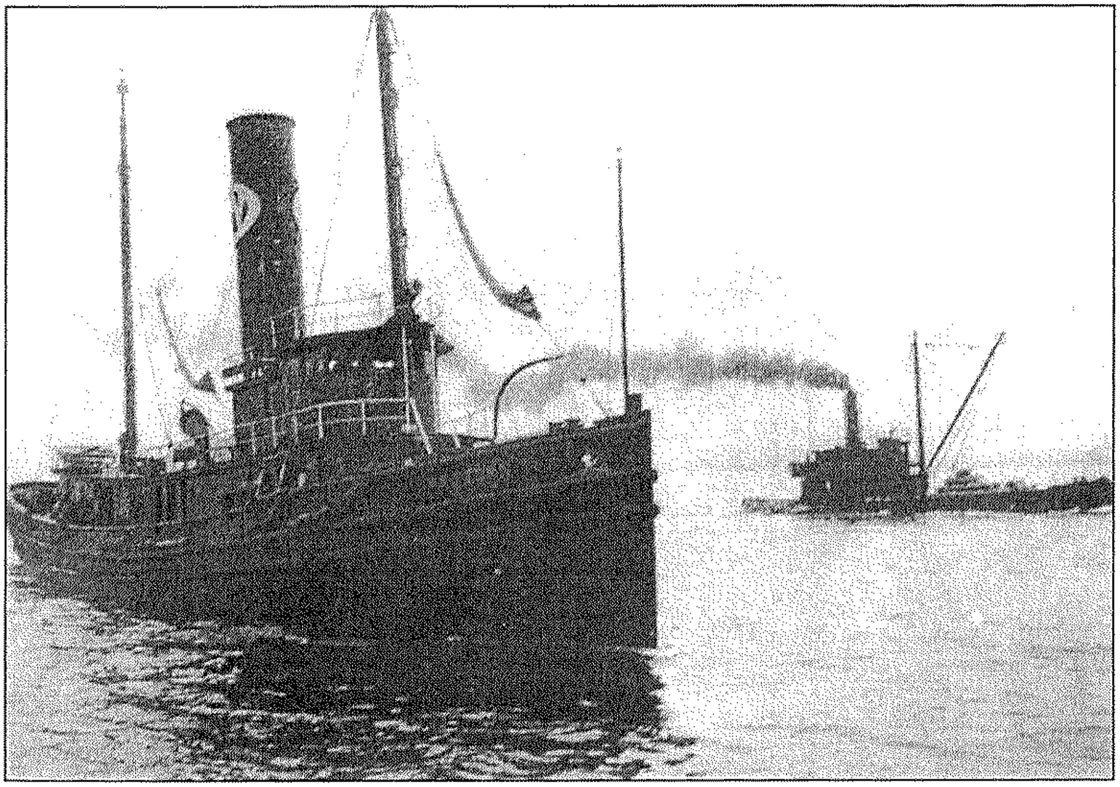

Figure 41. The open-decked steam lighter *Shooters Island* (at right), in the company of the harbor tug *Western*, also employed in the lighterage industry within the New York port area (as presented in Morris 1984:74).

5. PREVIOUS INVESTIGATIONS

Prior to the field project, a number of previous investigations were reviewed in an effort to gain a better understanding of the potential for submerged cultural resources within or near the project area. There has been a great deal of research done on vessels and structures along the shores of New York and New Jersey Harbor, both in conjunction with the Collection and Removal of Drift Project, as well as others. Investigations include literature searches, remote-sensing surveys, diver inspections, and complete recordation. Many remotely-sensed targets have been classified as potentially significant cultural resources; many of them have yet to be dived or recorded.

During 1986 the Corps instituted a Dredged Material Disposal Management Plan that outlined the potential areas for the disposal of material dredged from the Port of New York and New Jersey (Ferguson 1986:1). While the Corps had seven existing borrow pits, an additional four new borrow pits (Figure 42) were under consideration. Of the four potential pits, one (Ambrose Channel Pit) located south of Rockaway Point, is north of the current project area. The report titled *A Preliminary Assessment Of Cultural Resources Sensitivity For The Lower New York Bay New York And New Jersey* (Ferguson 1986) basically used Engebretsen's shipwreck inventory on the Greater New York Harbor (1982) to determine the potential for cultural resources within the proposed borrow pit areas. Ferguson's recommendations regarding the Ambrose Pit Area concluded that "If this area is selected, it is recommended that it be subjected to remote sensing to determine the presence of shipwrecks (or other obstructions)" (1986:28).

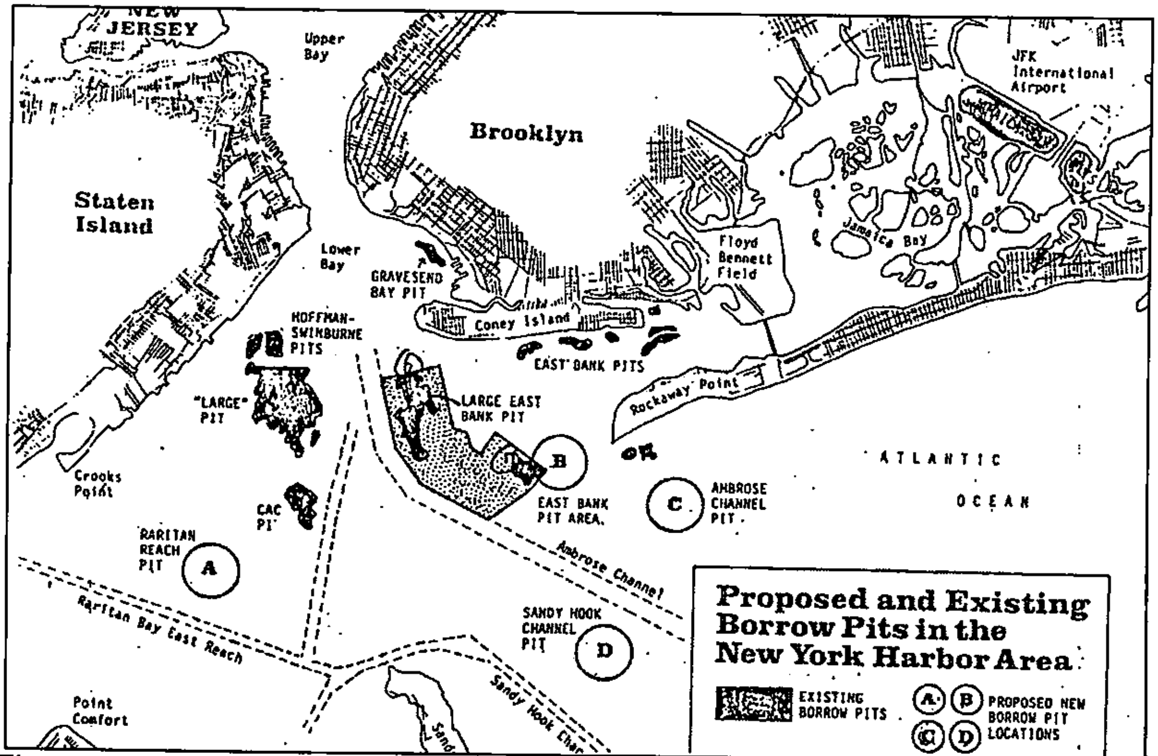

Figure 42. Proposed and existing borrow pits in the New York Harbor area (as presented in Ferguson 1986:3).

A remote-sensing survey of the Ambrose Pit Area was conducted by Ocean Services, Inc. (OSI) using a magnetometer, sidescan sonar, and bottom penetrating seismic reflection instruments. Field investigations conducted between January 7 and March 5, 1988 located 86 magnetic targets along with 24 sidescan sonar targets. Correlating all the data together, Nowak and Riess concluded that 12 of the sites had a high potential for shipwreck remains (1989:21).

In 1990 Pickman conducted a survey of the Atlantic coast of Brooklyn, just south of Coney Island. This study included a borrow area located between Coney Island, Ambrose Channel, and East Bank Shoal, and detailed a number of wreck locations. None of them are in the current project area.

Arnold Pickman (1990) conducted a cultural resources reconnaissance for a three-mile segment of beach zone along the Atlantic Coast of the Borough of Brooklyn in Kings County, New York. Consisting of both onshore and offshore study areas, Pickman used documentary data to determine the potential for prehistoric and historic sites within the project area. Relative to cultural resources within three proposed offshore borrow areas, Pickman documented two unidentified shipwrecks (on a marine chart) within Borrow Area C, located west of Rockaway Point (1990:55).

During the Liberty Pipeline survey (Miller and James 1992a and b), which cut across a portion of the Ambrose Channel, numerous anomalies and sidescan targets were located. These include several that appeared to have boat or vessel-like qualities. Avoidance was recommended for those targets and anomalies deemed most likely to represent submerged cultural resources. No targets were dived.

Another report compiled by Arnold Pickman, *Cultural Resources Reconnaissance, Atlantic Coast of Long Island, Jones Inlet to East Rockaway Inlet, City of Long Beach, Village of Atlantic Beach, Lido Beach and Point Lookout Areas, Town of Hempstead, Long Beach Island, Nassau County, New York.* (1993), is a comprehensive document on the growth, development, and maritime aspects of Long Island. The reconnaissance "was conducted in the areas to be affected by the proposed U.S. Army Corps of Engineers Beach Erosion Control Project along the Atlantic Coast of Long Island from East Rockaway Inlet to Jones Inlet, Nassau County, New York" (Pickman 1993:Abstract). More specifically, the study included documentary data for both onshore and offshore portions of the project area. As a result of the study, Pickman's survey and documentary data provide a valuable source of the prehistory and history of Long Island. Regarding the potential for shipwrecks within the project area, Pickman concludes that "Although there are no reported wrecks on the ocean bottom within the study area, historical sources indicate that numerous wrecks occurred here" (Pickman 1993:52).

Panamerican Maritime conducted an archival study of a mud dump site and Potential Remediation/Restoration Area in the New York Bight Apex, located just outside the entrance to Lower New York Bay (James and Krivor 1997). Fifteen sidescan targets previously identified as wreck sites were evaluated, along with thirteen vessels known to have sunk in the project area. One of the sidescan targets was determined not to be historically significant. Five of the 15 could not be positively identified due to lack of data. Of the remaining vessels, nine were determined to be historically significant. Recommendations included diver identification and additional archival research.

A number of other cultural resource investigations have taken place both to the east and west of the current project area. While not all of these studies are directly applicable, the results typify the propensity for both anomalies and shipwreck remains in the current project area.

In 1993 the Corps contracted with WCH Industries of Waltham, Massachusetts (in association with Boston Affiliates, Inc., of Boston, Massachusetts) to conduct a remote-sensing survey of Borrow Areas 1A and 1B (Figure 43) located approximately:

> 3 nautical miles to the southwest of Rockaway Point, adjacent to the borrow areas used in the original 1977 project...The east borrow area 1B measures 2,000 feet long by 1,800 feet wide. The west borrow area (1A) is smaller measuring 2,000 feet long by 1,600 feet wide (Riess 1993:2).

The Corps project plans called for the removal of sand from these two borrow areas to be placed along the section of Rockaway Beach from Beach 19th Street to Beach 149th Street. Previous research (Ferguson 1986; Nowak and Riess 1989; Gardner and Riess 1990; Pickman 1990) concluded the "probable previous destruction of any prehistoric aboriginal sites and the possibility of historic shipwreck remains in Borrow Areas 1A and B..." (Riess 1993:4). Both areas were also determined to have a high probability for historic shipwreck sites due to the intense shipping through the general area.

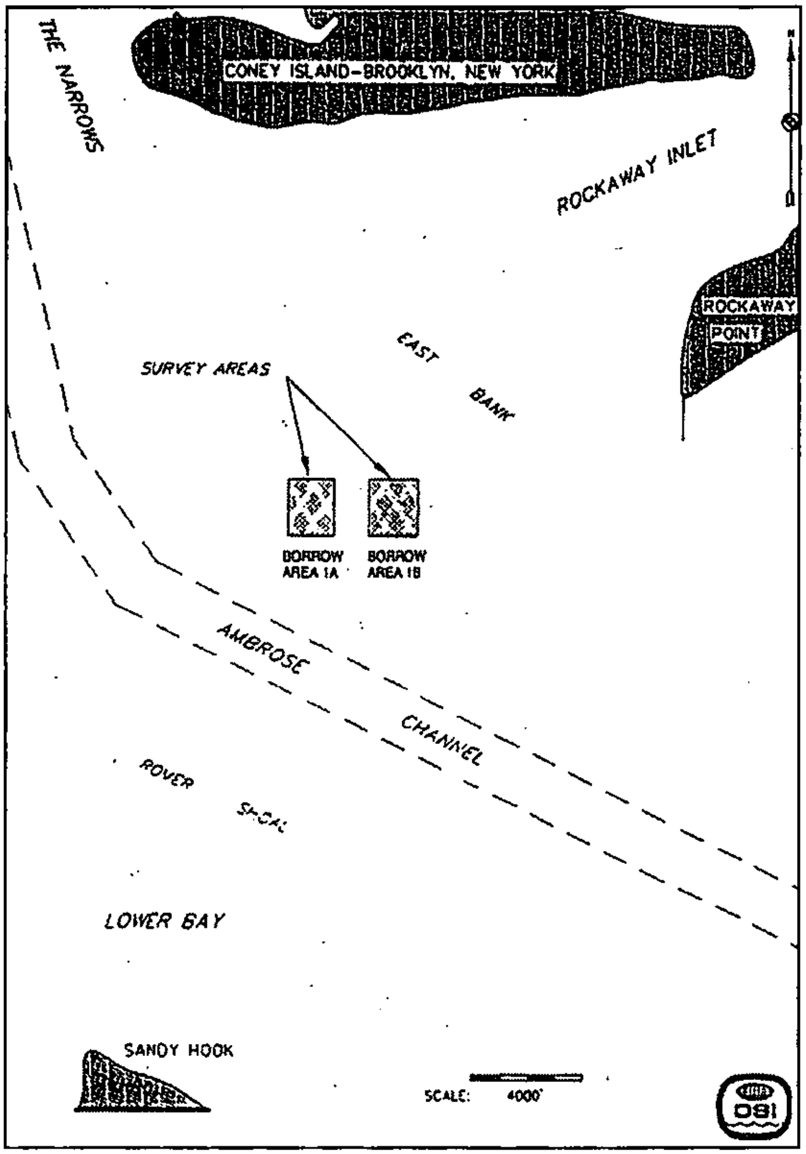

Figure 43. Proposed Borrow Areas 1A and 1B, Atlantic Coast of New York City, East Rockaway Inlet to Rockaway Inlet and Jamaica Bay, New York, Section 934 Study. Per OSI (as presented in Riess 1993:3).

After compiling the remote-sensing survey data, all magnetic anomalies over five gamma were considered as potentially significant cultural remains (Riess 1993:7). Results of the survey produced one probable significant cultural resource (magnetic anomaly with associated sidescan image) and six possible cultural resources (magnetic anomaly with no sidescan return) in Area 1A (West) and four probable significant cultural resources within Area 1B (Riess 1993:7). Recommendations for the ten targets were either avoidance by the Corps or inspection of targets if "the Corps plans are such that the target safety zones are a major impediment to the borrow project" (Riess 1993:13).

In 1977 Kardas and Larrabee examined an area stretching from the Manhattan Ferry Terminal to the Verrazano Narrows Bridge, and discussed several historic resources, including Fort Wadsworth. None of the resources studied are in the current project area.

A number of studies have dealt with the area around Shooter's Island, including Kill van Kull, Arthur Kill, and Newark Bay. They include Kardas and Larrabee (1976, 1980, 1984, and 1985), Rockman and Rothschild (1979), Brouwer (1981),Payne and Baumgardt (1986), Raber (1996a-d), and James (1987, 1999).

In 1976 Kardas and Larrabee conducted a Phase I survey on Kill van Kull and Newark Bay Channels, including Shooter's Island, in advance of a project to deepen and widen the channels from Robbin's Reef to Shooter's Island and Newark Bay Channel to Elizabeth Channel. They determined that no potentially significant resources would be affected by the project, but recommended caution during the removal of a sand bar off Port Elizabeth, as it might contain a prehistoric land surface. They also recommended caution in the shallow areas surrounding Shooter's Island, as they too might contain prehistoric land surfaces. Finally, they recommended further investigation of Shooter's Island proper.

In 1979 Rockman and Rothschild conducted a Phase I survey of Shooter's Island to identify any historic or prehistoric resources potentially eligible for NRHP status. They determined that any cultural resources located on the island would fall into six categories: 1) Prehistoric; 2) Associated with David Decker's mid-nineteenth century ownership of the island. Structures included docks, a house, and a joiner's shop; 3) Associated with the Petroleum Refining and Storage Company's use of the island; 4) Associated with the island's use as a shipyard; 5) Associated with the island's use as a dumping place for derelict vessels; and 6) Associated with filling and increasing the size of the island over time.

Kardas and Larrabee (1980) examined parts of Arthur Kill, Shooter's Island, and the west side of Newark Bay up to Port Elizabeth as part of the New York Harbor Collection and Removal of Drift project. They concluded that many of the structures and sites along the channels are eligible for NRHP status, and recommended further investigation of sites such as the Central Railroad bridge and the Singer plant, in the form of planning, monitoring, and recording. They also recommended detailed examination of several hulks in the vicinity of the Singer plant. None of the items discussed in this report are in the current project area.

Brouwer (1981) examined the area immediately west of Shooter's Island and determined that none of the vessels there were eligible for NRHP. He did recommend further study, and also suggested the recovery and preservation of certain artifacts including bollards and cleats.

In 1984 Historic Sites Research (Kardas and Larrabee 1984) conducted a cultural resource reconnaissance of Bayonne Reach in the Newark Bay Channel as part of the New York Harbor Drift Removal Project. The project examined 158 shore structures and 100 derelict vessels, with the majority not being recommended for further work. Eight vessels, including the *Occidental, Maceratta, Molfatta*, and *City of Austin* (all built in the Gulf Coast during WWI), were recommended for further investigation. This investigation was undertaken in 1991 by Panamerican Consultants, Inc. (James 1991). This study looked at seven of the eight vessels, and determined they were eligible for listing on the National Register of Historic Places. The report recommended excavation and recordation of the vessels. In 1996, Fanning, Phillips, and Molnar assembled a Health and Safety Plan for the mitigation of these vessels (FPM 1996). However, this project has yet to be implemented.

Payne and Baumgardt (1986) conducted a Phase I survey of several areas in the vicinity of Howland Hook. This survey included the areas surrounding Port Ivory, and located the remains of several wooden vessels, which they suggested to be sailing lighters. They recommended further investigation to determine what, if any, significance these vessels might have. These vessels have since been studied in greater detail by Raber (1996c) and James (1999).

In 1985 Historic Sites Research (Kardas and Larrabee 1985) conducted HABS/HAER recordation of four vessels at Shooter's Island. They identified numerous other vessels, some of which are in close proximity to the current project area, and are represented by several of the anomalies and sidescan targets located during the current project.

Five shipwrecks in proximity to the U.S. Dike in Arthur Kill were examined by Consulting Nautical Archaeologists (James 1987). This project coincided with the enlargement of South Newark Bay channel. Initially slated to assess the eligibility of two shipwrecks for nomination to the NRHP, three additional wrecks were located and assessed as well. These vessels included four wooden-hulled steam tugs and a wooden-hulled sidewheel steamboat. Due to the deteriorated condition of the hulls and the lack of diagnostic and cultural material, it was determined that none of the five vessels were eligible for NRHP status.

In 1995 Raber and Associates (Raber 1996a) examined 160 structures and 89 marine resources in Arthur Kill New Jersey Reach. Several potentially significant waterfront structures were identified, along with 21 derelict vessels and two vessel clusters. The structures were determined not to be subject to adverse effects, while the vessels were the opposite. Recommendations included additional studies of the potentially affected properties to determine NRHP eligibility.

Again in 1995, Raber and Associates (Raber 1996b) examined 63 structures and 253 marine resources in Arthur Kill New York Reach. None of the structures were considered significant, but 55 derelict vessels and six vessel clusters were identified as subject to adverse project effects. Recommendations included additional studies of the potentially affected properties to determine NRHP eligibility.

In 1995, Raber and Associates (Raber 1996c) examined 119 structures and 183 marine resources in Kill Van Kull New York Reach. One waterfront structure was determined to be potentially significant and subject to adverse effects, and one was determined to be significant, but not subject to adverse effects. Forty-seven derelict vessels and six vessel clusters were identified as potentially significant properties and subject to adverse effects. Recommendations included additional studies of the potentially affected properties to determine NRHP eligibility.

In 1995, Raber and Associates (Raber 1996d) conducted a study of derelict vessels in Bayonne Reach. This study divided 101 vessels identified in 1985 by Kardas and Larrabee (see above) into 13 clusters to study abandonment patterns. They were able to refine identities and vessel types for vessels previously determined to be eligible for NRHP status, including the Port Johnson vessels (see James 1991). Nine additional vessels were found to be NRHP-eligible. These additional vessels were recommended for further investigation.

In 1997, Panamerican Consultants, Inc. examined sections of Arthur Kill and Kill Van Kull as part of the New York Harbor Collection and Drift Removal Project. This project examined derelicts and structures in the project area and determined that 140 vessels and 14 vessel clusters, as well as a bridge and a pier, are potentially historic properties which could be affected by the project activities (James 1999). This number included 72 vessels and two structures that required varying degrees of mitigation, up to and including full HABS/HAER documentation.

6. POTENTIAL FOR SUBMERGED PREHISTORIC SITES AND SHIPWRECK INVENTORY

Consideration of the potential for cultural resources within the project area focuses on two distinct types: prehistoric sites and historic shipwrecks. Although the location of shipwreck sites can be realized through the employment of an array of remote-sensing equipment like that currently being utilized within the project area, the location of submerged prehistoric sites with current technology is highly unlikely. Rather, the emphasis during a study of this nature is more hypothesis than reality, the investigation basing potential submerged site locations on known above current sea level site locational parameters (i.e., land forms such as river terraces), as well as data on Pleistocene environments and resources for the area (i.e., estuaries, food types). However, it is possible to identify relic submerged landforms to some extent with the sidescan sonar and sub-bottom profilers, and then apply known parameters from above-sea-level sites to these landforms.

With this in mind, the potential for prehistoric resources within our project area is directly related to the geological morphology of the area resulting from post-Pleistocene sea-level changes. The last of the Pleistocene glacial stages was the Wisconsin glaciation; the project area lies just south of the maximum southerly limit of this glaciation (Ferguson 1986). Between 18,000 and 14,000 years before present (B.P.), sea level was more than 100 meters (325 feet) lower than it is now. Depending on the source quoted, by 12,000 B.P. sea level had risen to between 60 m and 30 m below its current level. Hunter et al. (1985:3-28) illustrate that all the project area was above sea level during the Holocene period, or termination of the Pleistocene. With human occupation believed to have begun in this area circa 12,000 B.P. (a conservative estimation), current speculation suggests that the entire project area would have been available for prehistoric occupation (Ferguson 1986:6).

During an early investigation Roberts et al. (1979:Volume II) indicated that evidence for Pleistocene megafauna and relic shell-fish beds has been reported from offshore areas, both representing Pleistocene resources and environments favorable or conducive to prehistoric population utilization, but there was no actual evidence for prehistoric occupation or utilization during the Holocene for offshore areas. Megafauna certainly could have been a resource exploited by prehistoric peoples. In the area there are three regions where megafauna remains appear to be clustered offshore. Mammoth teeth have been found at the depth of approximately 80 meters. Mastodon teeth have been found in two separate belts from 20-25 meters and 40-50 meters below present sea level. These clusters of terrestrial remains may corroborate with past sea levels, indicating possible areas for human occupation (Miller et al. 1990:7).

The potential for submerged prehistoric sites on the continental shelf has been treated by several authors since Roberts et al.'s research (Stright 1990, 1995; Pickman 1993; Thieme 2000). Stright (1990) listed numerous sites found in a shallow water context and then went on to create some predictive modeling as to where sites could be located. Later (1995), Stright focused her studies on the effect of sea-level change on potential archaeological site location and expected levels of preservation. Pickman (1993) also focused on the potential location of prehistoric sites relative to sea-level change in the Long Island, New York area. In his study of the New York harbor region, Thieme (2000) indicates that there are known Late Paleoindian or Early Archaic sites on Staten Island. He believes that the sites represent only a small portion of actual settlement in the region and settlement extended across the inundated surfaces of the harbor region (Thieme 2000:3).

Many submerged prehistoric sites have been located in various regions of the continental shelf. Stright's (1990) compilation of 34 submerged prehistoric sites indicated the potential for the resource to be found on the continental shelf. Although the definition of site is "...used to designate any locality of archaeological material, not necessarily an in situ archaeological deposit," and the sample is admittedly biased–from shallow water areas–the data support the thesis that there are early prehistoric sites located in a submerged context (Stright 1990:439). Supporting this hypothesis, artifactual materials in the New England/Long Island Sound area were located due to dredging activity and were assigned to the Archaic period (Stright 1990: 441-442). Thus there is a body of evidence to support the contention that there may be submerged prehistoric resources in the present project area.

It is believed that past dredging activity off of Sandy Hook, which is south of the present project area, may have exposed and redeposited portions of a prehistoric site. An assemblage of over 200 prehistoric artifacts was collected by a shell seeker on the beaches of Monmouth, New Jersey, well south of the park. The area where the artifacts were located had recently been renourished by sands dredged from offshore the lower end of the park and south of the current project area. The dredging took place in an area approximately one mile east off the southern portion of Sandy Hook in depths of 35 to 40 feet below mean low water. It is believed that the artifacts came from a layer within the first five feet of the sea bed from the Weeks 1 Borrow area (COE Memo, 9/21/95). The lithics, including numerous projectile points, have been tentatively identified as ranging from the Early Archaic to the Late Woodland periods, with a large portion from the Archaic. It is tentatively considered that the concentration of the artifacts, most from the Archaic period, can be considered to consist of a site that had been dredged from the borrow area and deposited with sands onto the beach at Monmouth (Merwin, personal communication 2001).

Comparable submerged sites have been found and investigated in Florida. Most artifacts have not been found by archaeologists, but by diver/collectors. Some of the extinct faunal remains found in a submerged context show evidence of butcher cuts and other evidence of human shaping (Faught 2001). However, in general the Florida environment is much more benign than the conditions found off New York Harbor. Lower sedimentation, clearer and warmer waters, milder or no tides, and less dynamic conditions have allowed the Florida sites to be more easily found and investigated (Merwin, personal communications 2001). Although the environment is presently quite different between New York Harbor and Florida, the evidence of Holocene occupation existing in now-submerged portions of the continental shelf may be applicable to the Holocene environment of the present project area.

With the knowledge that there are other submerged prehistoric sites located on previously terrestrial Holocene environments, there is the potential for sites to be located in the present project area. This is evidenced by the assemblage of prehistoric cultural artifacts recovered from a renourished beach context, the original in situ location of the artifacts being considered an offshore borrow area south of the current project area. This would indicate that there are indeed submerged prehistoric sites in proximity to the project area. The question then is how to identify prehistoric sites that cannot be recorded during a typical marine remote-sensing investigation.

The equipment utilized for this project, i.e., magnetometer and sidescan sonar, cannot positively identify prehistoric sites, which are non-magnetic and don't protrude from the sea bed. Alternate methods and techniques may have better results. The application of a subbottom profiler survey, with parameters to identify relict landforms, and in conjunction with coring could possibly identify likely locations for submerged prehistoric sites. Rather than using these instruments in a broad survey to look for specific sites, which would be difficult, their application should be to indicate past submerged Holocene landforms with potential to contain cultural material. Subsequent testing for prehistoric sites (i.e., coring) could concentrate on the areas of higher potential, increasing the chance to contact these materials.

Shipwreck Inventory of the Project Area

A number of sources have been written concerning the history of the approach to New York Harbor and the subsequent loss of numerous vessels due to foul weather, lack of navigational aids, marine accidents, or simply grounding-out near the surf zone (followed by the subsequent degradation of the hull if the vessel could not be removed). Rattray mentions that the south shore of Long Island is well-known for shifting sandbars which parallel the whole length of the island (1973:50). Any and all of these factors helped to make both the approach to New York Harbor and the harbor itself a haven for shipwreck disasters. Derelict vessels also figure prominently in any inventory of the project area, and have been studied extensively (James 1999).

Considering the volume of shipping that moved in and out New York Harbor for the last three centuries the probability of shipwreck remains within the project area can be considered high. The report written by the Harvard University Institute for Conservation Archaeology (ICA) study of the Atlantic Coast titled *Summary and Analysis of Cultural Resource Information on the Continental Shelf from the Bay of Fundy to Cape Hatteras* (1979) supplies some useful information regarding the final disposition, durability, historic shipping, data, and categories of shipwrecks:

A. <u>Shipwreck locations</u>

(1) References to shipwreck location are often vague, owing principally to the difficulty of locating things at sea. Even as late as World War II it was not customary or feasible for merchantships to maintain their position at sea with any great accuracy. Thus, a position reported at the time of the vessel's distress often refers to the last known position rather than the actual position at the time of the wreck.

(2) The change from sail to steam power during the mid-nineteenth century seems not to have affected shipwreck location.

B. <u>Construction material and durability of shipwrecks</u>

(1) Wooden shipwrecks tend to break up and disintegrate due to the effects of storms and/or attacks of marine organisms, with their remains scattered over an area much larger than the original dimension of the ship.

(2) Steel-vessel shipwrecks tend to retain a greater degree of structural integrity than wooden vessels.

(3) The early steel (actually iron) vessels of the 1860s were generally made of thin sheets of metal and tended to sink rapidly and scatter their remains over larger areas than the later, more-rigidly constructed steel vessels.

C.) <u>Historic shipping</u>

(1) The Harvard University study presents a brief history of shipping in the Greater New York Harbor area and makes predictions as to probable primary locations for shipwrecks for the various periods. New York Harbor has been an active port since the first Dutch settlements, and in fact since the early 1800s it has been a leading--often <u>the</u> leading--American port for commercial shipping. Because modern aids to navigation appeared only toward the latter part of the nineteenth century, it is probable that yearly vessel losses peaked during the period 1850-1880 (That the data contained in this shipwreck inventory does not show a peak towards the latter part of the nineteenth century is problematic, but perhaps is due only to the onset of record keeping in the twentieth century).

D.) <u>Shipwreck data sources through time</u>

(1) Pre-1800: there are not many records of any sort pertaining to shipwrecks during this period; what records do exist tend to be located now in European archives, since the ships involved, until 1776, were of European registry. Potential shipwreck locations are derived from analysis of shipping routes, trade, and settlement patterns.

(2) 1800-1880: coastal newspapers are the major source for information about ship arrivals and departures and about ship losses during this period.

(3) 1880-present: By 1880 the U.S. Life-Saving Service was publishing lists of casualties in its annual report. By 1910 a list of vessels lost was also included in Merchant Vessels of the United States, an annual record of registered vessels published by various government branches. By 1915 the U.S. Life-Saving Service was taken over by the U.S. Coast Guard, which also published annual reports of casualties and assistance.

4.) Categories of areas of expected shipwrecks

a. Primary: locations where popular shipping route pass through hazardous waters and/or close to shorelines.

b. Secondary: coastal and shoal areas less frequently utilized but known to contain submerged hazards and lee shores.

c. Tertiary: deep-water areas of major shipping channels, where shipwreck density relates directly to traffic density (as presented in Engebretsen 1982:2-3).

These factors (compiled by ICA) aided in establishing a shipwreck inventory for Lower New York Bay in a report titled *New York Harbor and Adjacent Channels Study Shipwreck Inventory* (Engebretsen 1982). In cooperation with the Corps and Port Authority of New York, this study established the potential for shipwrecks within navigation channels (and adjacent areas) in and near New York Harbor. Engebretsen created the inventory "of all known shipwrecks in the Greater New York Harbor area" (1982:3) using several shipwreck compendiums, lesser inventories, and government reports. The four major sources consulted include (but were not limited to) Londsdale and Kaplan (1964); Marx (1971); Berman (1972); and Rattray (1973).

Vessels lost in or near the project area are listed in Table 4.

Table 4. Vessel Losses Documented in or Near the Project Area.

Name	Rig	Tons	Built	Date	Comment
A.C. Nickerson	Steam screw	64	1864	3-25-1891	Lost, New York, NY.
A.J. Sinonfcon	Schooner			6-25-1873	Collided, off Long Island.
A.M. Andrews	Barge	2017	1919	1-28-1933	Foundered, Brooklyn.
Abangarez	Steamship			3-11-1955	Collided In fog, Gravesend Bay.
Abraham Leggett	Pilot boat			"1879"	Becalmed in lee of steamship, which rolled over & crushed her.
Abrao Collerd	Barge	217	1869	9-11-1905	Collided with steamer *Maine*. NY, NY.
Absecon	Barge	911	1918	5- 9-1911	Collided with Sta. *Sterlington* & Sts. *Empire Curzon*, NY Harbor.
Acapuloo	Steamer			2-11-1875	Anchored, Gravesend Bay; ice damage.
Adelaide	Steam side wheel	731	1853	6-19-1880	Collided, sank. New York, NY.
Admiral Dewey	Steamship			11-22-1908	Smashed into a steamer off Coney Island.
Adolph Obrig	Bark	1,118	1881	11-10-1907	Sailed from NY & not heard from.
Adriatic	Or it. Steamer			10-21-1874	Collided in New York Bay; damaged.
Adventure	Scot. merchantman			1760	Lost in Lower New York Bay.
Aetna	Citizen's line steamer			5-15-1821	Exploded in New York Harbor; complete wreck.
African Star	Farrell Line's Freighter			12-18-1956	Collided in New York Harbor; sank
AJace	Ital. bark			3-3/1-1881	Wrecked Rockaway Shoals (Coney Island); total loss.
Albany	Schooner	650	1889	11-16-1922	Stranded, Man-0-War Rock, New York Harbor.
Albion	Brit. merchantman			2-1818	Wrecked on Coney Island, crew & cargo saved.
Alexa	Brit. Schooner			1-23-190f	Total loss, Rockaway Point, LI.
Alfred & Edwin	Oil screw	109	1872	12-19-1926	Foundered, Brooklyn; iron vessel.
Alice	Steam screw	154	1897	1-28-1935	Foundered, Erie Basin, Brooklyn.
Alice Roy	Bark			8-1887	Abandoned, off New York.
Alice Sheridan	Coal barge	373	1919	10-1-1915	Sunk in NY Harbor after collision off Staten Island (St. George).
Ambrose Snow	Pilot boat			5-13-1912	Rammed & sunk in Lower Bay.
American Leader	Freighter			1-15-1953	Collided, New York Harbor, in fog.

Name	Rig	Tons	Built	Date	Comment
American Press	Freighter			0-29-1959	Collided in New York Harbor.
Americus	Scow	170	1898	4-18-1925	Collided w/Sts. *Bronx, Brooklyn.*
Andrew Fletcher	Steam aide wheel	160	1865	12-20-1872	Burned, Quarantine landing, Staten Island.
Annie Bulge?	Barge	233	1906	2-26-1918	Foundered, New York Harbor.
Arbitrator	Schooner	106	1897	12-13-1916	Sailed from NY, not heard from.
Ariel	Sloop	54	1857	9-21-1908	Burned, New York City, NY.
Aminda	Steamer			3-18-1931	Collided in Narrows; damaged.
Avon	Ship	1,573	1884	4-5-1918	Sailed from NY, not heard from.
Ayuruoca	Steamer Freighter (ft)	6872		"1940", 6-11-1945	
B.W. O'Hara	Barge	227	1903	5-11-1914	Foundered, NY Harbor.
B.Y. 11	Barge	157		1-15-1926	Foundered, NY, NY.
Belle P. Mustek	Barge	350	1904	2-26-1918	Foundered, Brooklyn.
Benj. E. Weeks	Schooner	77	1867	11-1-1920	Stranded, New York, NY
Benaore	Bark	1,178	1870	7-10-1921	Foundered, NY, NY; iron vessel.
Bertha L. Barker	Schooner		1895	11-7-1916	Foundered, NY, NY.
Betsey	Brit., troop-transport			1780	Wrecked on rooks, Lower NY Bay.
Betty B	Fishing boat			7-28-1951	Exploded & sank in Lower NY Bay.
Bit Bob	OAS yawl	51	1905	2-23-1920	Burned, NY, NY.
Black Warrior	Side wheel steamer			2-20-1859	Sank in 30ft off Rockaway Beach, LI
Bohemian	Steam screw	72	1906	6-13-1935	Collided, NY Harbor.
Boston City	Brit. screw steamship			1-31-1901	Collided in Lower NY Bay.
Boyle	Schooner			1-30-1900	Wrecked west of Rockaway Ft, LI.
Broadway	Steam side wheel	755	1869	9-19-1917	Burned, NY, NY.
Bronx No.4	Steam side wheel	100	1893	9-29-1913	Foundered, Pier 5, Staten Island.
Buffalo (R,B)	Steam side wheel	1129	1854	6-29-1854	Foundered, New York, NY.
Buffalo	Steam screw	131	1885	11-21-1913	Burned, Staten Island.
Cresent	Steam screw	68	1872	1-13-1929	Foundered, Brooklyn.
CI	Barge	518	1906	8-31-1928	Foundered, NY, NY.
C.W. Horae	Steam Screw	509	1889	7-17-1916	Sailed, NY, never heard from.
Caldwell H. Colt	Pilot boat			3-11/12-1888	Damaged in blizzard.
Caprice	Pilot boat			2-27-1876	Run down in Narrows; sank; raised.
Capt. Mathlasen	Steam screw	117	1899	4-20-1925	Burned, Gravesend Bay, NJ.
Caroline	Brig			unknown	Sunk near Bills Island.
Caroline	Steam screw	63	1875	8-6-1922	Burned, Brooklyn.
Caroline	Sloop			6-24-1874	Run into off Battery; filled; sank.
Carrie C. Miles	Schooner	106	1871	10-15-1907	Stranded, Dry Rooer Shoal NY.
Carrie S. Webb	Schooner			3-1-1881	Sand, Homer Shoals, alongside Auguste; wrecked.
Carrie Winslow	Brig			2-11-1878	Wrecked New York Bay.
Caatlefcon	Barge	1112	1899	10-1-1907	Collided w/*Rochester*, New York, NY.
Castor	Steam screw	73	1891	3-7-1923	Foundered, NY, NY.
Chaleur	HM Sloop			7-10-1761	Burned by mob in New York.
Chancellor	Steam screw	383	1910	7-31-1928	Burned, Bosebank,Staten Island.
Charlie & Willie	Schooner	123	1849	10-30-1923	Burned, NY, NY.
Charter Oak	Steam side wheel	439	1838	3-1-1850	Burned, NYC.
Chatham	Ferry			8-29-1960	Collided in fog in NY Harbor.
Chicago City	?			10-20-1919	Sunk in collision off Staten Island.
Chris Olsen	Steam screw	54	1907	4-19-1948	Burned, Mariner's Harbor, Staten Island.

Name	Rig	Tons	Built	Date	Comment
Christ!ane	Danish bark			12-27-1866	Panned & sunk 6 miles e. of Sandy Hook.
Cincinnati	Merchantman			11-10-1810	Wrecked on Governor's Island.
City of Albany	Steam side wheel	1158	1863	10-6-1894	Burned, New York, NY.
City of Detroit	PCanal boat?	118	1875	4-18-1906	Burned, St. George, Staten Island.
City of Worry	Amer ship			1761	Sunk in Narrows; crew saved.
Columbia	Pilot boat			12-3-1883	Run over; all lost.
Columbia	Steam screw	174	1890	12-24-1909	Sailed from NY; not heard from since.
Columbus	Ferry			1-1856	NY-SI ferry; hull crushed by ice off Battery; passengers and crew saved.
Coaefc	Steam screw	97	1904	6-17-1925	Burned, Brooklyn.
Comet.	Steam screw	77	1901	5-26-1939	Foundered at pier, Arlington, Staten Island.
Conineroe	Pilot boat			1852	Lost with all on board.
Copla	Schooner			9-18-1882	Total loss off Rockaway Pt, Cargo coal.
Cornelia Soule	3-Masted Schooner			4-26-1902	Sank off Rockaway Pt, LI.; cargo granite, called "Granite Wreck"
David E. Baxter	Barge	173	1889	5-8-1908	Foundered, St. George, Staten Island.
Denvlle	Lighter			8-5-1940	Capsized off Stapleton, Staten Island.
Dolphin	Gas screw			1960	unknown cause, 830 yd., 192° from Coney Island Light. Depth 27'.
Dom Pedro	Barge	193	1876	2-21-1906	Collided with dock, NY, NY.
Dredge No. 12	Barge	330		1-19-1939	Burned off Bayonne, NJ.
Duchess J	Steamer			8-26-1902	Burned, New York.
E.G. Hay	Schooner	63	1873	6-28-1906	Collided off Debrosses St., NY, NY.
E.M. Card	Steam screw	204	1920	4-3-1945	Burned, Red Hook, Brooklyn; steel vessel.
EX-PC 469	Oil screw			1961	Unknown cause, Swinburne Island area, NY Harbor. 40° 43.3' N, 74° 03.4' W U.S. navy vessel.
East Wreck	3-Coal barges			1917	In triangle w/in 5 miles of shore, near Rockaway Point.
Economy	Steam sidewheel	239	1853	6-30-1851	Burned, NY, NY.
Edmund Driggs	Pilot Boat			3-11/12-1888	Ashore at Bay Ridge, Brooklyn; hole in bottom; lost.
Kilward T. Dalzell	Steam screw	96	1900	10-26-1926	Collided, Brooklyn.
Edwin Collyer	Schooner			1903	Sunk, Gravesend Bay; cargo sand.
Ekefors	Swed motor vessel			12-16-1949	Collided at Narrow; badly damaged.
El Estero	ship			11-24-1903	Fire at Caven Ft., towed to Robbins Reef & sunk (Upper Bay).
El Sol	Steam screw	6,108	1910	3-11-1927	Collision in fog in New York Harbor; sank.
Elizabeth	steam side wheel	1,079	1867	10-22-1901	Burned, New York NY; ferryboat.
Ellis P. Rogers	Barge	68	1878	12-23-1907	Collided w/*Mauretania*, NY, NY.
Enna R.	Barge	251	1903	9-8-1906	Foundered, NY, NY.
Enmett McLoughlin	Barge	331	192'!	9-21-1938	Stranded, Gravesend, NY.
Escape	Schooner			7-6-1916	Sank after collision off Ambrose Lightship.
Europe	Ger. bark			10-7-1876	Fire in hold at New York.
Evelyn	Schooner			11-30-1900	Wrecked west of Rockaway Pt, LI.
Evelyn	Ferry			1-13-1917	Wrecked in explosion
Evelyn	Steam screw	57	18811	10-25-1930	Burned, Brooklyn.
Evening Star	?			1866	Foundered at sea, out of New York.
Express	Steam side wheel	1,023	1864	5-11-1933	Foundered, Brooklyn; iron vessel
Fly	Pilot boat			1813	Lost with all hands.
Fort Victoria	Passenger boat			12-18-1929	Collided; sank at entrance to NY harbor 0° 28.6" .N 73° 53.2' W Depth 12
Frank Pendleton	Schooner	1,393	1874	3-8-1917	Foundered, Ambrose Channel, NY.

Name	Rig	Tons	Built	Date	Comment
Gen. Meigs	Steam screw	267		10-27-1926	Foundered, NY, NY; steel vessel
George L. Garlick	Steam tug			5-25-1897	Wrecked. Coney Island.
George W. Beale	Steamer			10-1887	Collided, New York Harbor.
Glendower	Schooner-barge	855	1894	1-3-1930	Collided, Brooklyn, w/*City of Elwood*.
Glide	Schooner			1905	Lost at Rockaway, LI.
"Golden Nugget"	?			unknown	Wreck west of Rockaway Inlet.
Governor	Tug			3-12-1888	Sunk between Rockaway Pt. and Swash Channel.
H.S. Inc. No. 11	Barge	258		5-18-1948	Collided, off Pier 6, Staten Island.
Haleyon	Steam screw	89	1875	10-18-1923	Foundered, Coney Island.
Harry Bum	Steam screw	51	18611	5-27-1872	Exploded, New York, NY.
Hattie Thomas	Steam screw	56	1890	1-29-1928	Foundered, Elm Park, Staten Island.
Hazel Mitchell	Barge	377	1907	4-16-1929	Stranded, St. George, Staten Island.
Henry Eckford	Steamer	153	1824	11-27-1841	Exploded, NY, NY, used as coal barge.
Henry D. McCord	Steam screw	69	1872	4-18-1926	Burned, Brooklyn.
Herbert Parker	Oil screw	137	1919	5-16-1932	Burned off Ambrose Channel Lightship.
Hibernian	Liner			5-2-1867	Burned at Fulton Perry.
Hopafccong	Barge	563	1885	12-6-1910	Foundered, NY Bay; iron vessel
Hudson	Liner			5-29-1912	Rammed in New York Harbor; "began to sink".
Ideal	Steam screw	149	1906	1-7-1945	Stranded, Staten Island, NY.
Idle Time	Cabin cruiser			9-10-1951	Capsized off Rockaway Point.
Idler	Steam screw		1886	7-24-1912	Collided w/*Old Colony*, NY.
Ilion	Barge	113	1890	12-14-1917	Stranded, Coney Island.
Isabella	Schooner			11-1-1837	Foundered in gale near New York.
Isabella Gill	Schooner	585	1891	8-17-1906	Sailed from NY & not heard from.
Italy	Scow	339	1914	11-19-1920	Burned, Brooklyn.
Ithaca	Steam screw	1,462	1906	8-11-1946	Burned, Brighton Marine Repair yd. West New Brighton, NY.
J.A. Reynolds	Tug			12-13-1940	Collided, New York Harbor; sank.
J.J. Rudolf	Lighter			11-11-1941	Sank at Atlantic Basin Pier, Brooklyn.
J.H. HcLaren	Bark			11-25-1871	Sunk In Lower Bay off Staten Island, probably total loss; cargo coal.
J.P. MeAUiater	Steam screw	133	1909	5-18-1934	Burned, Brooklyn.
Jacob A. Stamler		1,198	1856	2-17-1916	Burned, NY.
Jácob W. Morrisa	Schooner			unknown	Total loss off Battery.
James F. Murphy	Tug			1961	Unknown cause, Sailors Snug Harbor, NY Harbor. Depth 27
James H. Robinson	Canal boat	97	1881	5-26-1909	Foundered, Brooklyn.
Jaoea Funck	Pilot boat			1862	Sank In Narrows; raised.
James Logan	Steam screw	201	1914	11-17-1917	Collided w/*Lexington*, NY, NY.
Janes Runsey	Steam side wheel	341	1845	11-11-1853	Burned, NY, NY. Ferryboat.
James Rumsey	Steam side wheel	671	1867	2-20-1891	Sank, NY, NY. Ferryboat.
Jane	Pilot boat			4-2-1873	Ashore on West Bank, Lower Bay; filled.
Japanese	Pilot boat			3-11/12-1888	Collided; damaged.
Jenny	Merchantman			1778	Wrecked during gale on Staten Island.
Jenny	Merchantman			1798	Wrecked in Lower New York Bay.
John A. Hadgeman	Steamer			2-19-1890	Burned, New York.
John B. Mather	Schooner			3-21-1860	Damaged in collision off West Bank.
John D. Jones	Pilot boat			3-18-1871	Run down by City of Washington; all saved.
John E. Berwind	Steam screw	75	1888	2-16-1931	Foundered, Stapleton, Staten Island.
John G.. Olsen	Steam screw	134	1900		Burned, Pier 31, Brooklyn.

Name	Rig	Tons	Built	Date	Comment
John Mckeon	Pilot boat			7-18-1939	Off NJ; lost at sea in hurricane.
John Nelson	Barge	341	1849	8-19-1905	Stranded, NY, NY.
John Schmults	Schooner	59	1884	2-26-1925	Foundered, Brooklyn.
Johnson No. 17	Barge	131	1806		Burned, Black Tom Island, New York Harbor, due to explosion.
Joseph J Flannery	Steam screw	107	1881	1-25-1927	Burned, Port Richmond State Island.
Josephine Elliot	Schooner	391	1890	1-9-1908	Sailed from NY, NY., not heard from.
Joaiah Johnaon	Pilot boat			3-6-1869	"Run down & sunk by schooner sunk in bay".
Josle Mildred	Bark			8-1873	Run into at anchor in Lower Quarantine, cut through from water line up.
Joyce Card	Steam tug	123	1892	3-7-1931	Exploded in Erie Basin, Brooklyn; sank.
Juanita	Tug			12-27-1917	Sank in collision. New York Bay.
Julia	Schooner	57	1878	9-13-1907	Collided, Coney Island.
Kaoikawa Maru	Jap. Freighter			6-9-1966	Collided in fog with Nor. freighter *Nordvind* near Ambrose Lightship.
Kaskaskia	Steam screw	2,931	1918	1-31-1920	Burned, New York, NY.
Kate Dyer	?			1866	Sank about 10 miles off Fire Island after colliding w/*Scotland*; cargo cotton.
Kate Marquise				11-12-1890	Total loss off Highlands, NJ.
Kelsey	Barge	203		11-28-1904	Foundered, New York, NY.
Kenneth W. KcNeil	Barge	261	1903	5-2-1907	Foundered, New York, NY.
Kenyon	Schooner			11-30-1900	Wrecked off (w) of Bockaway Pt., LI.
Knoxville	Steam side wheel	1,210	18511	12-22-1856	Burned, New York, NY.
L.A. Buzby	?	117	1892	1-31-1919	Collided w/*McAllister*, NY, NY.
Lamartlne	Schooner			1888	Lost in East Bay, NY.
Lanarkshire	Freighter			2-15-1943	Collided in main ship channel. Upper Bay, w/U.S. destroyer *Hobpy*.
Liguria	Ital. Liner			12-1906	Collided, New York Bay, with *Peconic*.
Lizzie D	Steam screw	122	1907	10-19-1922	Sailed from Brooklyn; not heard from.
Lloyd H. Dalzell	Steam screw	202	1927	1-19-1951	Burned at commercial wharf, foot of Atlantic Basin, Brooklyn.
Lord Dufferin	Freighter			2-28-1919	Sunk in New York Bay by *Sultana*.
Louis	Steam screw	89	1863	10-16-1876	Stranded, Coney Island.
Louise	Side wheel steamer	1,351	1864	5-11-1933	Foundered, Brooklyn. Steel vessel.
Lucy & Elizabeth	Amer. ship			1812	Lost in Lower New York Bay; All saved.
Ludlow	Barge	1113	1899	11-3-1911	Burned, Pier 22, Brooklyn.
Mamie K	Motor boat			11-25-1919	Total loss 1 mile w. of Rockaway Beach.
Mandalay	Steam screw	1,120	1889	5-28-1939	Rammed & sunk by Acadia, New York Bay. Iron vessel.
Manhattan	U.S. Coast Guard Cutter			1-13-1932	Collided w/*Guayaouil*. New York.
Margaret Julia Howard	Bary	500	11(8	11-27-1920	Collided w/Brit *Clifftower*. NY.
Margaret Olaen	Steam screw	78	1890	5-4-1929	Collided w/tug *Joseph A. Cinder*, Brooklyn.
Maria Dagwell		110	1890	7-19-1919	Collided w/*Townsman*. NY.
Marigold	Steam screw	115	1863	11-30-1875	Burned, New York, NY.
Marion Olsen	Steam screw	87	1881	8-22-1931	Burned, Brooklyn.
Martha Ogden	Steamer			11-12-1832	Stranded, New York.
Martha Stevens	Steam screw	283	1862	7-20-1909	Collided w/*Confidence*, NY Harbor; iron vessel.
Mary	Dutch ship			1802	Lost in Lower New York Bay.
Mary	Steam tüg	58	1859	3-15-1875	Collided with Harlem passenger boat *Shady Side*. New York Harbor; sank.
Mary A. Hall	Schooner	381	1882	5-29-1919	Burned, NY Harbor.

Name	Rig	Tons	Built	Date	Comment
J Mary Heitman	Schooner			3-11/12-1888	Last seen going through Narrow.
Masootta	Bark			2-18-1891	Wrecked in collision, NY Harbor.
Matthew Kinney	Schooner			2-5-1872	In Narrows, bow port stove in by ice; vessel filled.
McCall	U.S. destroyer			12-3-1917	Collided w/*Comanche* below Narrows in high wind.
Metinio	Schooner	261	1901	2-26-1916	Sailed from NY Harbor, not heard from.
Michael Howard	Barge	502	1918	3-18-1912	Foundered, New York Harbor.
Mississippi	Merchantman			1807	Wrecked in Lower New York Bay; crew & some cargo saved.
Mohawk	Yacht			7-20-1876	Capsized in bay near New York; lost.
Mohawk	USN revenue cutter			10-1-1917	Lost in collision off New York.
Mohawk	Schooner	913	1882	1918	Sailed from NY & not heard from.
Montague	Side wheel steamer	110	1853	12-8-1853	Burned, NY. Used as ferryboat.
Morning Star	Brit. Ordnance sloop			8-1-1778	Blew up near New York coffeehouse; believed struck by lightning.
Mosea B. Bramhall	Schooner			10-21-1891	Unknown: entrance to NY Harbor.
Mutual	Steam screw	84	1890	1-3-1930	Collided w/ferry *W.R. Hearst*. Erie Basin, Brooklyn.
Mutual	Tug			4-30-1929	Collided w/ferry *Youngstown*; sunk.
Mystery	Gas boat	137	1905	2-23-1920	Burned, NY. Steel vessel.
N.B. Starbuck	Steam screw	101 (72)	1863 (65)	10-17-1928	Burned, New York (2 listings in B, with variances).
N.S. Starbuck	Steam tug			6-9-1872	Collided off Battery w/*City of London* (Brit.); badly damaged.
Narragansett	Steam screw	115	1873	8-I3-113B	Burned, Pier 32, Brooklyn.
Nathaniel Bacon	U.S. Cargo ship			11-21-1942	Damaged in collision w/*Esso Belgium* in NY Harbor.
Nat Sutton	Steam screw	66	1887	5-27-1946	Burned at Canal Terminal, ft. of Columbia St., Brooklyn.
Navesink	U.S. Dredge			5-7-1928	Sank after collision. New York Harbor.
Hellle T	Barge	255	1904	11.14-1919	Collided w/unknown vessel, Brooklyn.
Nelson	Brit. Merchantman			1815	Sank in Lower New York Bay.
New York	Barge	523	1923	1-1964	Foundered, Foot of Columbia St., Brooklyn.
New York Marine Co 16	Steam screw	179	1904	2-17-1926	Foundered, Brooklyn.
Nifadelos	Bark			12-16-1865	Collided & sank. New York Harbor
North Dakota	Tanker			1-26-1959	Collided off Bayonne, NJ with U.S. Army Dredge *Essayons*.
Northfleld	Staten Island Perry			6-14-1901	Radioed sunk in New York Harbor.
Northumberland	Oil screw	169	1897	10-24-1955	Foundered, 40° 22' M 73° 31' W.
No. 7	Schooner	957	1907	10-6-1918	Collided w/USS *Monitor*. NY.
No. 9	Oil screw	299	1920	12-21-1951	Foundered, Brooklyn.
Oceanua	Steam screw	1,996	1665	5-21-1868	Burned, NY. (East River?)
Ohio	Side wheel steamer	1112	1829	7-6-1842	Exploded, NY.
Ohioan	Steam ship			11-22-1933	Collided w/*SS Liberty*. Ambrose Channel; settled on shoals.
Old Glory	Hontauk Steamboat Co Steamer			1921	Destroyed by fire, New York.
Oliver A, Arnold	Steam screw	50	1863	2-11-1890	Burned, New York, NY.
Oregon	Side wheel steamer		1845		Collided w/*City of Boston*, sank in NY Harbor.
Orlo VI	Gas screw	79	1917	16-Sep	Collided w/*Barwick*. Brooklyn.
Oreanfcan	Steam screw	2,293	1880	11-3-1915	Sailed from NY & not heard from.
Ovidia	Steal ship			11-19-1930	Sank off Ambrose Lightship.

Name	Rig	Tons	Built	Date	Comment
P.W. fiprague	Steamer			10-1880	Burned, New York.
Palnella	Steam screw	595	1867	6-30-1870	Lost, NY, NY.
Passaic	Barge	552	1922	5-8-1930	Burned, Bayonne, NJ.
HKS Penfcland Firth	Brit. oil screw	500		9-22-1942	Torpedoed & sunk, Rockaway Inlet 40 25' 19" N 73° 52' 05" w. Patrolcraft Depth 50' (70'-Rattray).
Pequoit Hill	Tanker			1.14.1946	Exploded, Bayonne, NJ; on fire.
Petersburg	Tanker			5-24-1944	Exploded, Constable Hook, NJ.(Bayonne).
Phantom	Pilot boat			3-11/12-1888	Lost in storm.
Philip J. Kenny	Steam screw	142	1884	1-19-1923	Burned, off Ambrose Channel.
Phoenix	Schooner	901	1898	2-3-1926	Stranded, New York, NY
Pilgrim	Steam screw	261	1891	3-27-1937	Burned, Bayonne, NJ.
Pilot	Pilot boat			12-16-1917	Caught in submarine net off New York; rammed, sunk, by steamer *Berkshire*.
Pilot Boat	Pilot boat	361		4-27-1939	Collided w/Oslofjord off Sandy Hook. NJ. lO" 27' 45" N 73^9' 30" W. Depth BO
Pocono	?			9-5-1930	Total loss, Atlantic Highlands.
Pontin 227	Barge	234	1916	6-8-1966	Burned, Port Richmond, Staten Island.
Portland Packet	Schooner	91	1885	7-16-1916	Sailed from NY & not heard from.
Port Philip	Brit. steamer	4060		10-16-1918	Rammed, sunk by USS *Proteus*, Ambrose Channel.
Queens	Steam side wheel	802	1877	11-9-1918	Burned, New York, NY.
Quickstep	Bark			unknown	Run down & sunk In Lower NY Harbor, wreck removed & buoy placed on spot to mark shoal, near West Bank.
R.S. Lindsay	Schooner			11-10-1887	Sank sw of Rockaway Life Saving Station.
Rundlet	Schooner	271	1892	6-29-1916	Foundered, New York, NY.
Red Ash	Steam screw	117	1888	7-7-1927	Burned, Staten Island, NY.
Reichers Bros.	Steam Screw	85	1873	9-3-1930	Burned, New York, NY.
Relief Lightship NO. 5				6-211- 1960	Hit on Ambrose Station in fog; sank; wreck site marked, but moved.
Relief Lightship UAL				1961	Unknown; in vicinity of Ambrose Channel Lightship Station.
Rhea	Nor. bark			5-31-1871	Collided w/*Hansa*; sank.
Richard Card	Steam screw	182	1904	10-1-1944	Foundered, north side of pier, foot of 31st St., Brooklyn.
Richard Jaokaon	Barge	230	1880	3-6-1913	Foundered, New York, NY.
Richard Morrell	Schooner			10-12-1888	Unknown; Coney Island, NY
Richiond	Ferry			9-14-1944	Capsized, Bay Ridge, Long Island.
Robt.. C. Bonhaa	Oil screw				Burned, ft. of 6th St, Jersey City, NJ.
Robt.. Rodo«rs	Steam screw	142	1881	10-11-1913	Burned, New York, NY.
Rose	Naval vessel			12-1778	Wrecked on Staten Island.
Rose McLoughlin	Barge	199	1912	9-21-1938	Stranded, Gravesend Bay, NY
Rotterdam			1882	1902	Run down and damaged.
Rudolph	Steam screw	200	1898	9-25-1918	Collided w/USS *St. Louis*, NY, NY.
Ruth	Barge	224	1916	3-21-1942	Stranded, Brooklyn.
Ruth E. Pember	Gas screw				Struck submerged wreck off Scotland Light: total loss.
Ruth Shaw	Barge	185	1916	11-11-1939	Foundered, 2 miles SE of Jones Inlet Buoy, LI. tO0 29' M 73° 15' W.
S.H. 5	Tug			2.5-1940	Sunk at Brooklyn by ice floe.
S.M. Hayena	Schooner			8-30-1887	Collided, New York Bay.
S.S. Wyckoff	Steam screw	267	1860	3-13-1913	Collided w/*Heroine*, NY Harbor.

Name	Rig	Tons	Built	Date	Comment
Sb, Janes	Brit. troop-transport			1783	Wrecked on Staten Island.
Sb. Vincent	Tug			11-23-1917	Damaged in collision, NY Harbor.
Sallle E. Ludiam	Schooner	237	1873	6-17-1917	Collided w/ Corozal, NY Harbor.
Sally	Merchantman			1789	Wrecked on Coney Island.
Samson	Ferry			7-1-1839	Wrecked between NY & Staten Island.
Samuel Marquand		101	1882	5-17-1918	Foundered, Erie Basin, NY.
San Jacinbo	Pilot Boat			18/12	Lost with all hands.
San Jose II	Pan. Tanker			7-23-1956	Damaged in collision, 3 miles south of Ambrose Lightship.
Sander-art	Steamer	2,054	1918	7-2-1950	Sank after collision w/*Melrose*, entrance to Narrows. Steel vessel; Depth 47'.
Sandy Hook	Pilot boat steamer	361	1902	4-27-1939	Collided w/*Oslofjord*, 1 mile outside Ambrose Lightship. Steel; 40° 27' 45" M 73° 49' 30" W.
Santa Barbera	Steam ship			9-17-1935	Collided w/Ambrose Lightship.
Sarah	Barge	296	1889	10-12-1929	Collided w/ George W. Loft. Bay Ridge, Brooklyn.
Satellite	Steam screw	381	1894	11-20-1915	Burned, New York Harbor.
Scow Franklin	Scow			8-15-1897	Total wreck; Rockaway Inlet.
Sea Bird	Steamer			5-9-1932	Burned, New York.
Sea Wave	Scow			3-18-1950	Capsized off Ambrose Lightship.
Secaucua	Steam screw	919	1873	11-3-1935	Burned in ferry slip, foot of Bay Ridge Ave, Brooklyn.
Seneca	Side wheel steamer	313	1819	6-30-1872	Burned, New York, NY; ferryboat.
Seneca	Steam screw	2,963	1894	1-9-1928	Burned, New York. NY.
Seth Low	Fireboat			1917	Wooden City of Brooklyn boat; sank at dock.
Shamokin	Barge	829	1904	5-11-1925	Foundered, Scotland Lightship.
Shepherd Knapp	Side wheel steamer	186	1845	1856	Burned, New York, NY.
Silveryew	Brit. motor vessel			3-18-1931	Damaged in collision, Narrows.
Soaeraefc	Schooner	629	1905	2-10-1918	Foundered off Ambrose Light, NY.
Speculator	Schooner			7-21-1831	Sank off Coney Island.
Spitfire	Side wheel steamer	221	1846	10-12-1819	Burned, New York, NY.
Springhill	Tanker			2-5-1915	On fire after collision in Lower New York Bay.
SquantuB	Steam screw		1089	1-16-1121	Foundered, Brooklyn. Steel vessel.
Star	Barge	89		9-12-1905	Foundered, New York, NY.
Staten Island	Steamer			7-30-1871	Exploded, NY, NY. Ferryboat.
Supply 3	Oil screw	66	1921	1-30-1920	Foundered, Brooklyn.
T.W.O. Co. 28	Barge	312	1917	3-1-1930	Burned, Staten Island.
Teka	Barge	389	1917	1-13-1942	Collided, NY, NY.
Tempest	Side wheel steamer	80	1849	10-1-1866	Burned, New York, NY.
The Bruce	Ship			2-11-1891	Unknown, Bayonne, NJ.
Theodore	Barge	126	1882	7-30-1916	Burned, Jersey City, NJ.
Thomas Bulger	Barge	265	1900	2-11-1925	Collided w/B&O RR Bridge, Bayonne, NJ
Thomas E. Hulae	Side wheel steamer	314	1851	3-30-1875	Damaged by ice, New York, NY.
Thonas Hale	Barge	207	1896	2-5-1917	Foundered, Brooklyn.
Tloellne	Steam screw	99	1896	11-22-1920	Collision, w/*Correction*, NY, NY
Titania	Brit. steamer			11-19-1881	Collided in Narrows w/*Hypatla*.
Transport	Steam screw	162	1900	3-22-1933	Foundered, Brooklyn.
Trojan	Side wheel steamer	280	1812	8-9-1851	Burned, New York, NY.
True American	Merchantman			2-20-1809	Wrecked near the Narrows, Upper New York Bay.
Tynefield	Tanker			2-8-1958	Collided off Staten Island with ferry; damaged.
U.S. 110	Barge	294	1919	3-7-1921	Foundered, Brooklyn. Concrete vessel.

Name	Rig	Tons	Built	Date	Comment
U.S. Lightship, Ambrose Channel	Coast Guard Lightship			winter 1961-62	Disappeared.
U.S. Navy Escort Vessel				7-22-1911	Exploded, Tompkin, SI.
Umberto Prino	Bark			3-13-1891	Unknown. Romer Shoal; cargo hides and wool.
Union	Side wheel steamer	296	1811	12-15-1878	Burned, New York.
Union	Side wheel steamer	516	1862	7-17-1929	Burned, Port Richmond, 31 Perry.
Union Star	Side wheel steamer	163	1861	10-16-1862	Burned, New York, NY.
Universe	Barge	120	1915	1-2-1926	Foundered, New York, NY.
(unknown)	Sloop			8-20-1798	Struck Lightning off west end of Long Island.
(unknown)	Many			1839	Many wrecks, Coney Island, in gale
(unknown)	?			1890's	Suck en wreck miles NE. from Ambrose Channel Lightship; found 1893.
(unknown)	?			1920 vintage	Charted as obstruction, 5 miles off Sandy Hook in Ambrose Channel. Depth 40'.
(unknown)	?			unknown	5 miles off Sandy Hook, In 60' of water.
(unknown)	?			11-22-1933	Rammed off Coney Island; sank on Craven Shoals.
(unknown)	Launch			8-31-1935	Sank in collision with oil tanker at East Chester Bay, Staten Island.
(unknown)	?			unknown	40° 21' 18" N 73° 56' 06" W, Depth 35'.
(unknown)	?			unknown	40° 21' 24"-M 73° 49' 18" W. Pre WWII.
(unknown)	?			unknown	40° 25' 12" N 73° 45' 18" W. Depth 70'.
(unknown)	?			unknown	40° 27' 22" N 73° 59' 13" W.
(unknown)	?			unknown	40° 27' 24" N 73° 53' 06" W Derrick barge.
(unknown)	?			unknown	40° 30' 08" N 73° 51' 40" W Depth 7'.
(unknown)	?			unknown	40° 32' 00" N 73° 51' 90" W Depth 24'; pro WWI.
(Unknown)	Barge			1946	5 miles off Sandy Hook.
Vallderooaa J	Steamer			5-11-1944	Collided w/*Woodrow Wilson,* approaching New York.
Violet BloasoB	Barge	371	1907	2-20-1913	Collided w/McAlliater Bros. NY.
Vivi	Nor. Tanker			2-5-1915	Collision, New York Harbor.
Vulcan	Steamer			1875	Struck rock between Bobbins Reef and Liberty Island; sank; cargo machinery.
W.A.L. 505 Lightship				6-21-1960	Struck by freighter *Green Bay* on Ambrose Station; sank. Wreck site marked, but moved.
W.J. Townsend	?	133	1876	1-16-1941	Foundered, Bayonne, NJ.; concrete vessel.
V. J. Tracy	Tug			9-8-1931	Foundered in Narrows.
W.L. Webater	Steam a crew	73	1882	6-3-1919	Collided w/unknown object; Brooklyn.
M.S. & A.L. Rogera	?	106	1889	12-1916	Foundered, New York.
Waubesa J	Freighter			3-17-1919	Sank after collision. New York Harbor; cargo grain.
Wellesley Victory	Tanker			1-31-1917	Collision, off Ambrose Lightship.
White Rook	Schooner			7-25-1890	Unknown cause; New York Bay.
Wm. A. Carroll	Steamer	71	1906	3-17-1918	Foundered, Battia St., Brooklyn.
Wm. Dinsdale	Steamer			1-24-1911	Collided w/*Conoho.* NY Harbor.
Wm. F. Havemeyer	Steamer	110	1875	7-28-1907	Burned, New York, NY.
Wm.. Gulndon	?	103	1888	6-1915	Foundered, South Brooklyn.
Win, H. Babcock	3 Basted schooner			5-21-1927	Sank at looping, Bensonhurst, Brooklyn.
Wm. H. Vanderbilt	Barge	211	1871	8-19-1905	Stranded, New York, NY.
W. J. Hahoney	Barge	320	1927	3-23-19611	Foundered off boardwalk. Coney Island.
Wm. J, Rooer	Pilot boat			1863	Struck submerged wreck & sank.

Name	Rig	Tons	Built	Date	Comment
WH. H. Clark	Schooner			unknown	Lost in Gravesend Bay.
Wm. O'Brien	Steamer	5,211	1915	1-18-1920	Sailed from NY & not heard from.
Wm. V.R. Smith	Steamer	207	1905	3-11-1920	Stranded, New York, NY.
Wo, Voorhia	Schooner	89	1866	11-2-1907	Collided w/dock. New York, NY.
Yankee	Barge	531	1902	2-4-1920	Stranded, Brooklyn.
Yeada	Yacht			5-25-1890	Wrecked, New York Bay.
Zero	Barge	331	1926	9-21-1938	Foundered, Oraveaend Bay.

Engebretsen's principal purpose was to inventory shipwrecks "known or presumed to have occurred in the New York Harbor project area" (Engebretsen 1982:7). Additional purposes of the inventory were to:

- Assess the potential magnitude of the overall "shipwreck problem" with regard to deepening the navigation channels.

- Predict which areas have a high density of shipwrecks and which areas have a low density of wrecks.

- Predict the likelihood that a wreck encountered comes from a particular century and possibly predicting the parent material it is likely to be made from.

- Begin to track down and pinpoint the name and history of any shipwreck encountered (Engebretsen 1982:7).

As Table 4 above indicates, New York Harbor was an area of numerous historic vessel losses.

Pickman's cultural resources reconnaissance study (1993) provides an appendix of vessels wrecked in the general area of Long Beach, directly to the west of the current project area. Considering the amount of vessels wrecked off of Coney Island/Ambrose Channel (west of the project area) and the number of vessels wrecked to the east of the project area, it can be inferred that the potential for wrecks remains high.

A number of other, more recent publications regarding historic vessel losses off the south shore of Long Island have been published as diver's guides (Berg 1990) and as narratives to some of the many vessels which met their demise in and near the approaches to New York Harbor (Sheard 1998). While these sources include a plethora of wreck information for the south shore of the Long Island area, only those wreck sites presented below have been identified by the authors as being near the current project area.

Daniel Berg's book *Wreck Valley Vol. II* "is designed as a diver's guide to shipwrecks located off the New Jersey and Long Island coasts" (1990:vi). Berg provides historical background, water depths, currents, visibility, and types of aquatic life on over 90 shipwrecks within the New York Bight or "Wreck Valley."

Another source of wreck accounts off Long Island is titled *Lost Voyages: Two Centuries of Shipwrecks in the Approaches to New York* by Bradley Sheard (1998). Sheard's book covers the evolution of oceangoing vessels, the tragedy of shipwrecks, and documents a number of wrecks located near the approaches to New York Harbor. Sheard admits that his map is:

> ...only a partial listing; there were more documented wrecks, as well as undocumented ones. Note that the wreck locations are approximate. Early records are often incomplete and imprecise, and the sheer number of wrecks shown cannot be plotted with any accuracy due to space limitations alone (Sheard 1998:70).

Sheard's work provides a map of wreck sites along the south shore of Long Island with the names and dates of vessels lost (Sheard 1998:70). While Sheard's book provides a useful glimpse into numerous wreck sites strewn throughout the approach to New York Harbor, no history or loss accounts (besides the date and general location) of any of the vessels listed above are provided in the book. Sheard does acknowledge that:

> Estimates of the number of shipwrecks in the region run from the hundreds into the thousands. The Long Island and New Jersey coastlines form the two sides of a "funnel" directing traffic into New York's great harbor, and have witnessed more shipwrecks than anywhere else along the East Coast of the United States, with the possible exception of Cape Hatteras, along the Carolina Outer Banks (Sheard 1998:8).

From the maritime history and shipwreck information above it is clear that the potential for shipwrecks within the approaches to New York Harbor remains extremely high. Vessel types spanning every era in American history have traversed the waters off New York, making it a haven for a variety of shipwreck sites, many still undocumented and unidentified.

7. INVESTIGATIVE PROCEDURES

Panamerican conducted archaeological field work under the direction of Principal Investigator Andrew D. W. Lydecker, commencing on August 6, 2001. The archaeological field crew consisted of Norine Carroll and Christopher Morris. The project used equipment and procedures chosen specifically to meet the project requirements (see *Remote Sensing Plan*, Appendix B). Two vessels were used during the course of the survey: the *Venture III* and Panamerican's Wellcraft. The low water visual assessment was done both from the Wellcraft as well as from shore.

ENVIRONMENTAL CONDITIONS

The conditions encountered during the project could probably be called typical for New York in August. Daytime temperatures were either an average 75 degrees and sunny or 65 degrees and overcast. Winds were typically out of the south, increasing to 10-20 knots in the afternoon.

Commercial and pleasure vessel traffic was generally moderate to heavy. Although several vessels passed through the survey and diving areas each day, they were not considered a hazard to navigation, as most of the survey took place outside the navigation channel.

REMOTE SENSING SURVEY EQUIPMENT

The remote-sensing survey was conducted with equipment and procedures intended to facilitate the effective and efficient search for magnetic anomalies and acoustic targets and to determine their exact location. The positioning system used was a Motorola LGT-1000 Global Positioning System (GPS) instrument linked to a Starlink MRB-2A, MSK Radiobeacon receiver for differential (DGPS) capabilities. Remote-sensing instruments included an EG&G Geometrics Model G-866 recording proton precession magnetometer and a Marine Sonic Technology SeaScan PC sidescan sonar system. An Edgetech Geostar full spectrum sub-bottom profiler was also employed during the survey.

DIFFERENTIAL GLOBAL POSITIONING SYSTEM

A primary consideration in the search for acoustic targets and magnetic anomalies is positioning. Accurate positioning is essential during the running of survey tracklines, and for returning to recorded locations for supplemental remote-sensing operations. Those positioning functions were accomplished with a Motorola LGT-1000 global-based positioning system (Figure 44).

The Motorola LGT-1000 is a global positioning system that, when linked to the Starlink MRB-2A, MSK Radiobeacon receiver, attains differential capabilities. These electronic devices interpret transmissions both from satellites in Earth's orbit and from a shore-based station to provide accurate coordinate positioning data for offshore surveys. The Motorola system used here has been specifically designed for survey positioning. This positioning was provided through virtually continuous real-time tracking of the moving survey vessel by utilizing corrected position data provided by an on-board GPS, which processed both satellite data and differential data transmitted from a shore-based GPS station utilizing Radio Technical Commission for Maritime Services (RTCM) 104 corrections. The shore-based differential station monitored the difference between the position that the shore-based receiver derived from satellite transmissions and that station's known position. Transmitting the differential that corrected the difference between received and known positions, the DGPS aboard the survey vessel constantly monitored the navigation beacon radio transmissions in order to provide a real-time correction to any variation between the satellite-derived and actual positions of the survey vessel. New York State Plane coordinates, based on the 1983 North American Datum (NAD 83) coordinate system, were used for this project.

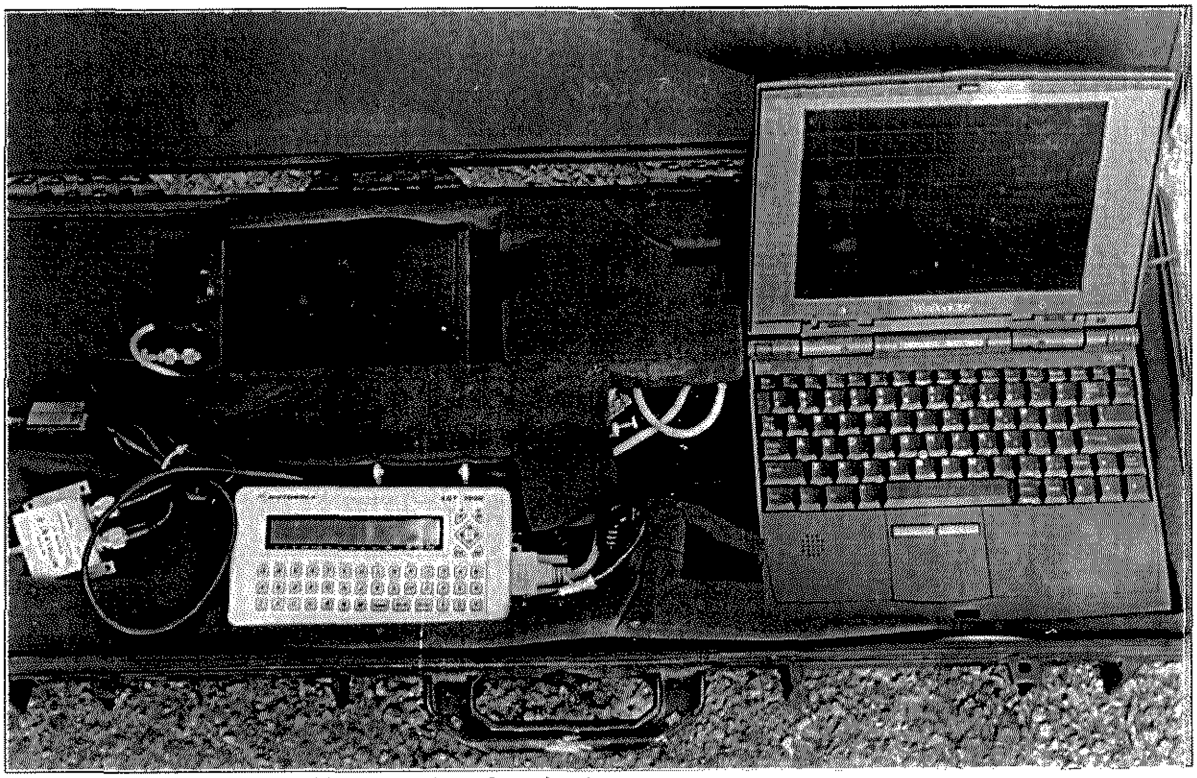

Figure 44. Motorola LGT-1000 global-based navigation system.

Both the satellite transmissions and the differential transmissions received from the shore-based navigation beacon were entered directly into an IBM Thinkpad computer with an auxiliary display screen aboard the survey vessel. The computer and associated hardware and software calculated and displayed the corrected positioning coordinates every second and stored the data every two seconds. The level of accuracy for the system was considered at ±1 meter throughout the survey. Computer software (Navtrak®) used to control data acquisition was written and developed by Chris Ransome & Associates (CRA) specifically for survey applications. It was used to provide real-time trackline data for the vessel operator during remote-sensing survey operations. Positioning information was printed on hard copy and stored on magnetic disk aboard the survey vessel.

All positioning coordinates are based upon the position of the antenna of the DGPS. Each of the remote-sensing devices was oriented to the antenna, and their orientation relative to the antenna (known as a lay back) was noted. This data is critical in the accurate positioning of targets during the data analysis phase of the project. The lay back of the magnetometer sensor was 60 feet aft.

MAGNETOMETER

The remote-sensing instrument used to search for ferrous objects on or below the ocean floor of the survey area was an EG&G Geometrics Model G-866 proton precession magnetometer linked to an EG&G Model G-801 marine sensor (Figure 45). The magnetometer is an instrument that measures the intensity of magnetic forces. The sensor measures and records both the Earth's ambient magnetic field and the presence of magnetic anomalies (deviations from the ambient background) generated by ferrous masses and various other sources. These measurements are recorded in gammas, the standard unit of magnetic intensity (equal to 0.00001 gauss). The stripchart printout of the G-866 recorded data at two-second intervals both digitally and graphically, providing a record of both the ambient background field and the character and amplitude of anomalies encountered. This information was also stored electronically in the navigation computer.

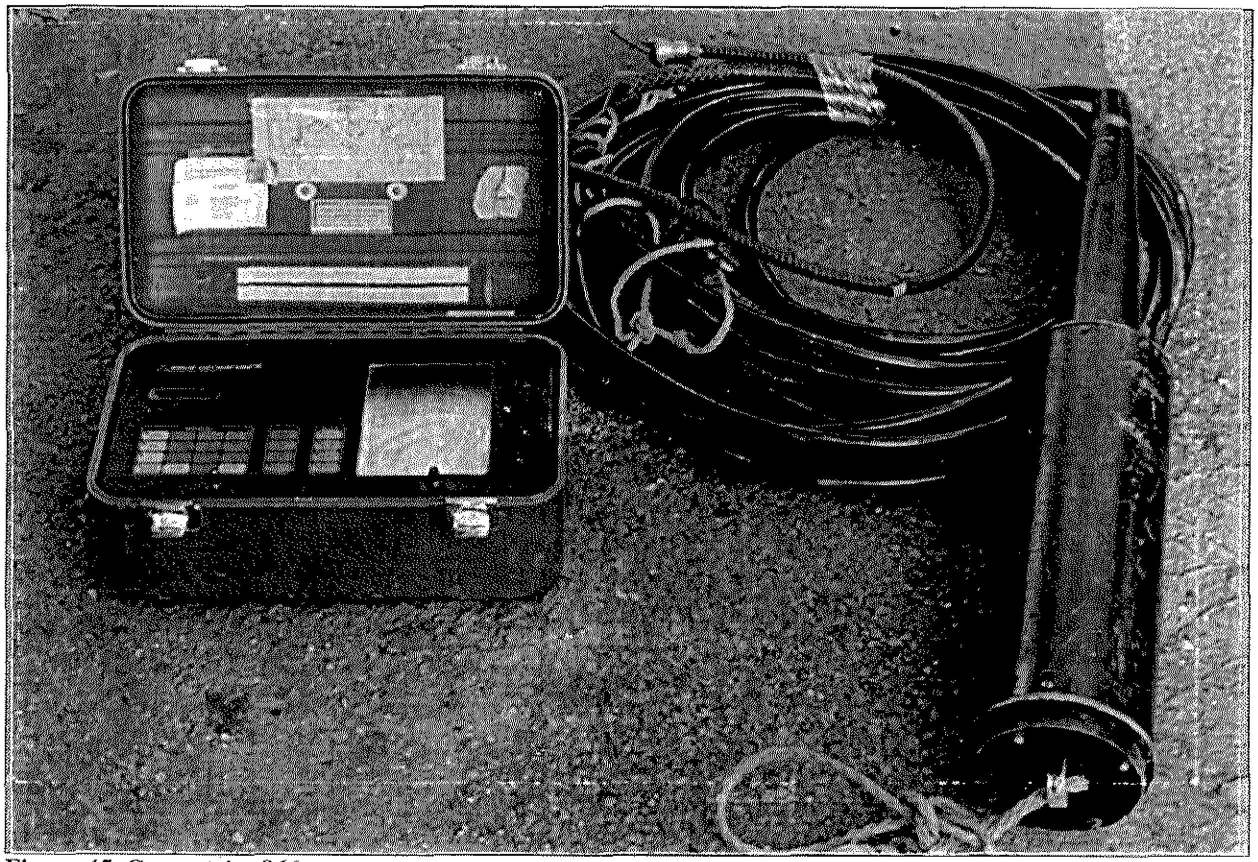

Figure 45. Geometrics 866 magnetometer.

The ability of the magnetometer to detect magnetic anomalies, the sources of which may be related to submerged cultural resources such as shipwrecks, has caused the instrument to become a principal remote-sensing tool of marine archaeologists. While it is not possible to identify a specific ferrous source by its magnetic field, it is possible to predict shape, mass, and alignment characteristics of anomaly sources based on the magnetic field recorded. It should be noted that there are other sources, such as electrical magnetic fields surrounding power transmission lines, underground pipelines, navigation buoys, or metal breakwaters and structures, that may significantly affect magnetometer readings. Interpretation of magnetic data can provide an indication of the likelihood of the presence or absence of submerged cultural resources. Specifically, the ferrous components of submerged historic vessels tend to produce magnetic signatures that differ from those characteristic of isolated pieces of debris. While it is impossible to identify specifically the source of any anomaly solely from the characteristics of its magnetic signature, this information, in conjunction with other data (historic accounts, use patterns of the area surveyed, visual inspection), other remote-sensing technologies, and prior knowledge of similar targets, can lead to an accurate estimation.

For this project the magnetometer was interfaced with an IBM Thinkpad laptop computer, utilizing Navtrak® software for data storage and management. It was also interfaced with the positioning system, allowing positioning fix points to be included on the stripchart printout.

SIDESCAN SONAR

The remote-sensing instrument used to search for physical features on or above the bottom of the harbor bed was a Marine Sonic Technology (MST) Sea Scan PC Sidescan Sonar System (Figure 46). The sidescan sonar is an instrument that, through the transmission of dual fan-shaped pulses of sound and reception of reflected sound pulses, produces an acoustic image of the bottom.

Under ideal circumstances, a sidescan sonar is capable of providing a near-photographic representation of the bottom on either side of the trackline of a survey vessel. The Sea Scan PC has internal capability for removal of the water column from the instrument's video printout, as well as correction for slant range distortion. This sidescan sonar was used with the navigation system to provide manual marking of positioning fix points on the digital printout. Sidescan sonar data are useful in searching for the physical features indicative of submerged cultural resources. Specifically, the record is examined for features showing characteristics such as height above bottom, linearity, and structural form.

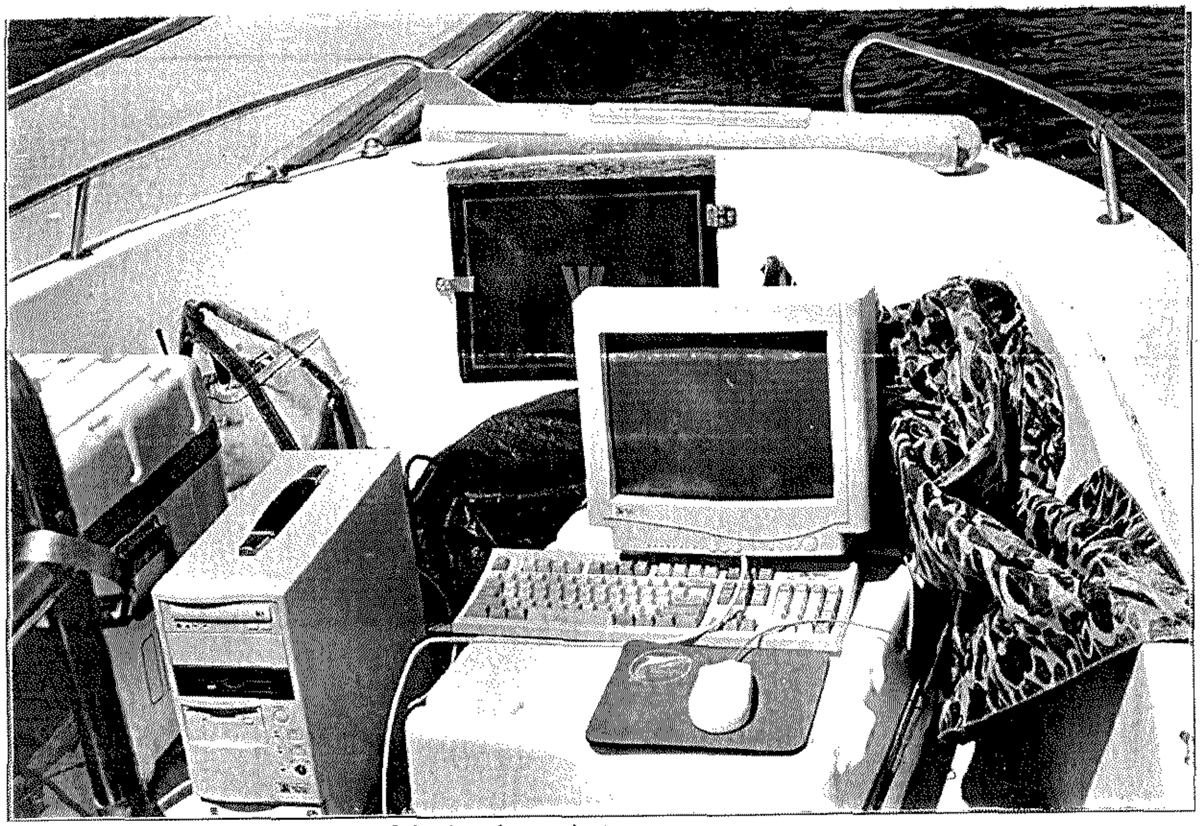

Figure 46. Sidescan sonar unit used during the project.

The MST Sea Scan PC sidescan sonar was linked to a towfish using a 600-kHz power setting and a variable side range of up to 100 meters per channel (200-meter coverage per line) on each of the side scan lines run. The range setting was selected to provide maximum possible detail on the record generated. The 20-meters-per-channel selection made it possible to collect acoustic data over a 40-meter (130-foot) wide area on each line the sidescan sonar was employed, creating a general image of the harbor bed. A 50-meter single-channel selection was used to create a detailed image of the area immediately adjacent to the breakwater, without having to get too close. The sidescan sonar was operated on the same tracklines as the magnetometer.

SUB-BOTTOM PROFILER

Sub-bottom data were collected using an Edgetech Geostar full spectrum sub-bottom profiler with an SB-424 towfish operating in the 4-24 kHz range (Figure 47). The system operates by emitting a tuned FM acoustic pulse which travels through the water column and into the sea floor. Each acoustic interface in the bottom reflects part of the pulse back to the surface where it is received by the hydrophone, processed, and presented graphically in the standard sub-bottom profile format (signal strength vs. travel time). Data were digitally recorded for later playback and analysis.

The sub-bottom system accepts DGPS information that is integrated with the data, providing correlation of latitude-longitude location and sub-bottom targets.

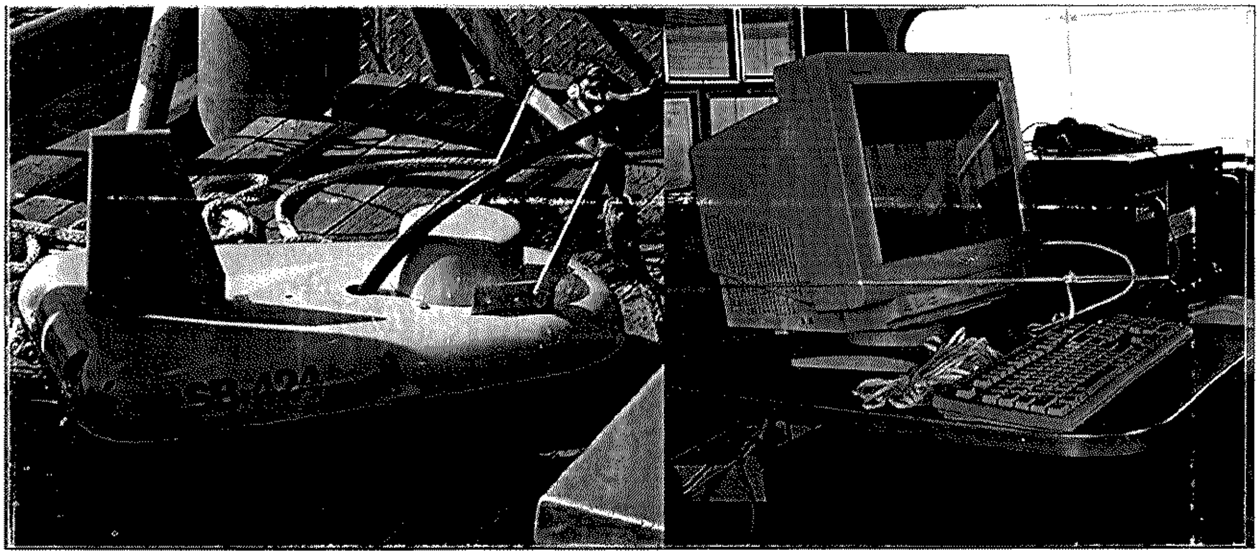

Figure 47. Edgetech subbottom profiler system.

SURVEY VESSELS

The vessel used for the remote-sensing survey was the *Venture III* (Figure 48), a 46-foot Breaux-built crew boat, powered by two eight-cylinder diesel engines. The survey vessel had a generator as an onboard power supply for the electronic equipment. It had an enclosed cabin for the onboard electronics and ample deck space for the handling of overboard sensors. The *Venture III* conformed to all U.S. Coast Guard specifications according to class, and had onboard all required safety equipment. It carried its own spare-parts kit, tool kit, first-aid materials, and potable water. Captain Paul Hepler piloted the survey vessel and was assisted by his mate Ruth Hepler. The vessel was berthed in Atlantic Highlands, New Jersey, and later in Brooklyn, and transited to the work area each day.

Another vessel used for the survey was a 20-foot center console modified V-hull fiberglass Wellcraft with a 150 hp Yamaha outboard. Panamerican employs this vessel for electronic surveys on inland waters. The Wellcraft has a stand-up center console and ample deck area for the placement and operation of the necessary remote-sensing equipment and sensors. The Wellcraft conforms to all U.S. Coast Guard specifications according to class and had a full complement of safety equipment. The vessel carried appropriate emergency supplies including life jackets, a spare parts kit, a tool kit, first aid materials, and potable water.

SURVEY PROCEDURES

MAGNETOMETER, SIDESCAN AND SUBBOTTOM PROFILER

The remote-sensing phase of this project began on August 6th, 2001. The positioning and remote-sensing instruments were installed and tested aboard the survey vessel. Transects were run roughly parallel to the navigation channel at 50-foot intervals. The magnetometer was run on all lines, while the sidescan was run on alternating lines, as its area of coverage is 100 meters.

The project area was examined with the remote sensing instruments where safely navigable. The survey vessel began each run outside each survey area, running parallel to the navigation channel. At the proper interval the vessel would turn perpendicular to the channel and proceed down the next trackline.

Figure 48. Project survey vessel, the Venture *III*.

As the survey vessel maneuvered down the transect, the navigation system determined vessel position along the actual line of travel every second. These positioning points along the line traveled were recorded on computer hard disk. During the running of a line, event marks were annotated on the sidescan printout at the start and end of the line.

The remote-sensing survey phase of the project concluded on August 26, 2001 with the project area completely surveyed. Upon completion of the remote-sensing survey, the data were reviewed. Sidescan and magnetometer features were prioritized as to possible significance by employing signal characteristics, e.g., spatial extent, structural features, etc, as detailed in the next section.

DATA ANALYSIS PROCEDURES

MAGNETOMETER ANALYSIS

Interpretation of data collected by the magnetometer is perhaps the most problematic to analyze. Magnetic anomalies are evaluated and prioritized on the basis of magnetic amplitude or deflection of gamma intensity in concert with duration or spatial extent; they are also correlated with sidescan targets. The problems of differentiating between modern debris and shipwrecks on the basis of remote-sensing data have been discussed by a number of authors. This difficulty is particularly true in the case of magnetic data, and therefore it has received the most attention in the current body of literature dealing with the subject. Pearson and Saltus state that "even though a considerable body of magnetic signature data for shipwrecks is now available, it is impossible to positively associate any specific signature with a shipwreck or any other feature" (1990:32). There is no doubt that the only positive way to verify a magnetic source object is through physical examination. With that said, however, the size and complexity of a magnetic signature does provide a usable key for distinguishing between modern debris and shipwreck remains (see Garrison et al. 1989; Irion et al. 1995; Pearson et al. 1993). Specifically, the magnetic signatures of most shipwrecks tend to be large in area and tend to display multiple magnetic peaks of differing amplitude.

The state of technology of iron-hulled or steam vessels may also be considered a factor in their potential for being detected by modern remote-sensing techniques. The magnetometer detects ferrous objects that create deviations in the Earth's natural magnetic field. The greater the weight of iron in the remains of a shipwreck, the greater the likelihood the remains will be observed, at least theoretically. The mass of metal on iron-hulled or steam vessels is made up of the hull and/or boilers, pipes, valves, steam engines, hogging trusses and straps, deck gear, auxiliary engines, pumps, hoists, winches, and other pieces of equipment. As the state of steam technology advanced, boilers and engines got larger, and/or more were used for larger vessels. Larger locomotion systems contained more iron and therefore are more likely to have a detectable magnetic signature.

In a study of magnetic anomalies in the northern Gulf of Mexico, Garrison et al. (1989) indicate that a shipwreck signature will cover an area between 10,000 and 50,000 m^2. Applicable to the Gulf Coast and based on large vessel types, the study's findings are not totally relevant to wooden sailing vessels in the pre-steam era. However, criteria from the Garrison et al. (1989) study and others developed to identify the signatures of larger vessel types are applicable. Using the Garrison et al. (1989) study, as well as years of "practical experience," in an effort to assess potential significance of remote-sensing targets, Pearson et al. (1991) developed general characteristics of magnetometer signatures most likely to represent shipwrecks. The report states that "the amplitude of magnetic anomalies associated with shipwrecks vary [*sic*] considerably, but, in general, the signature of large watercraft, or portions of watercraft, range from moderate to high intensity (>50 gamma) when the sensor is at distances of 20 ft. or so" (1991:70). Using a table of magnetic data from various sources as a base, the report goes on to state that "data suggest that at a distance of 20 ft. or less watercraft of moderate size are likely to produce a magnetic anomaly (this would be a complex signature, i.e., a cluster of dipoles and/or monopoles) greater than 80 or 90 ft. across the smallest dimension. . . " (Pearson et al. 1991:70).

While establishing baseline amounts of amplitude and duration reflective of the magnetic characteristics for a shipwreck site, the authors recognize "that a considerable amount of variability does occur" (1991:70). Generated in an effort to test the 50-gamma/80-foot criteria and determine amount of variability, Table 5 lists numerous shipwrecks as well as single- and multiple-source objects located by magnetic survey and verified by divers. All shipwrecks meet and surpass the 50-gamma/80-foot criteria, while all single-object readings, with the exception of the pipeline, fall below the criteria. However, the signature of the pipeline should show up as a linear feature on a magnetic contour map and not be confused with a single-source object. While the shipwrecks and single objects adhere to the 50-gamma/80-foot criteria, the multiple objects do not. If all targets listed on the table had to be prioritized as to potential significance based on the 50-gamma/80-foot criteria, the two multiple-object targets would have to be classified as potentially significant.

Table 5. Magnetic Data from Shipwrecks and Nonsignificant Sources.

Vessel (object)	Type & Size	Magnetic Deviation	Duration (feet)	Reference
Shipwrecks				
Tug	Wooden tug with machinery	-30257	176	Tuttle and Mitchell 1998
Mexico	288 ton wooden bark	1260	454	Tuttle and Mitchell 1998
J.D. Hinde	129-ft. wooden sternwheeler	573	110	Gearhart and Hoyt 1990
Utina	267-ft. wooden freighter of 238 tons	690	150	James and Pearson 1991; Pearson and Simmons 1995
King Phillip	182-ft clipper of 1,194 tons	300	200	Gearhart 1991
Reporter	141-ft. schooner of 350 tons	165	160	Gearhart 1991

Vessel (object)	Type & Size	Magnetic Deviation	Duration (feet)	Reference
Mary Somers	iron-hulled sidewheeler of 967 tons	5000	400	Pearson et al. 1993
Gen. C.B. Comstock	177-ft. wooden hopper dredge	200	200	James et al. 1991
Mary	234-ft. iron sidewheeler	1180	200	Hoyt 1990
Columbus	138-ftwooden-hulled 416 ton Chesapeake Sidewheeler	366	300+	Morrison et al. 1992
El Nuevo Constante	126-ft. wooden collier	65	250	Pearson et al. 1991
James Stockton	55-ft. wooden schooner	80	130	Pearson et al. 1991
Homer	148-ft. wooden sidewheeler	810	200	Pearson and Saltus 1993
Modern shrimp boat	segment 27 x 5 ft.	350	90	Pearson et al. 1991
Confederate obstructions	numerous wooden vessels with machinery removed and filled with construction rubble	110	long duration	Irion and Bond 1984
Single Objects				
pipeline	18-in. diameter	1570	200	Duff 1996
anchor	6-ft. shaft	30	270	Pearson et al. 1991
iron anvil	150 lbs.	598	26	Pearson et al. 1991
engine block	modern gasoline	357	60	Rogers et al. 1990
steel drum	55 gallon	191	35	Rogers et al. 1990
pipe	8 ft. long x 3 in. diameter	121	40	Rogers et al. 1990
railroad rail segment	4-ft. section	216	40	Rogers et al. 1990
Multiple Objects				
anchor/wire rope	8-ft. modern stockless/large coil	910	140	Rogers et al. 1990
cable and chain	5 ft.	30	50	Pearson et al. 1991
scattered ferrous metal	14 x ft	100	110	Pearson et al. 1991

(after Pearson et al. 1991)

Although data indicate the validity of employing the 50-gamma/80-foot criteria when assessing magnetic anomalies, other factors must be taken into account. Pearson and Hudson (1990) have argued that the past and recent use of a water body must be an important consideration in the interpretation of remote-sensing data; in many cases it is the most important criterion. Unless the remote-sensing data, the historical record, or the specific environment (e.g., harbor entrance channel) provide compelling and overriding evidence to the contrary, it is believed that the history of use should be a primary consideration in interpretation. What constitutes "compelling evidence" is to some extent left to the discretion of the researcher; however, in settings where modern commercial traffic and historic use have been intensive, the presence of a large quantity of modern debris must be anticipated. In harbor, bay, or riverine situations with heavy traffic, this debris will be scattered along the channel right-of-way, although it may be concentrated at areas where traffic would slow or halt; it will appear on remote-sensing surveys as discrete, small objects.

Sidescan Sonar Analysis

By contrast, sidescan sonar analysis is less problematic. The chief factors considered in analyzing sidescan data included linearity, height off bottom, size, associated magnetics, and environmental context. Since historic resources in the form of shipwrecks usually contain large amounts of ferrous compounds, sidescan targets with associated magnetic anomalies are of top importance. Targets with no associated magnetics usually turn out to be items such as rocks, trees, and other non-historic debris of no interest to the archaeologist. Also, since historic shipwrecks tend to be larger in size, smaller targets tend to be of less importance during data evaluation. In addition, the area in which the target is located can have a strong bearing on whether or not the target is selected for further work. If a target is found in an area with other known wreck sites, or an area determined to be high probability for the location of historic resources, it may be given more consideration than it would have otherwise. However, every situation, and every target located, is different, and all sidescan targets are evaluated on a case-by-case basis.

Sub-Bottom Profiler Analysis

Sub-bottom profile data were collected to assist in identifying buried cables in the cable crossing area in the New York Harbor entrance channel south of the Verrazano Narrows Bridge. The data were collected along 12 lines oriented approximately north-south and analyzed for point targets in the upper 10 meters of the sub-bottom. Targets were classified as having good or weak signatures, and are presented in Figure 90 (page 245) and tabulated in Table 8. The tabulated data also contains the burial depth of the target.

Targets within one meter of the surface probably represent discrete objects such as large rocks or man-made debris. Such objects tend to concentrate near the surface in an active sedimentary environment such as the mouth of New York Harbor. If cables were present in the near surface, there would most likely be some surface expression visible on sidescan sonar records.

Low Water Visual Survey Procedures

The purpose of this part of the project was to assess any potentially significant cultural resources that exist in the near-shore area and can be viewed at low tide. This was done in two ways, depending on accessibility of each site. Access was taken by boat for the entire area at low tide, and was also attempted from shore in areas where access to the waterline was not blocked by soggy ground or excessive vegetation. Video and still photographs of each area were taken, and where applicable, measurements were taken and sketches made. Detailed field notes on each potentially significant site were taken as well. All these items, as well as distance from the project area, were used in determining significance and potential impact of the proposed project on the potentially historic sites.

8. FIELD RESULTS AND INTERPRETATIONS

REMOTE SENSING SURVEY RESULTS

The remote-sensing phase of this project successfully collected data in all safely navigable areas within the project area during August 6-26, 2001. Several areas were not surveyed, including areas of Kill Van Kull in the vicinity of Bayonne Bridge, and part of the intersection of Kill Van Kull and Newark Bay Channels, due to Corps blasting operations. The South Elizabeth Channel was only surveyed with sidescan due to shallow water. In other areas, including much of Arthur Kill and portions of Kill Van Kull Channel, only the edge of the channel could be surveyed, due to shallow water, moored vessels, or piers and other structures. DGPS, magnetometer, sidescan, and subbottom profiler data were collected and digitally recorded on computer disk. A total distance of 170 line miles in New York Harbor were investigated. Due to the coverage given the project area, slight survey trackline deviations are not considered a significant loss of data. Utilizing a 10-gamma contour interval, maps were generated from magnetometer and positioning data digitized during the survey and processed following completion of the fieldwork using the computer program Surfer® 7.0.

Analysis revealed 93 magnetic anomalies and 24 sidescan targets that met established criteria for recommendation of further work. Of these, 28 anomalies and 11 sidescan targets remain unknown or unidentified, and are recommended for further investigation. Magnetic criteria included a strength of at least 50 gamma coupled with a duration of at least 80 feet, presence on at least two survey lines, and association with known cultural resources. Sidescan sonar criteria included general appearance, associated magnetics, and association with known cultural resources. Several exceptions to these criteria can be noted, and several targets were selected for further work that did not meet all criteria. Such anomalies may have been in the vicinity of a wreck marked on the navigation chart, of excessive strength or duration, or in close proximity to a sidescan target. It is recommended that all 28 anomalies and 11 sidescan targets be avoided. If avoidance is not possible, the course of action should be as follows: (1) relocation and careful delineation with appropriate remote-sensing instruments; (2) specific identification through diver/archaeologist investigation; and (3) evaluation by a maritime archaeologist for potential cultural significance and possible further action.

Analysis of sub-bottom data revealed two bands of targets trending generally east-west across the survey area, at approximately the same depth below the seafloor. Whether these targets represent buried cable is inconclusive, and additional information gathered via cable laying reports or sediment coring might help in identification.

There were several areas, particularly along Arthur Kill and Kill Van Kull, where the project actions have the potential to impact shoreline structures or abandoned vessels (Figure 49). This occurs primarily in areas where the channel edge comes closest to the shoreline, but also includes areas where large numbers of vessels have been abandoned. Care should be taken in these areas to minimize impact to shoreline structures and vessels. If avoidance of impact is not possible, evaluation of potentially affected structures should be undertaken by a maritime archaeologist or architectural historian.

MAGNETOMETER SURVEY RESULTS

The magnetometer survey successfully covered the project area. Analysis of the collected data revealed 93 anomalies (Figures 50 and 51; Table 6). Twenty-eight of the anomalies are recommended for further investigation (see Table 9; Figure 50). Figure 51 is an index map showing the locations of submaps 51.01–51.45. All submaps shown in Figure 51 are presented together for the reader's convenience.

Of the 93 magnetic anomalies, 36 appeared on multiple survey lines, and 38 are attributed to navigation buoys, barges, sheet pile, or other modern debris. Anomaly numbers are not listed in sequential order because numerous anomalies were tentatively identified and subsequently discarded.

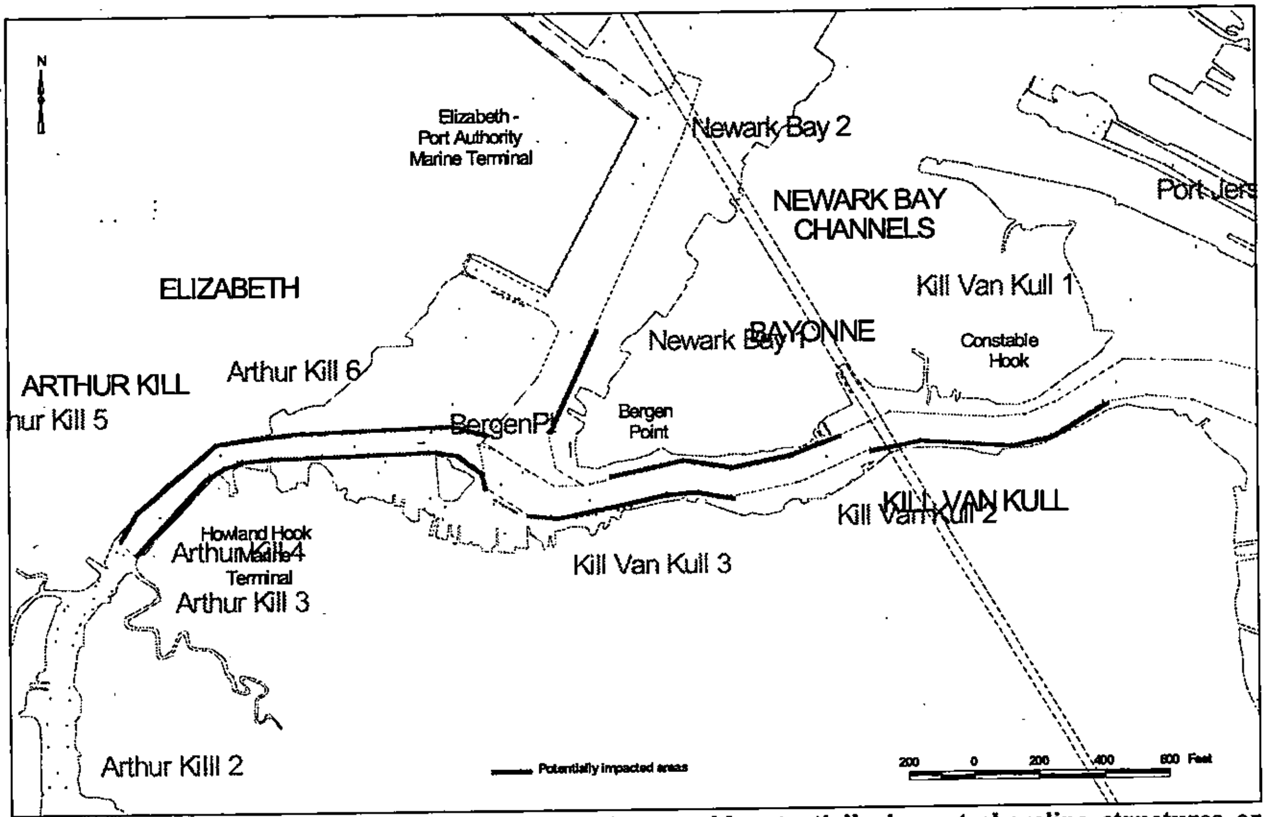

Figure 49. Location of areas where project actions could potentially impact shoreline structures or abandoned vessels.

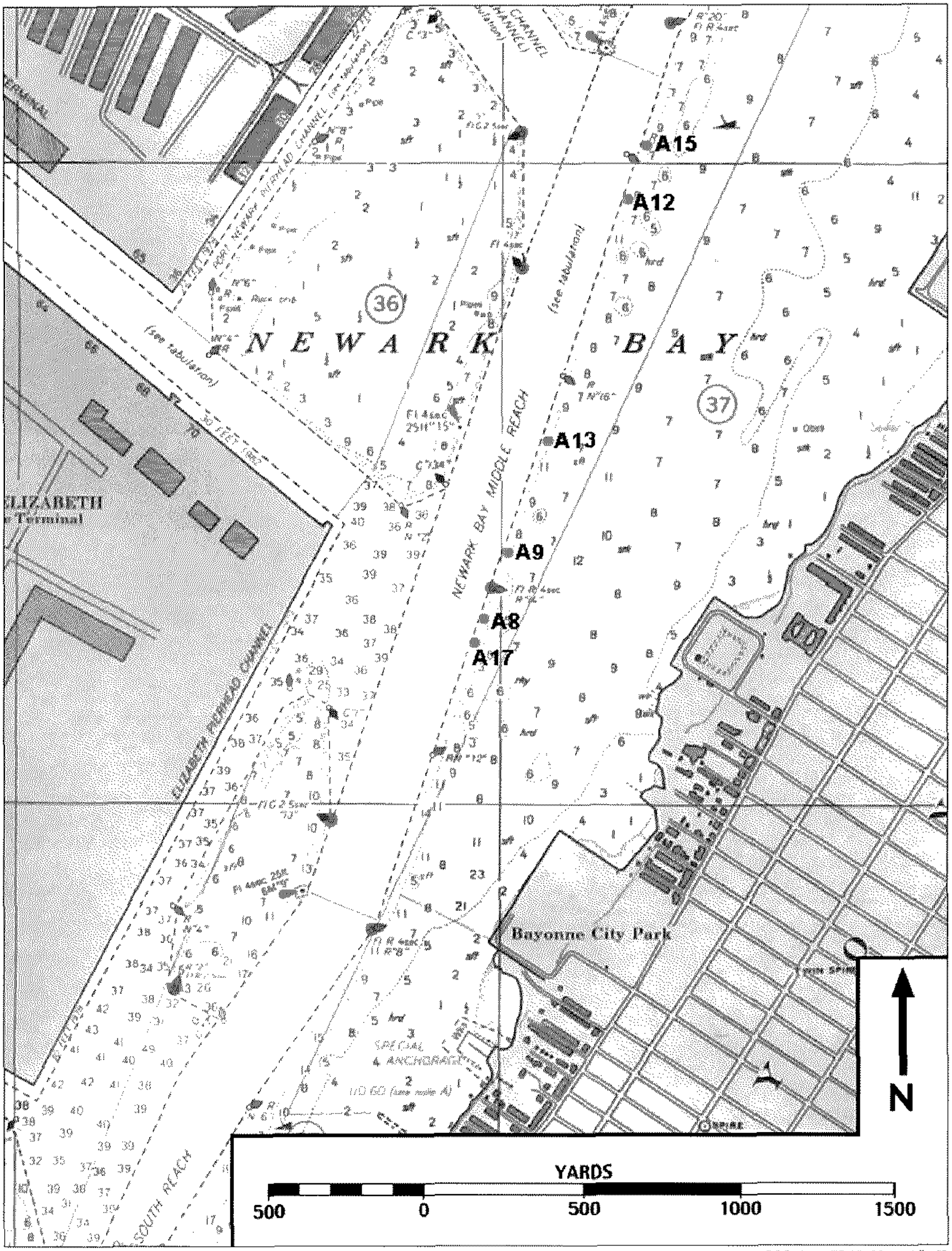

Figure 50a. Location of targets recommended for further work, map 1 of 4 (base map: NOAA Kill Van Kull and Northern Part of Arthur Kill, NY navigation chart).

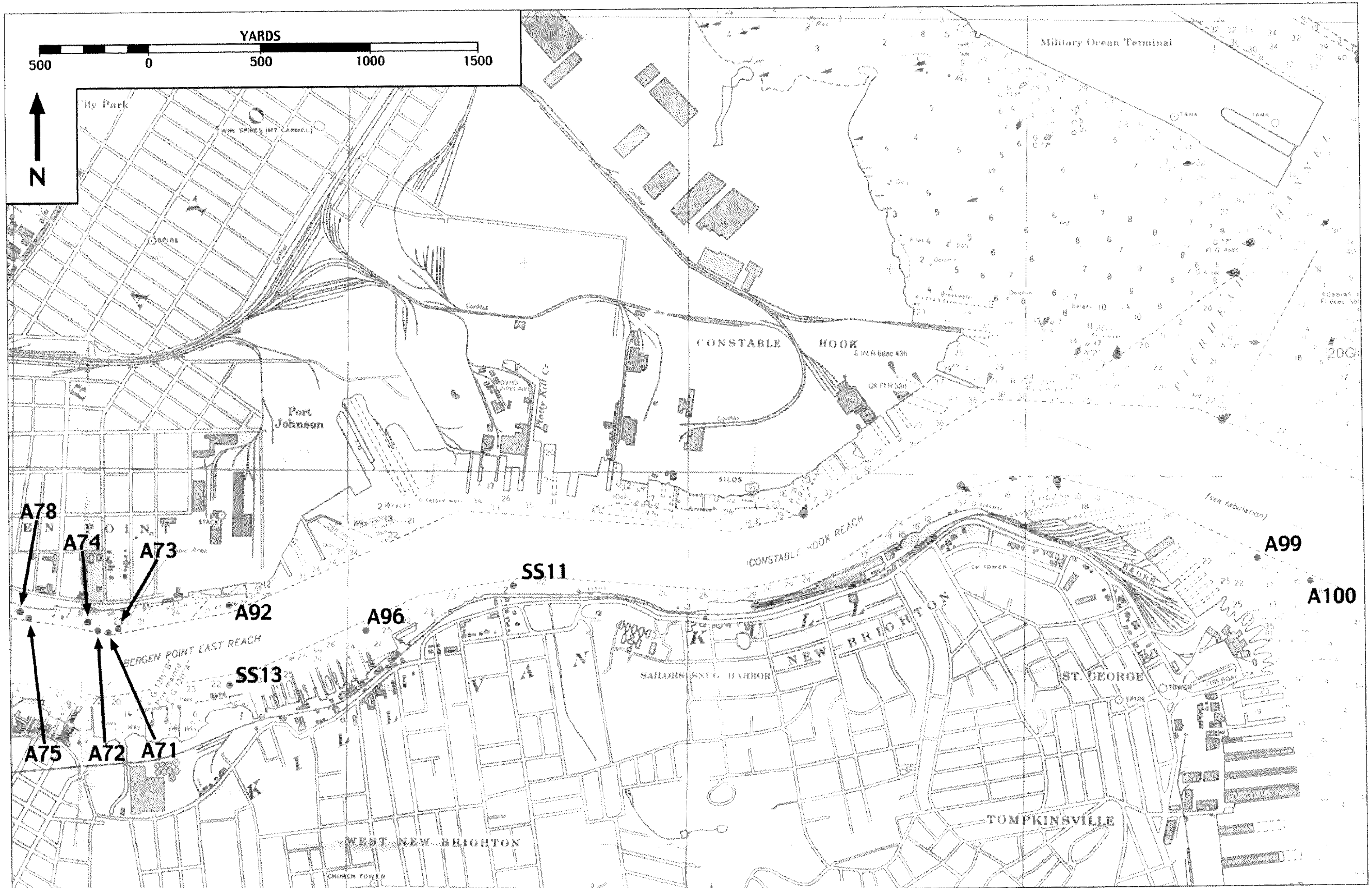

Figure 50b. Location of targets recommended for further work, map 2 of 4 (base map: NOAA Chart No. 12333, Kill Van Kull and Northern Part of Arthur Kill).

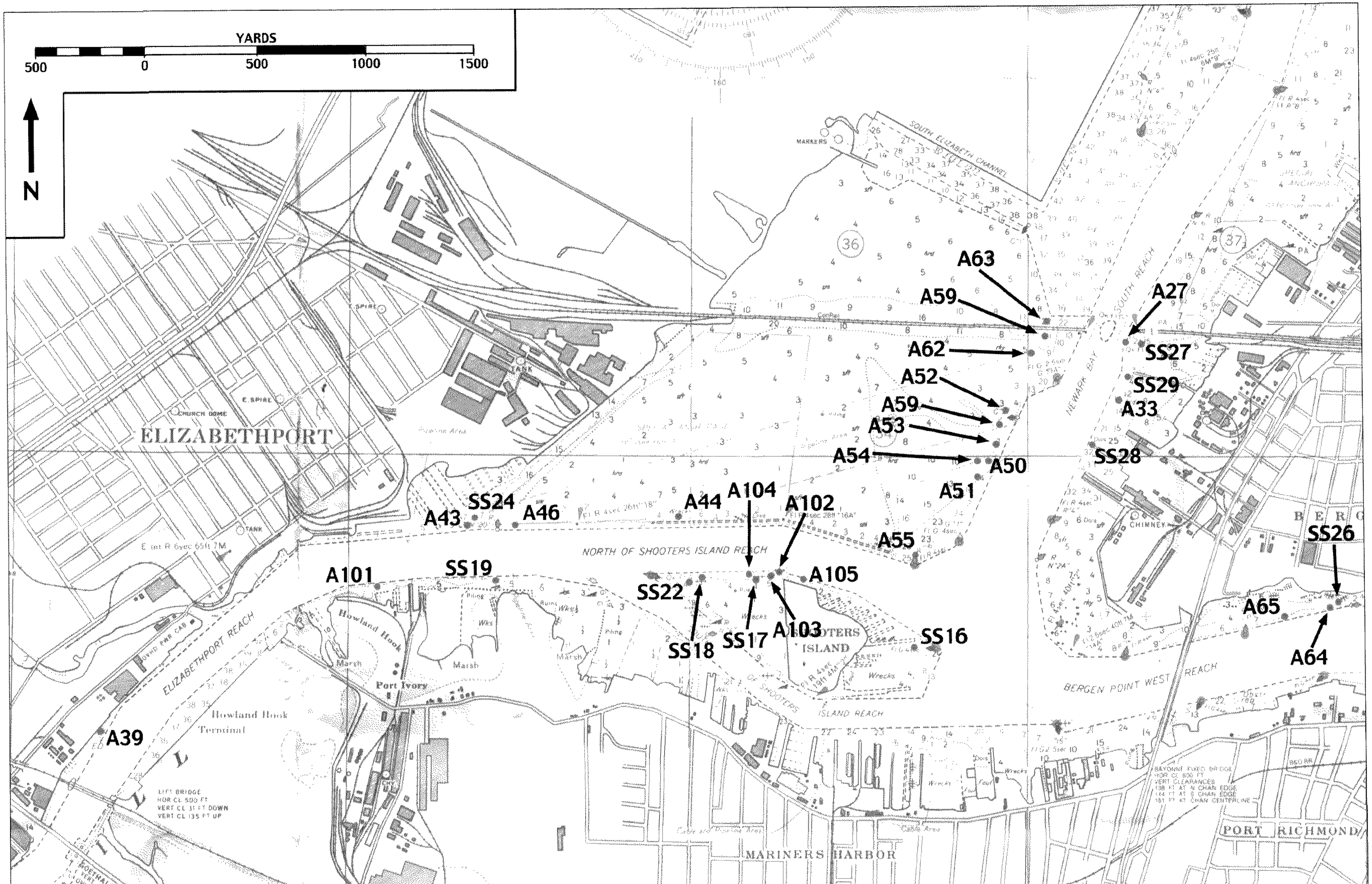

Figure 50c. Location of targets recommended for further work, map 3 of 4 (base map: NOAA Chart No. 12333, Kill Van Kull and Northern Part of Arthur Kill).

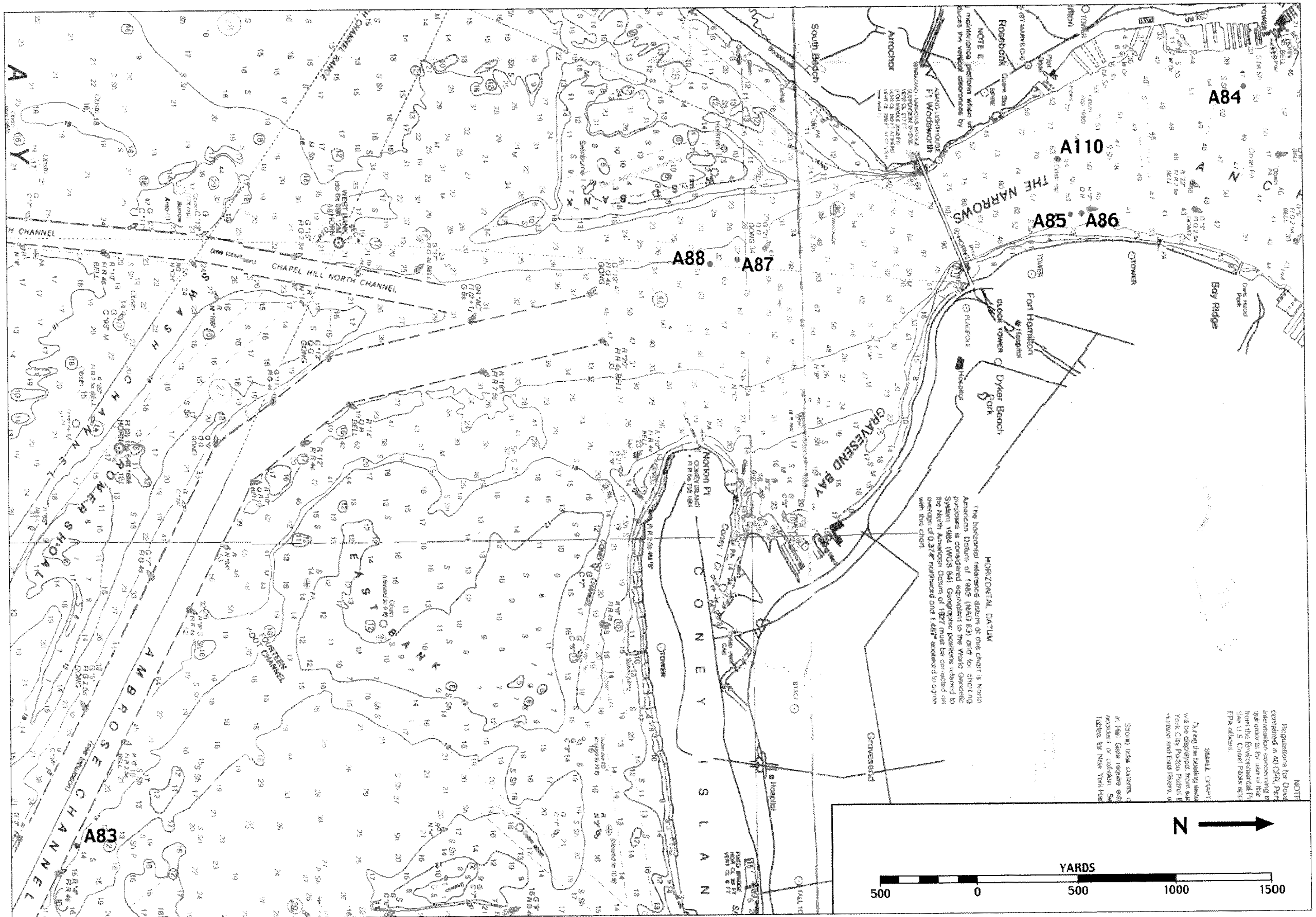

Figure 50d. Location of targets recommended for further work, map 4 of 4 (base map: NOAA Chart No. 12327, New York Harbor).

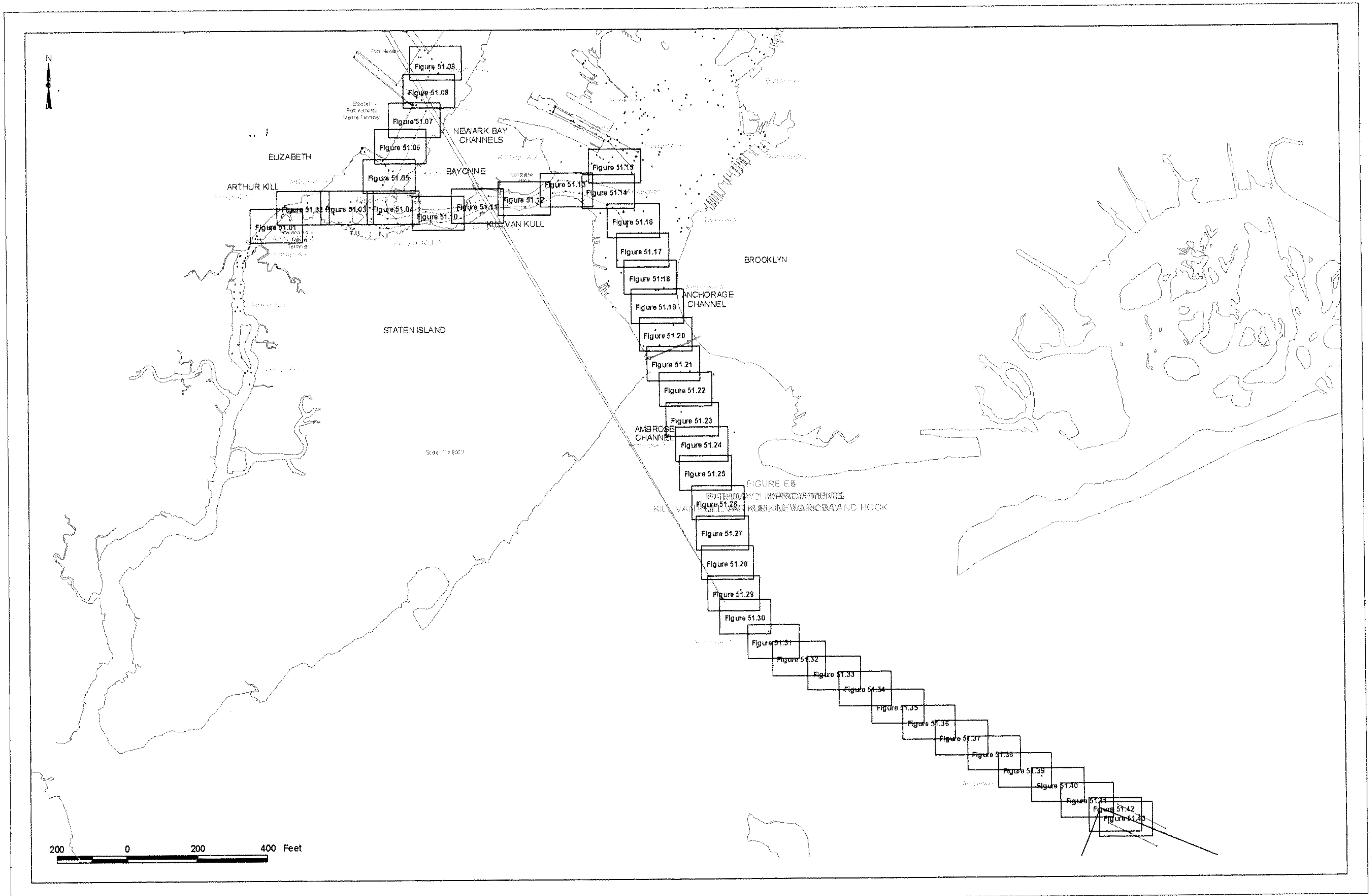

Figure 51. Map of survey area showing magnetic anomalies and sidescan targets located during the survey.

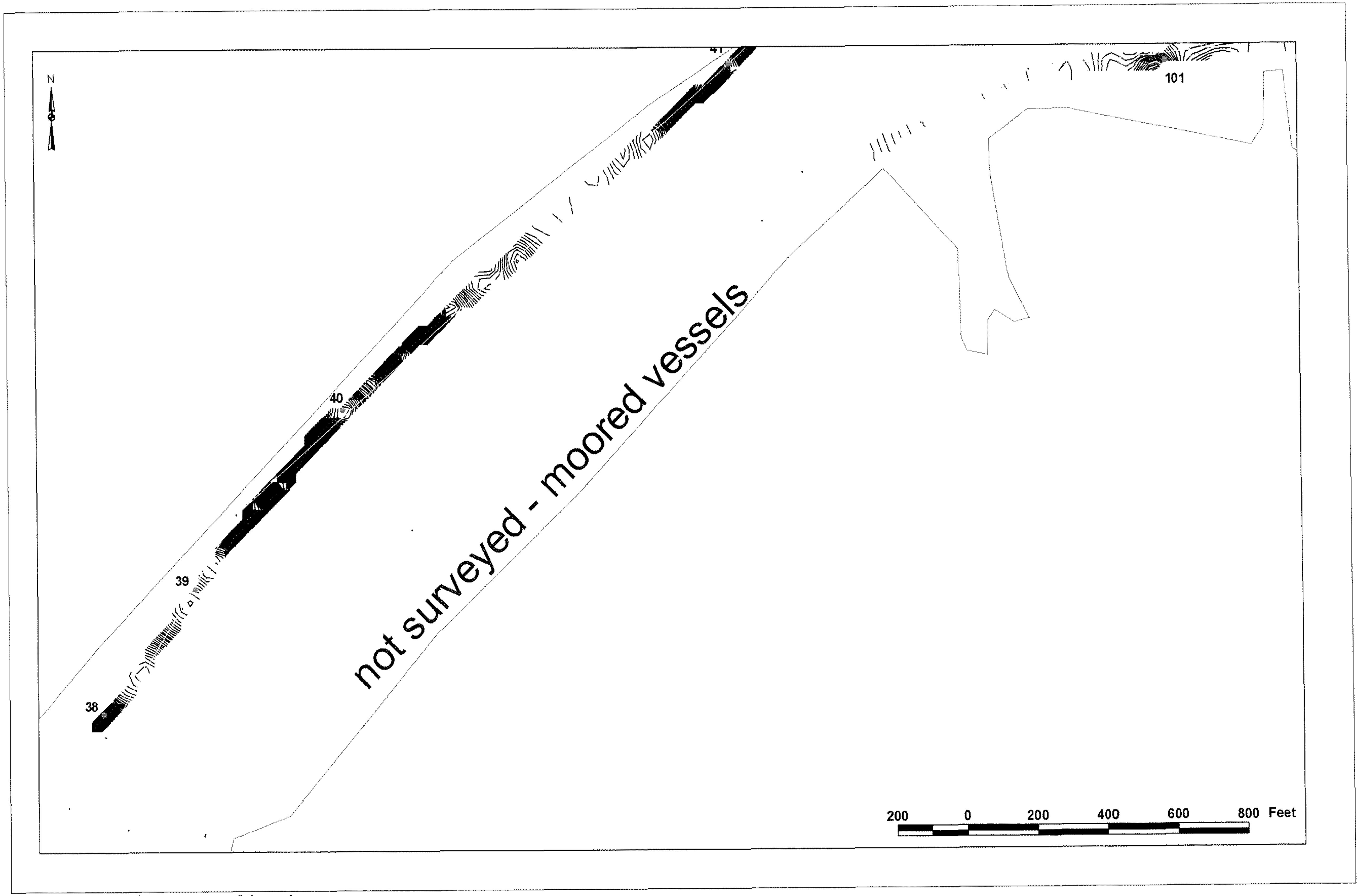

Figure 51.01. Magnetic contour map of the project area.

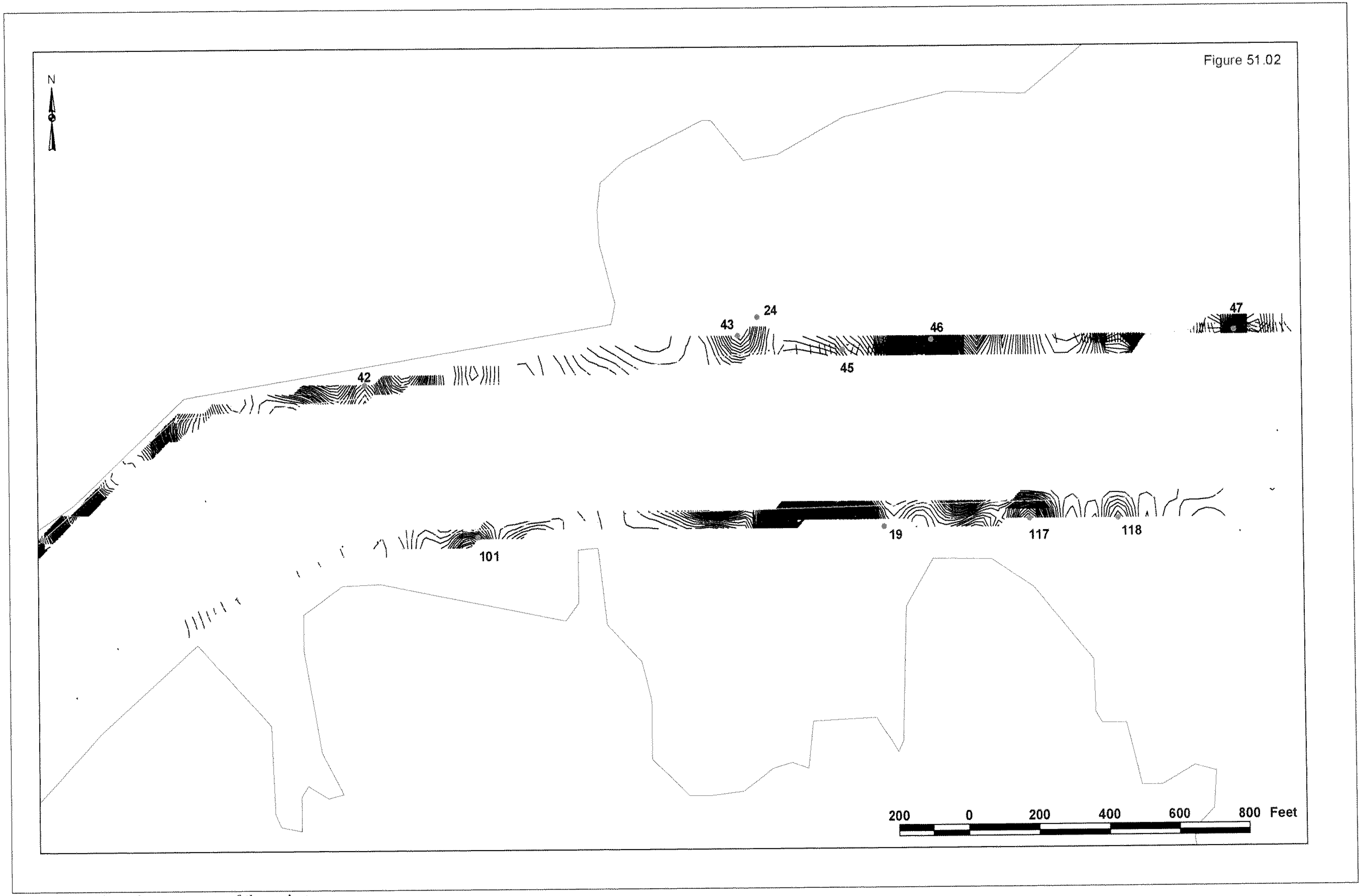

Figure 51.02. Magnetic contour map of the project area.

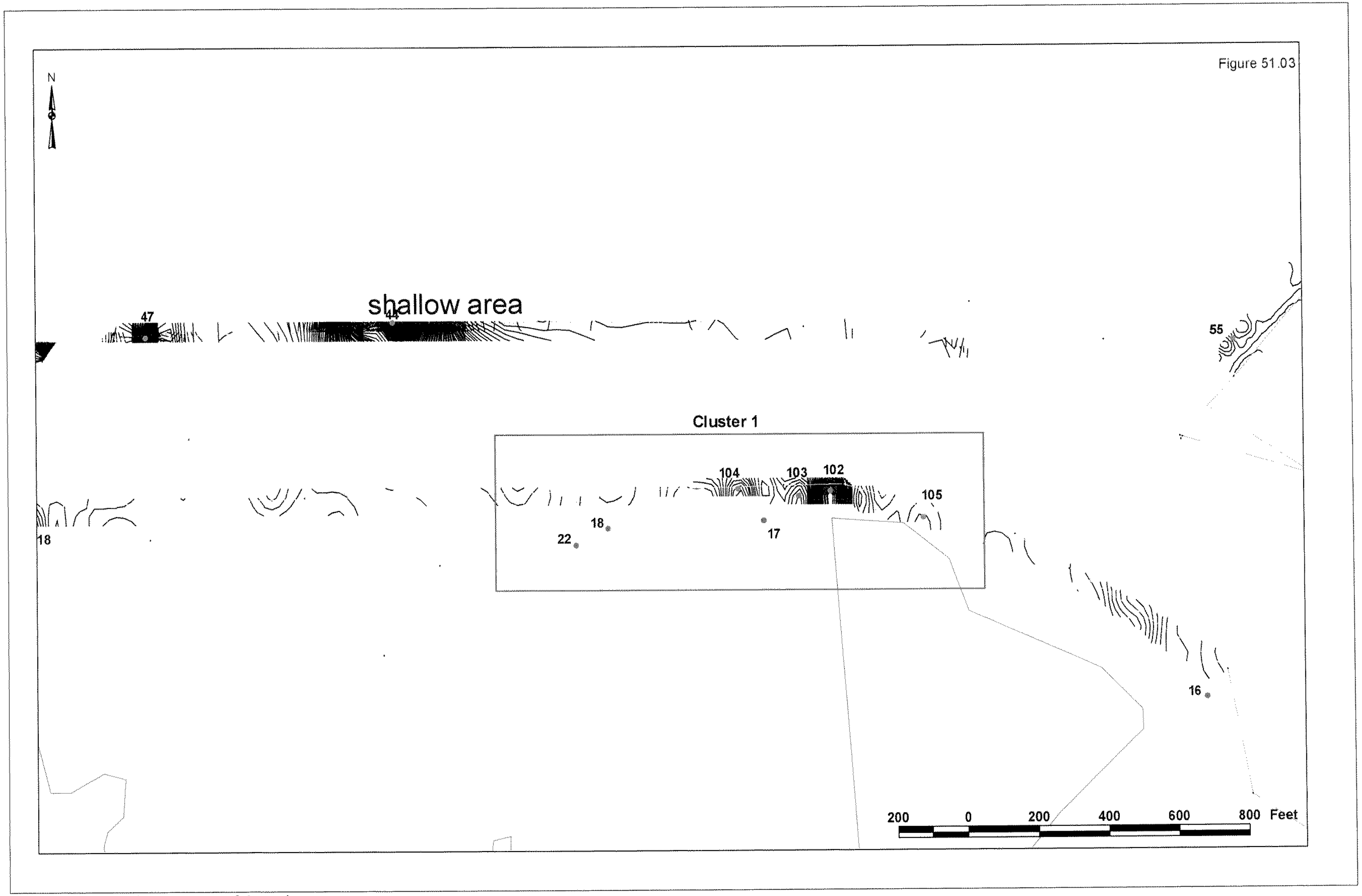

Figure 51.03. Magnetic contour map of the project area.

Figure 51.04. Magnetic contour map of the project area.

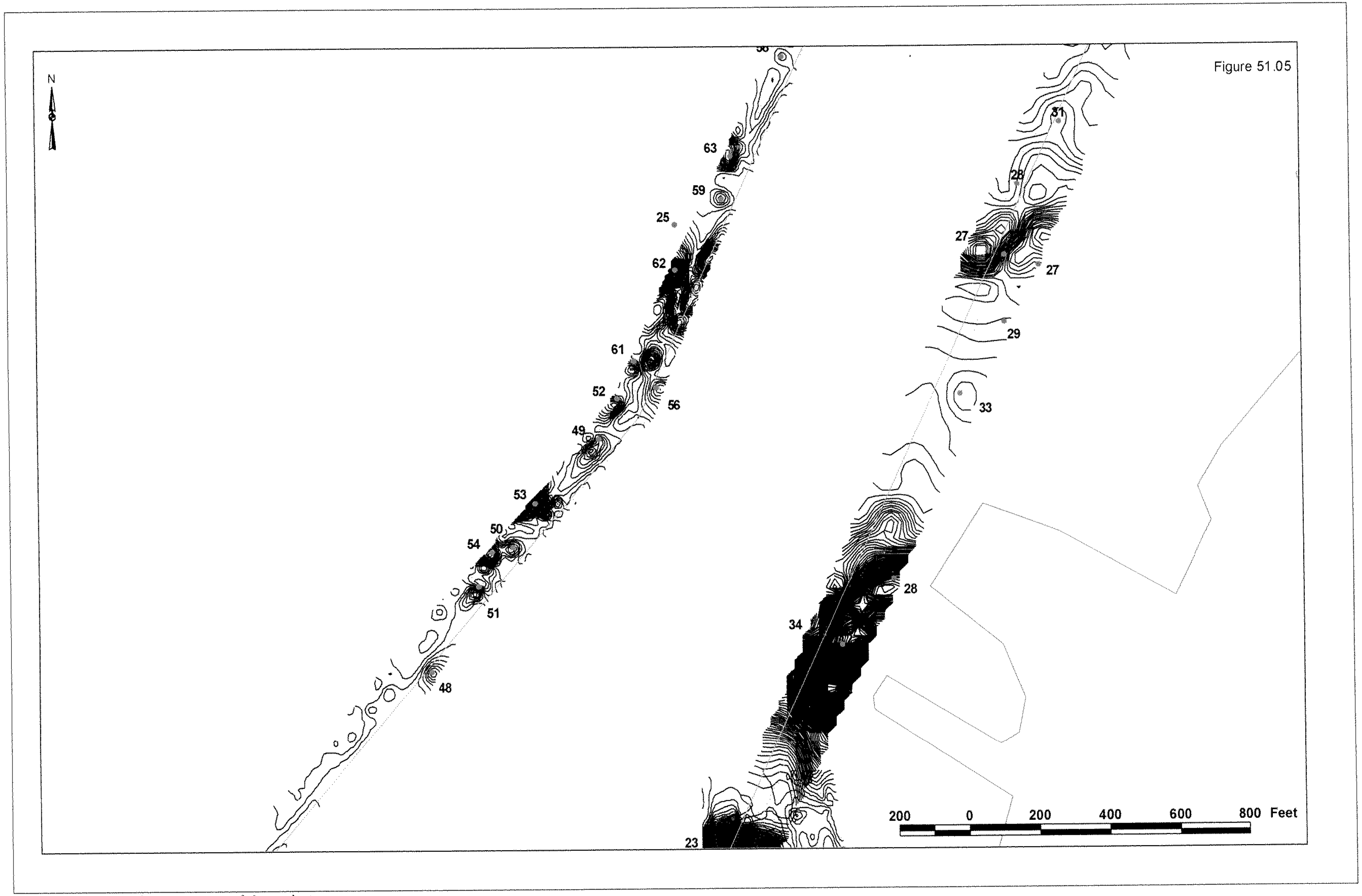

Figure 51.05. Magnetic contour map of the project area.

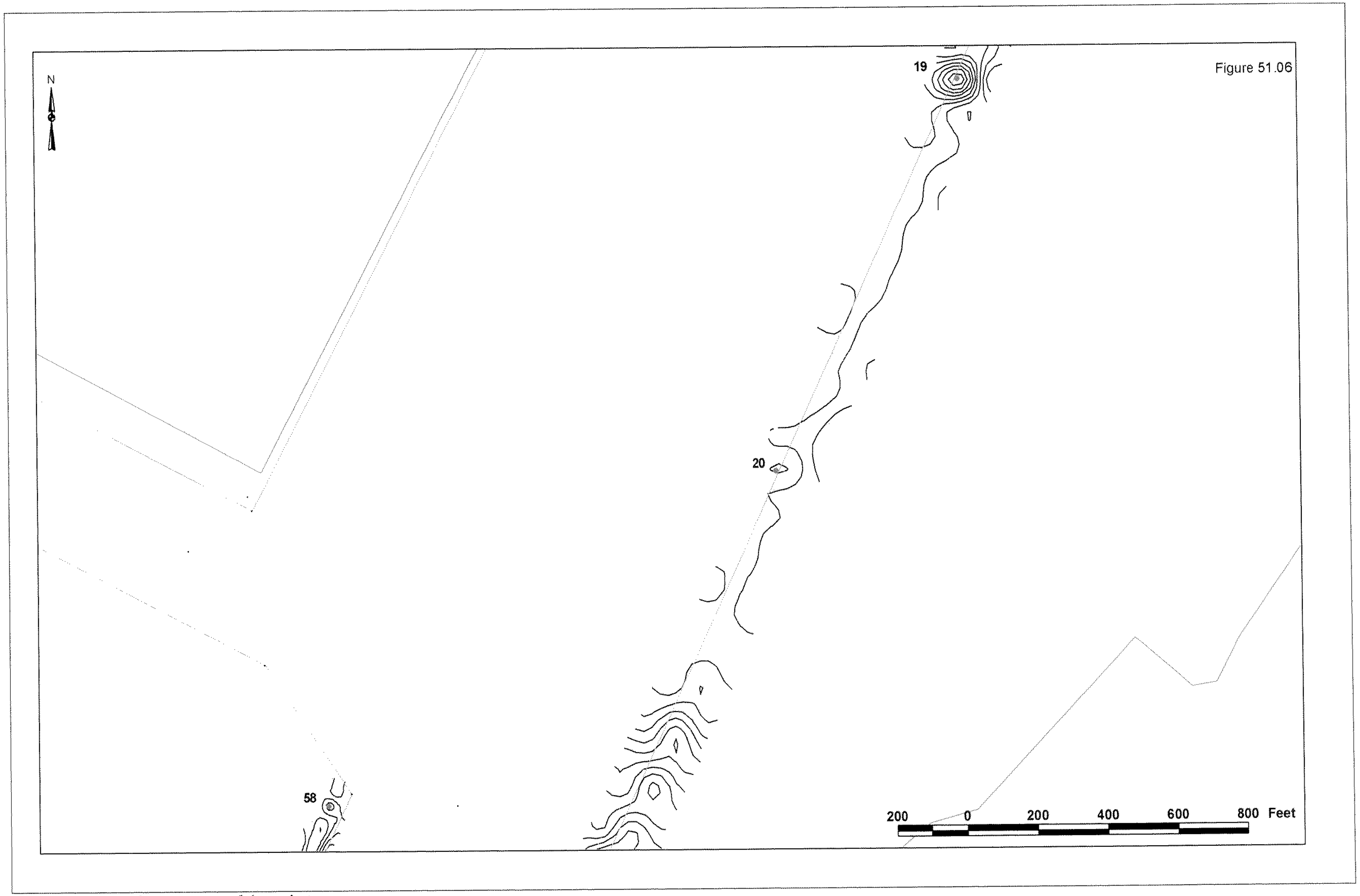

Figure 51.06. Magnetic contour map of the project area.

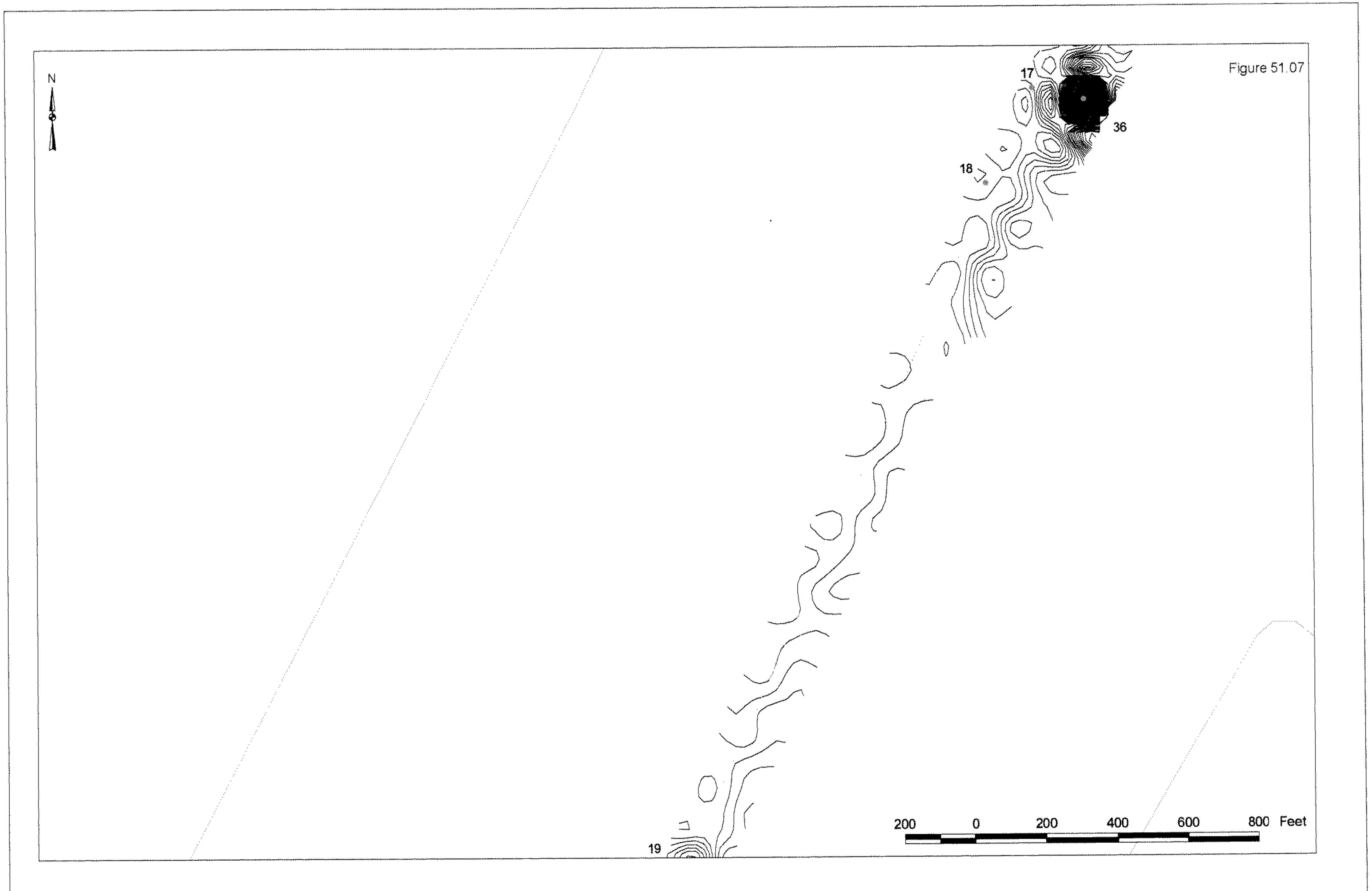

Figure 51.07. Magnetic contour map of the project area.

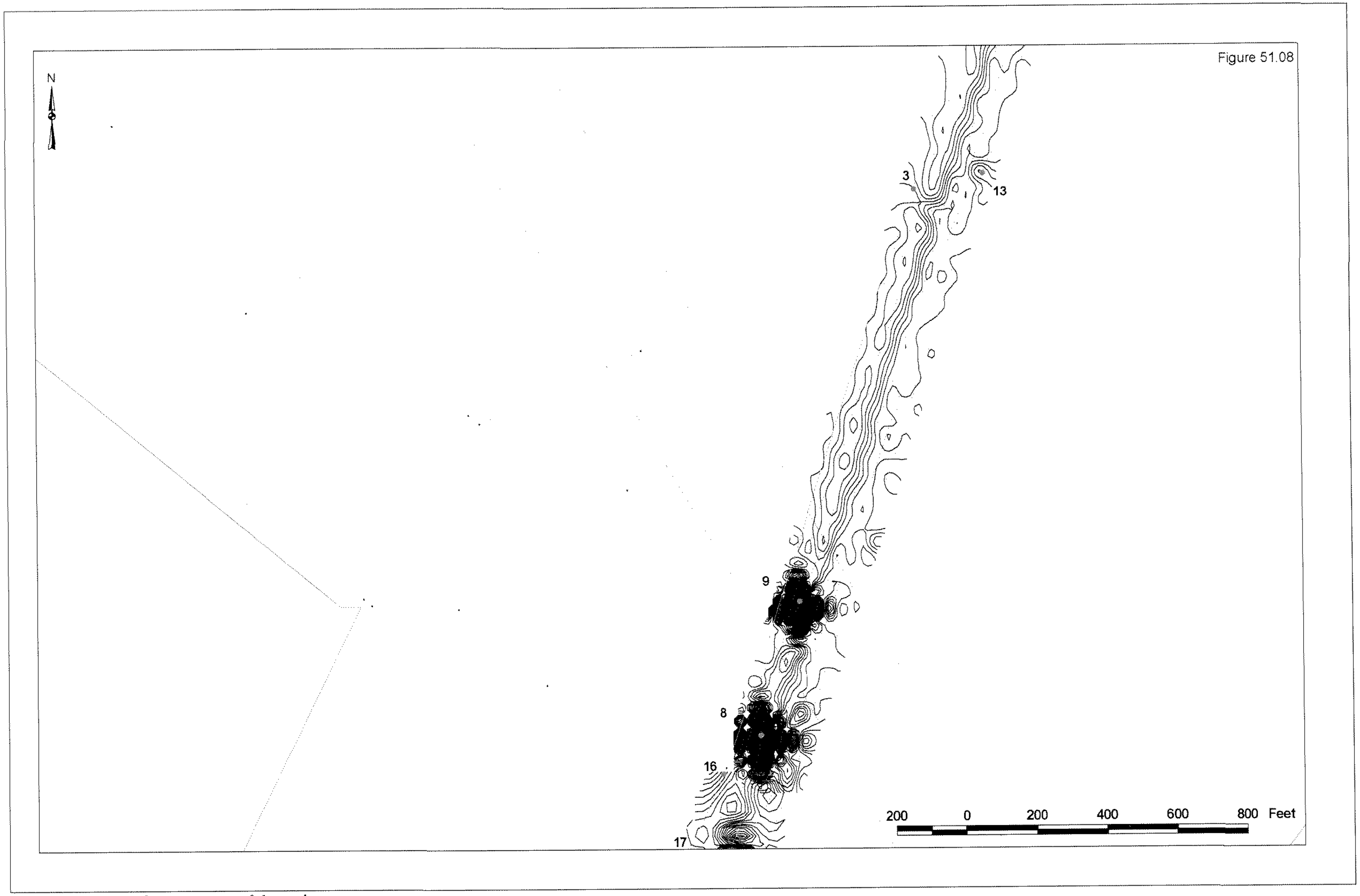

Figure 51.08. Magnetic contour map of the project area.

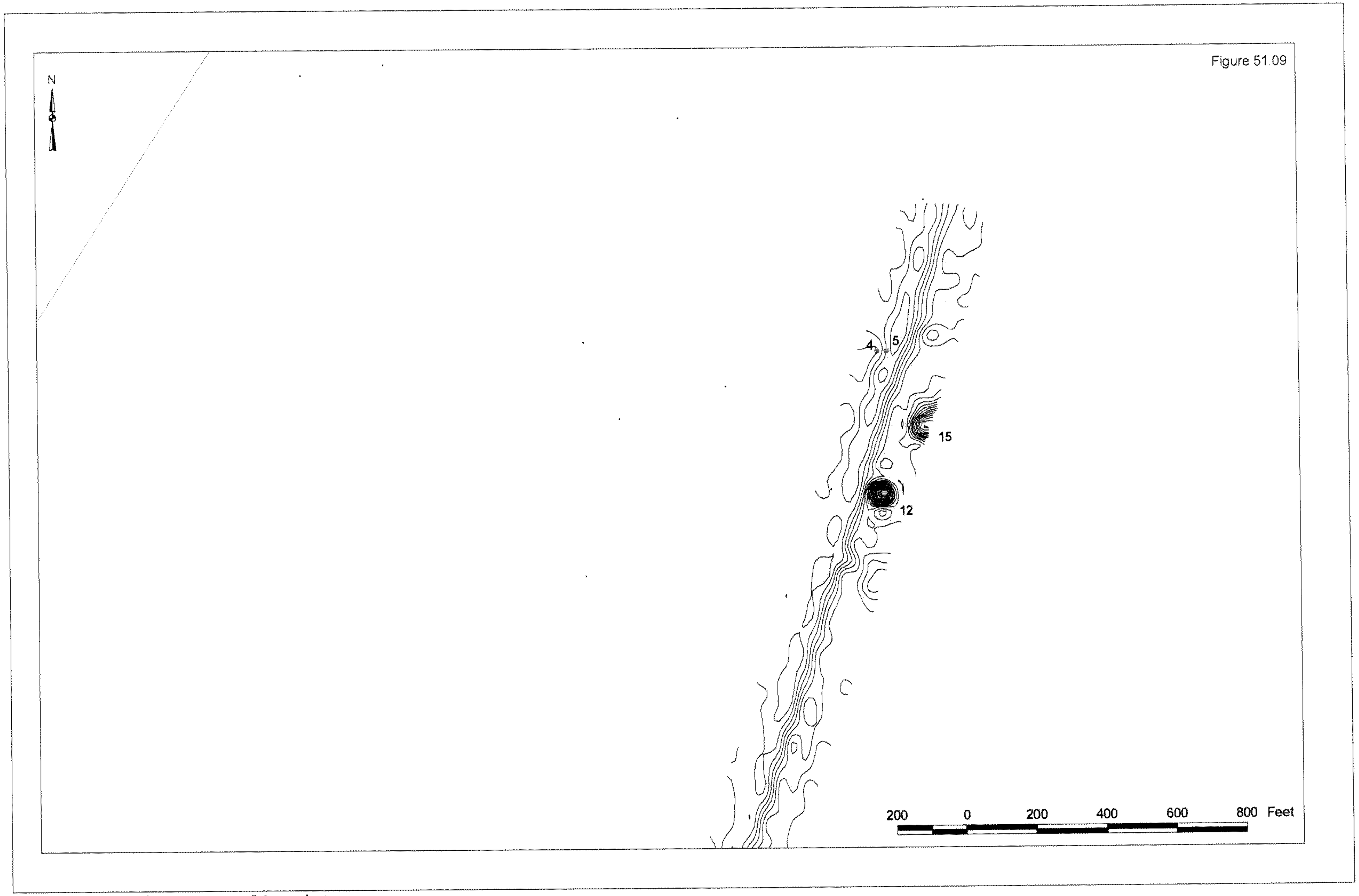

Figure 51.09. Magnetic contour map of the project area.

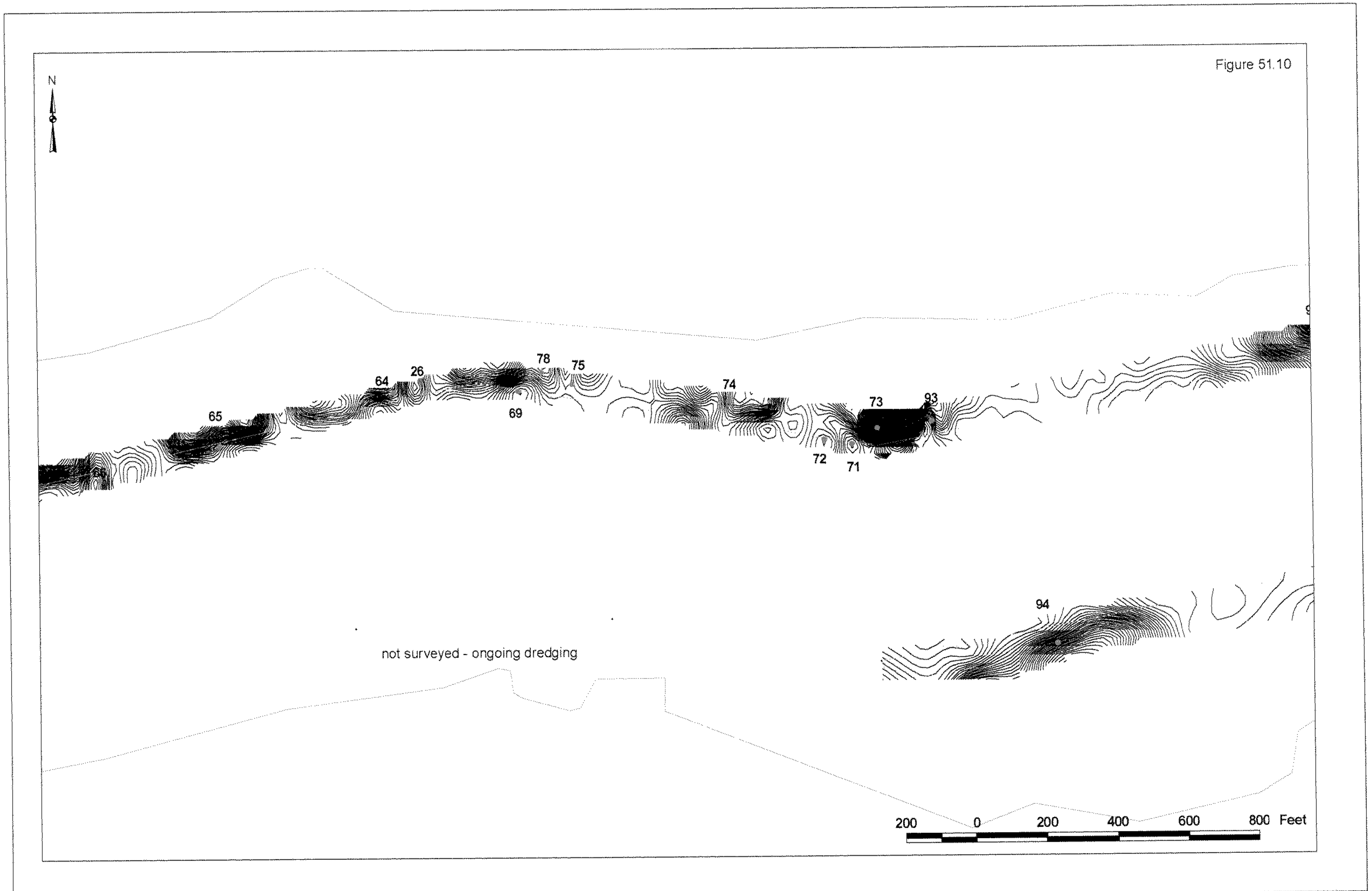

Figure 51.10. Magnetic contour map of the project area.

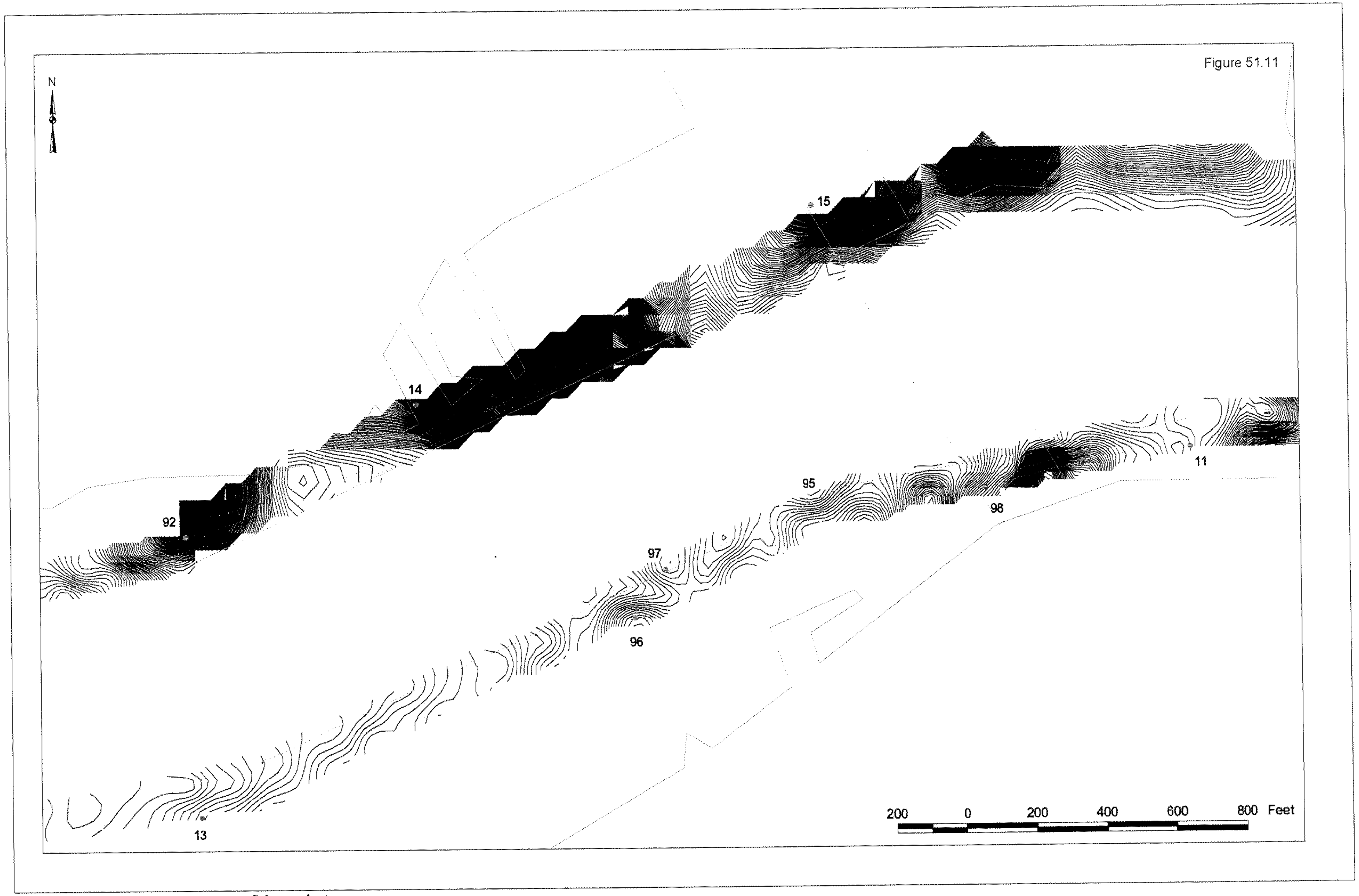

Figure 51.11. Magnetic contour map of the project area.

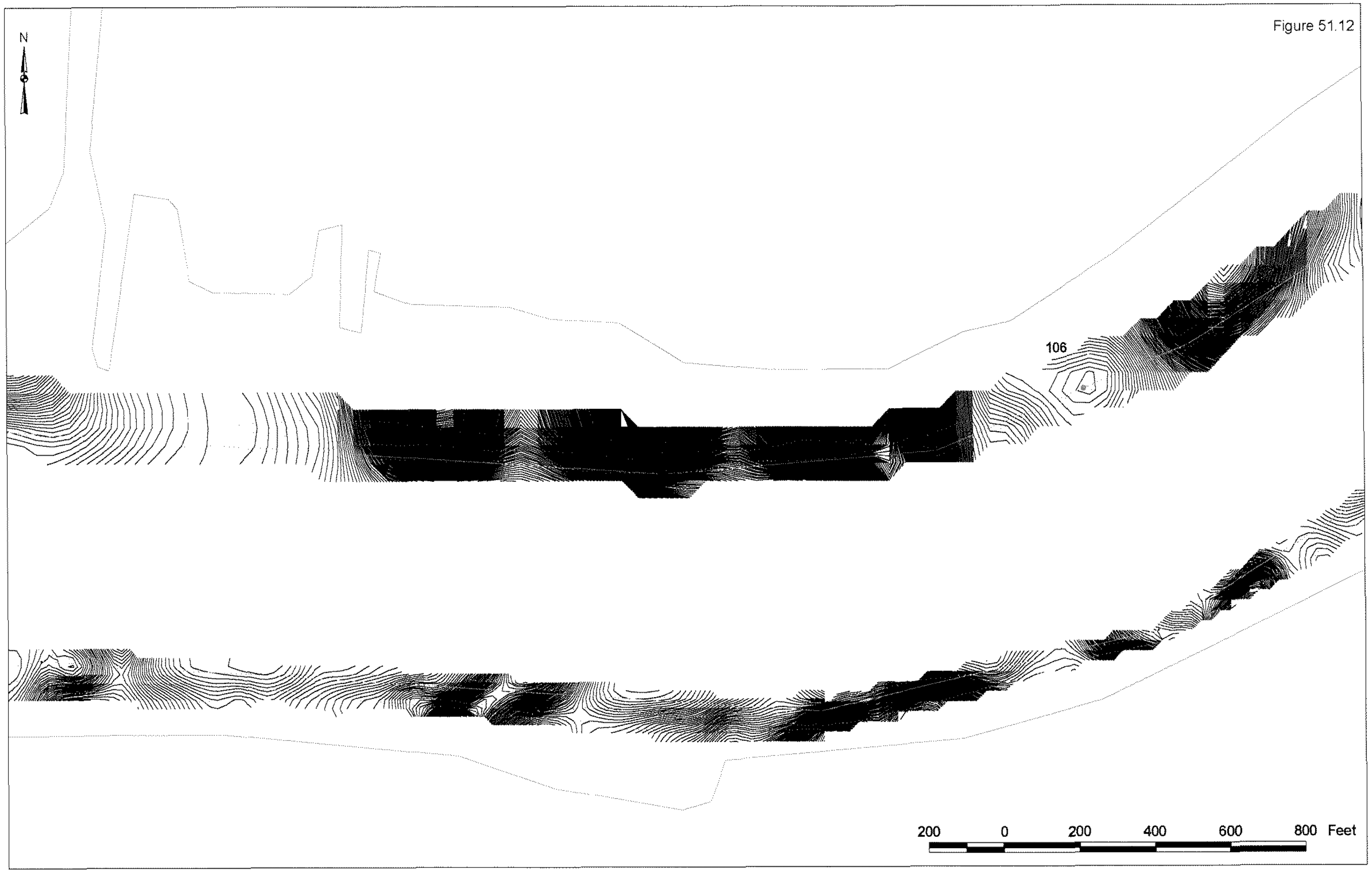

Figure 51.12. Magnetic contour map of the project area.

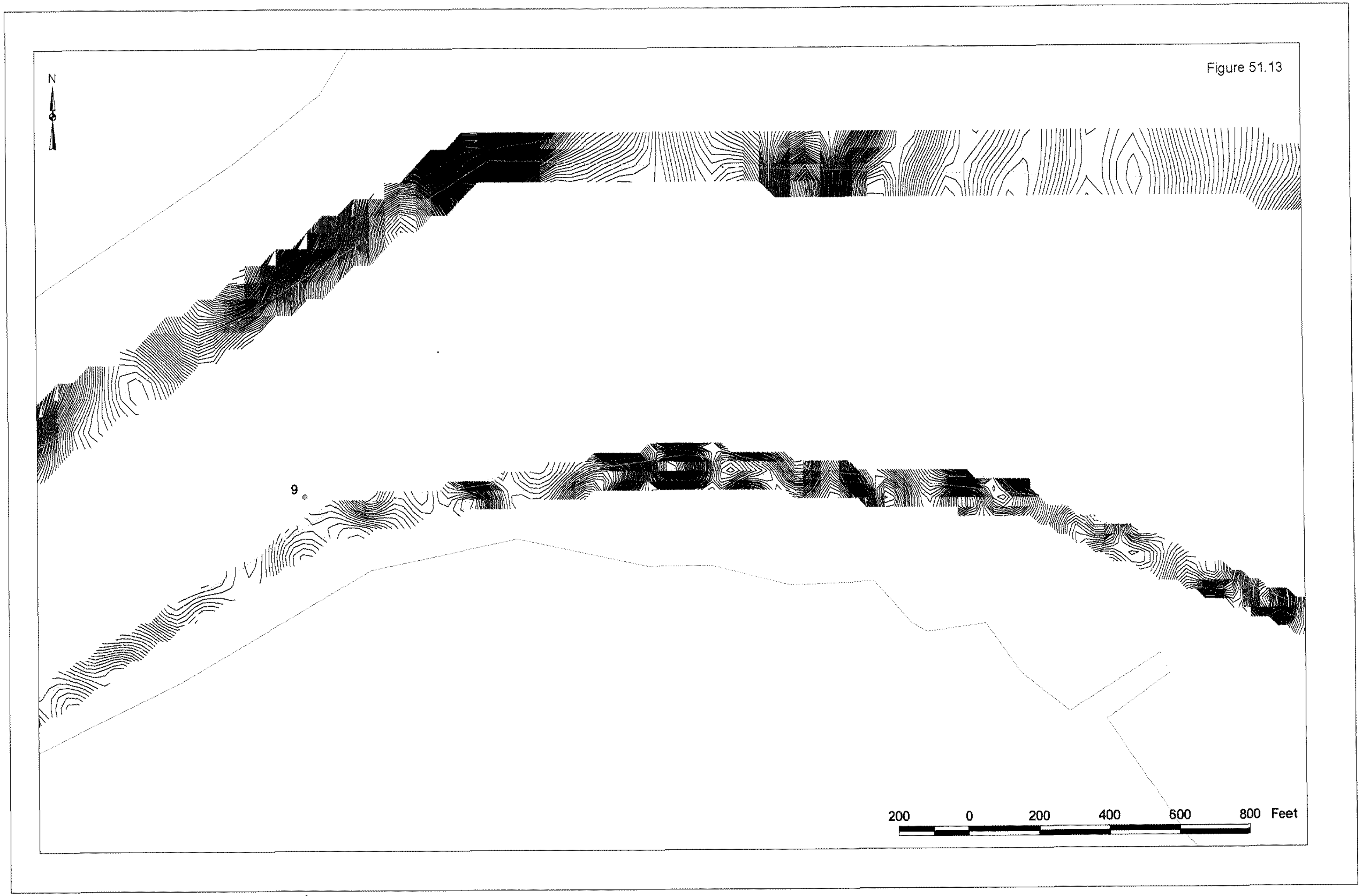

Figure 51.13. Magnetic contour map of the project area.

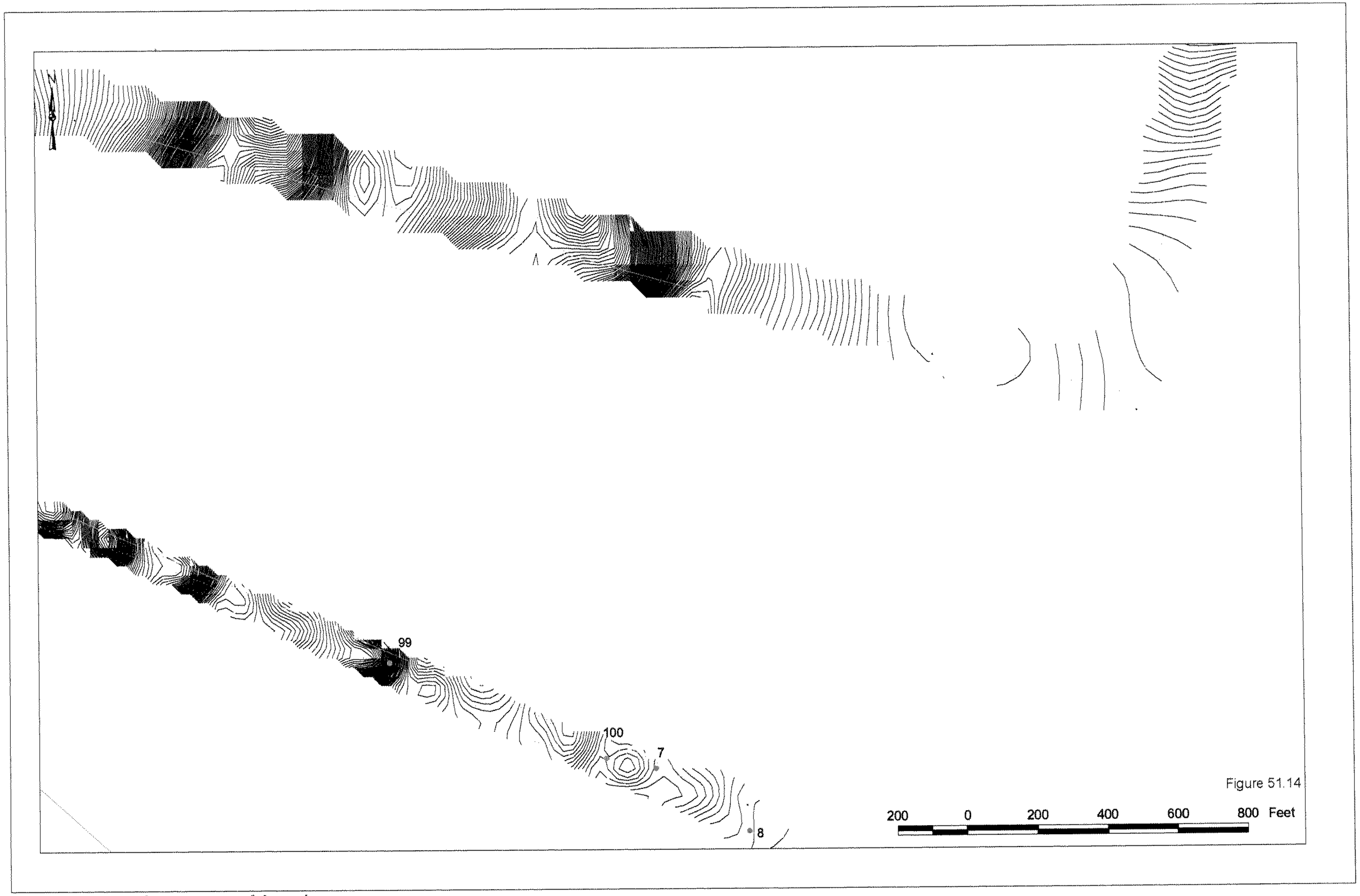

Figure 51.14. Magnetic contour map of the project area.

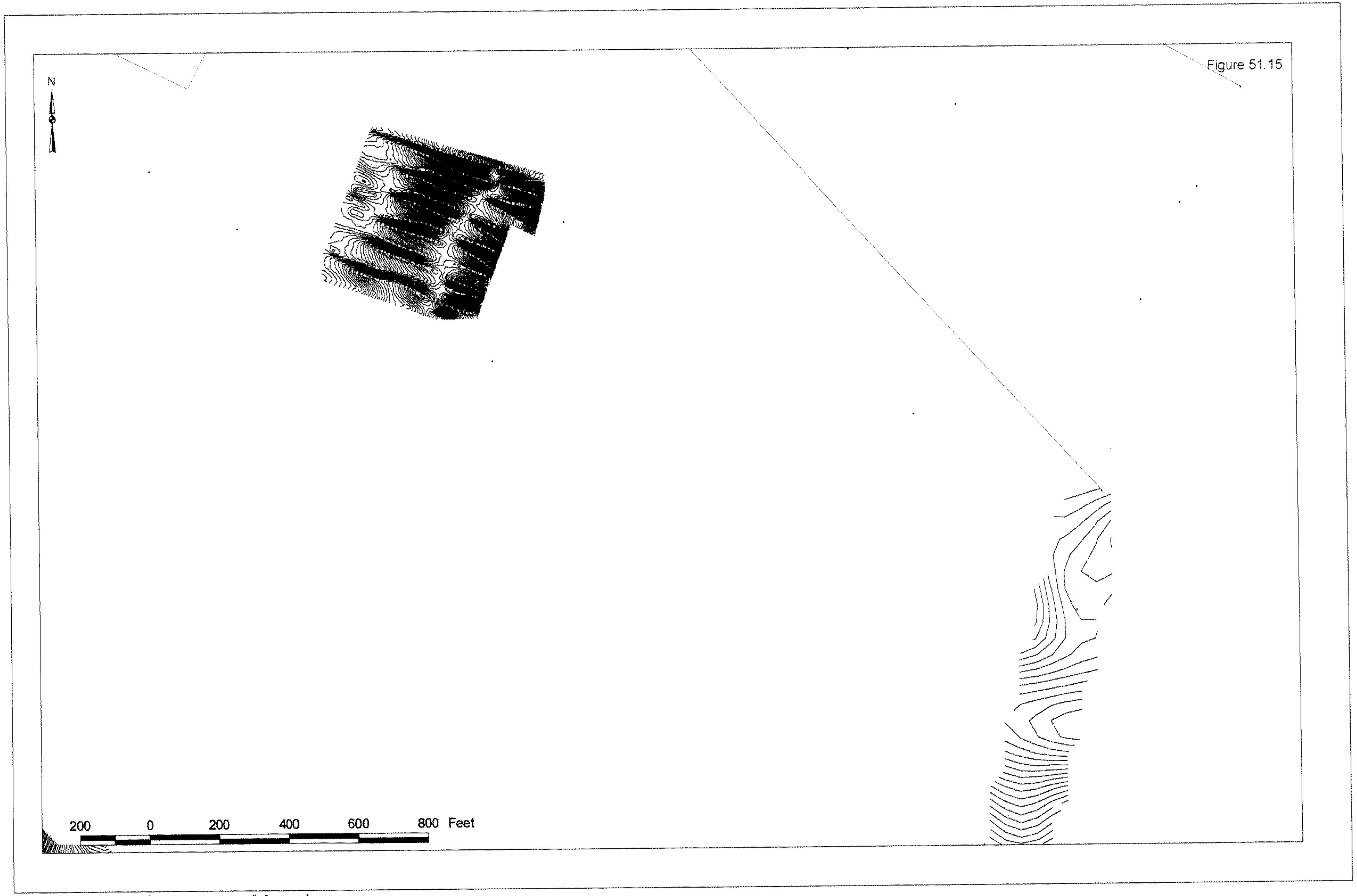

Figure 51.15. Magnetic contour map of the project area.

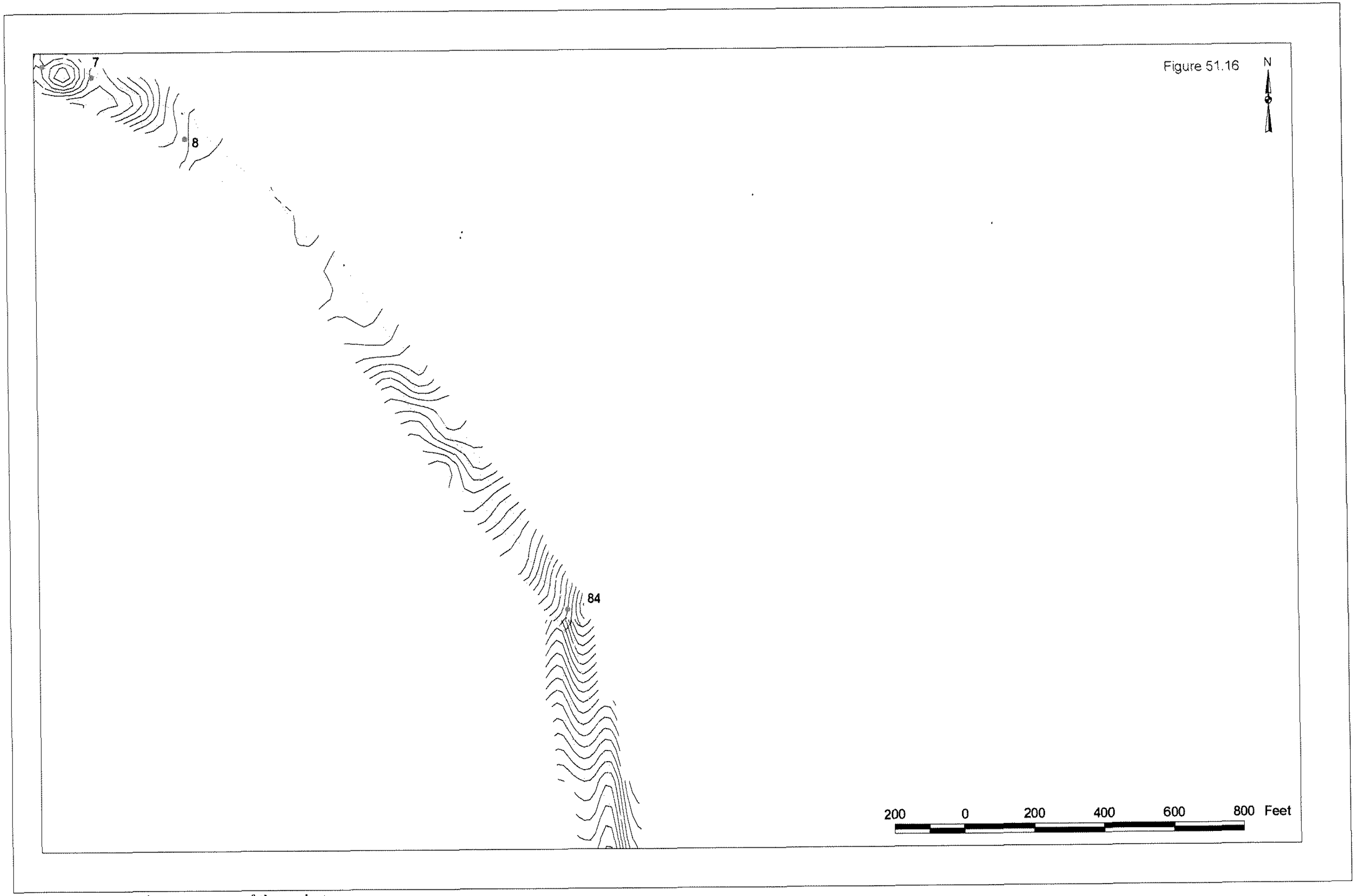

Figure 51.16. Magnetic contour map of the project area.

Figure 51.17. Magnetic contour map of the project area.

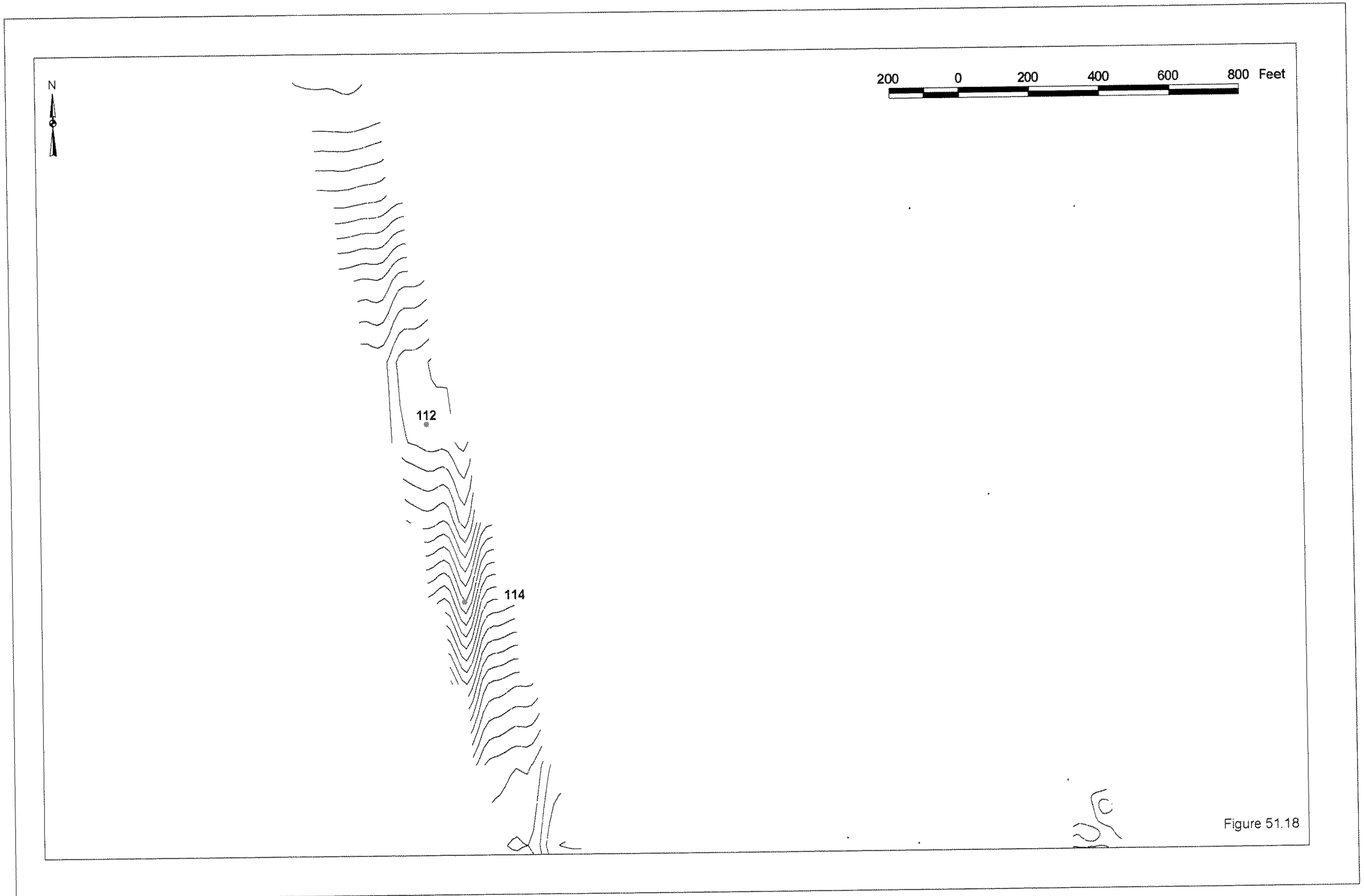

Figure 51.18. Magnetic contour map of the project area.

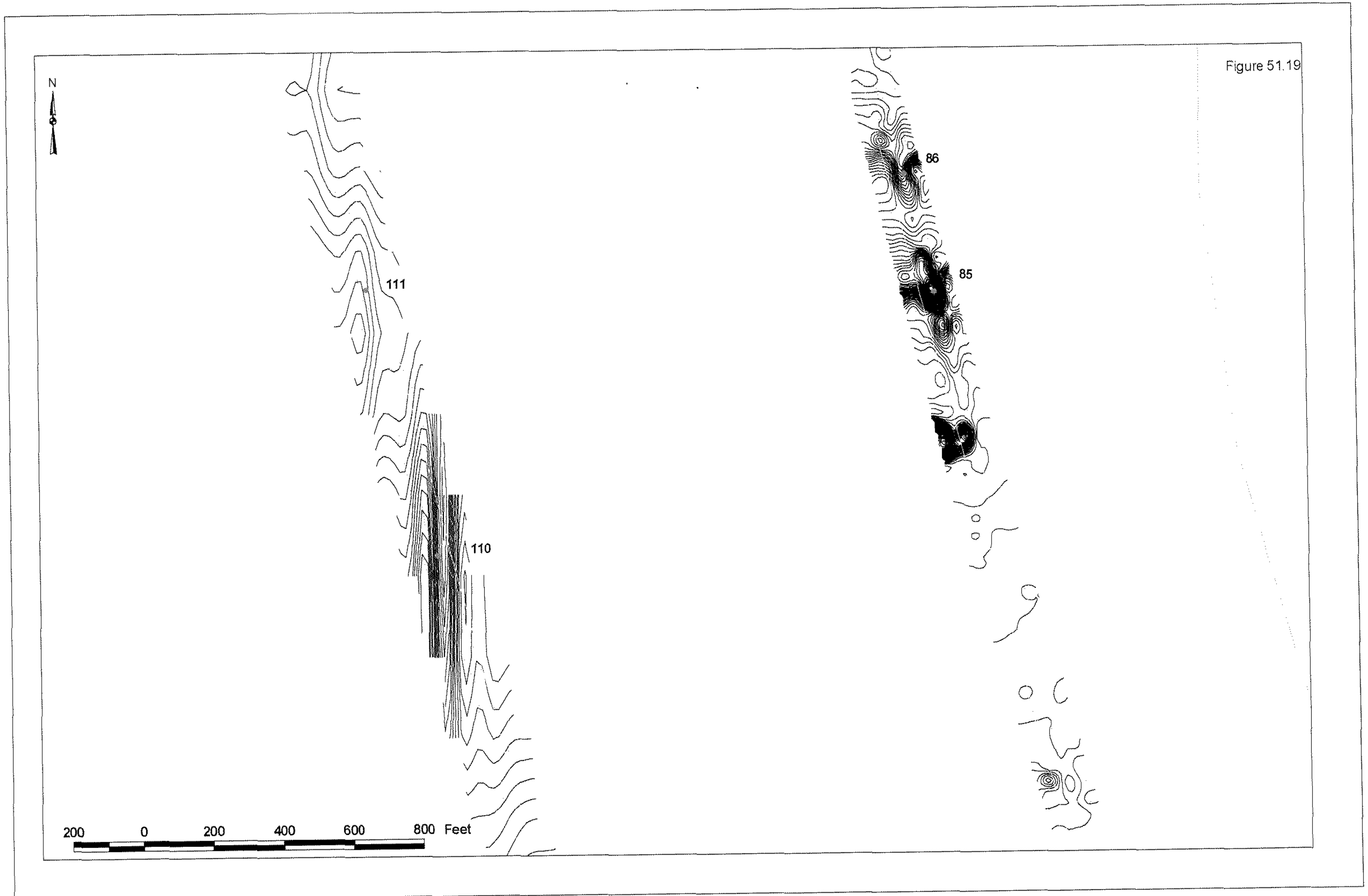

Figure 51.19. Magnetic contour map of the project area.

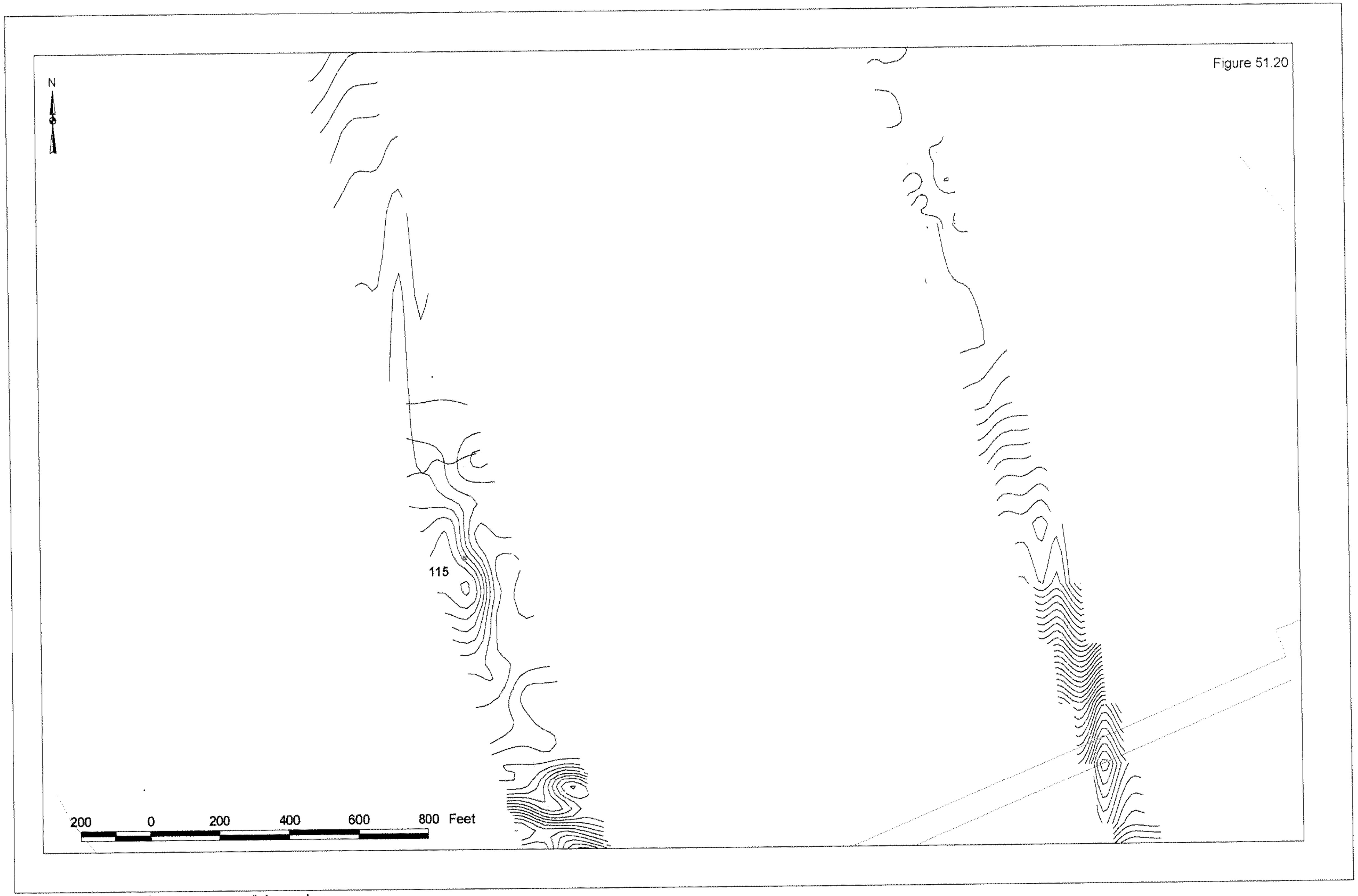

Figure 51.20. Magnetic contour map of the project area.

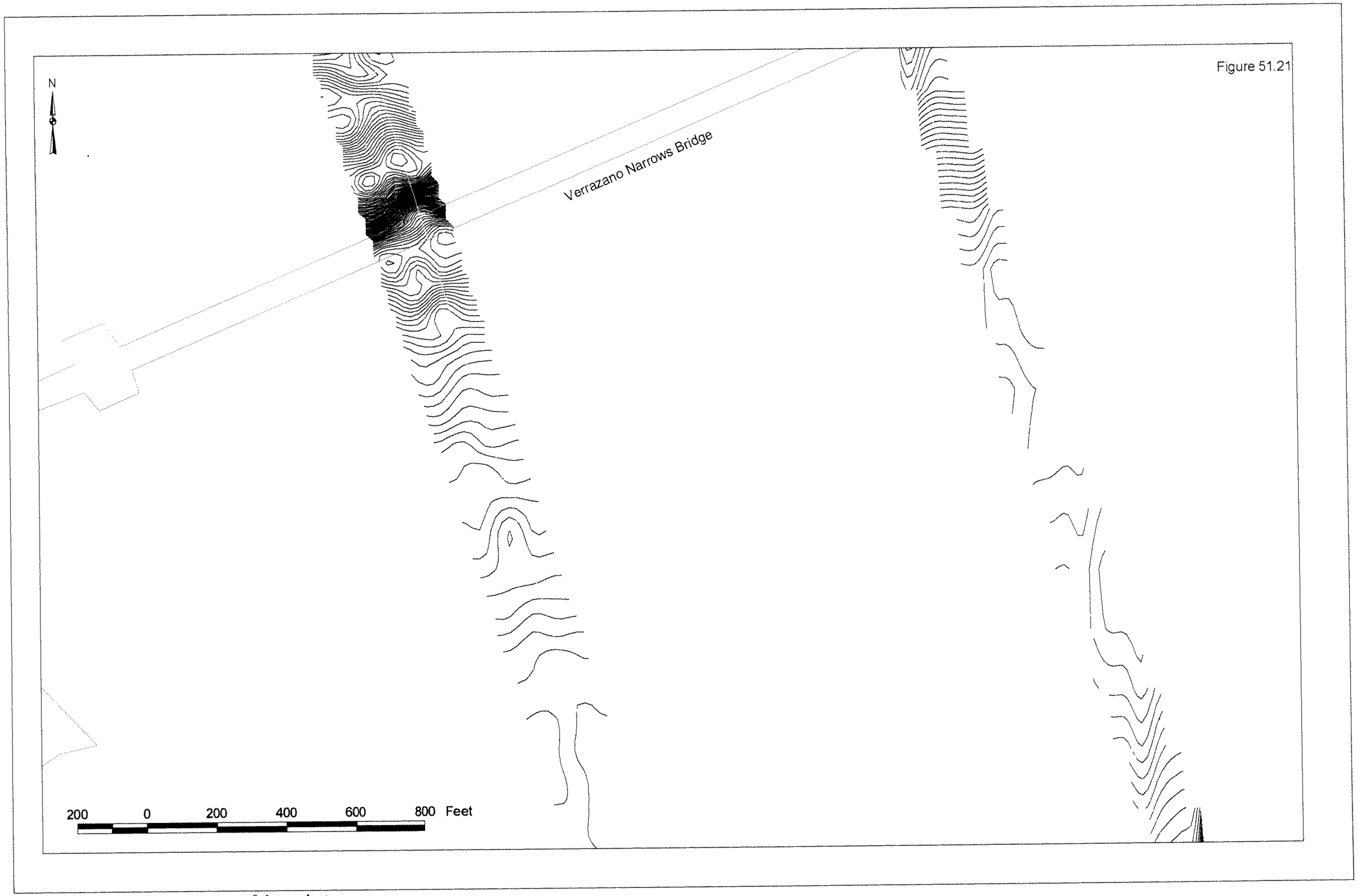

Figure 51.21. Magnetic contour map of the project area.

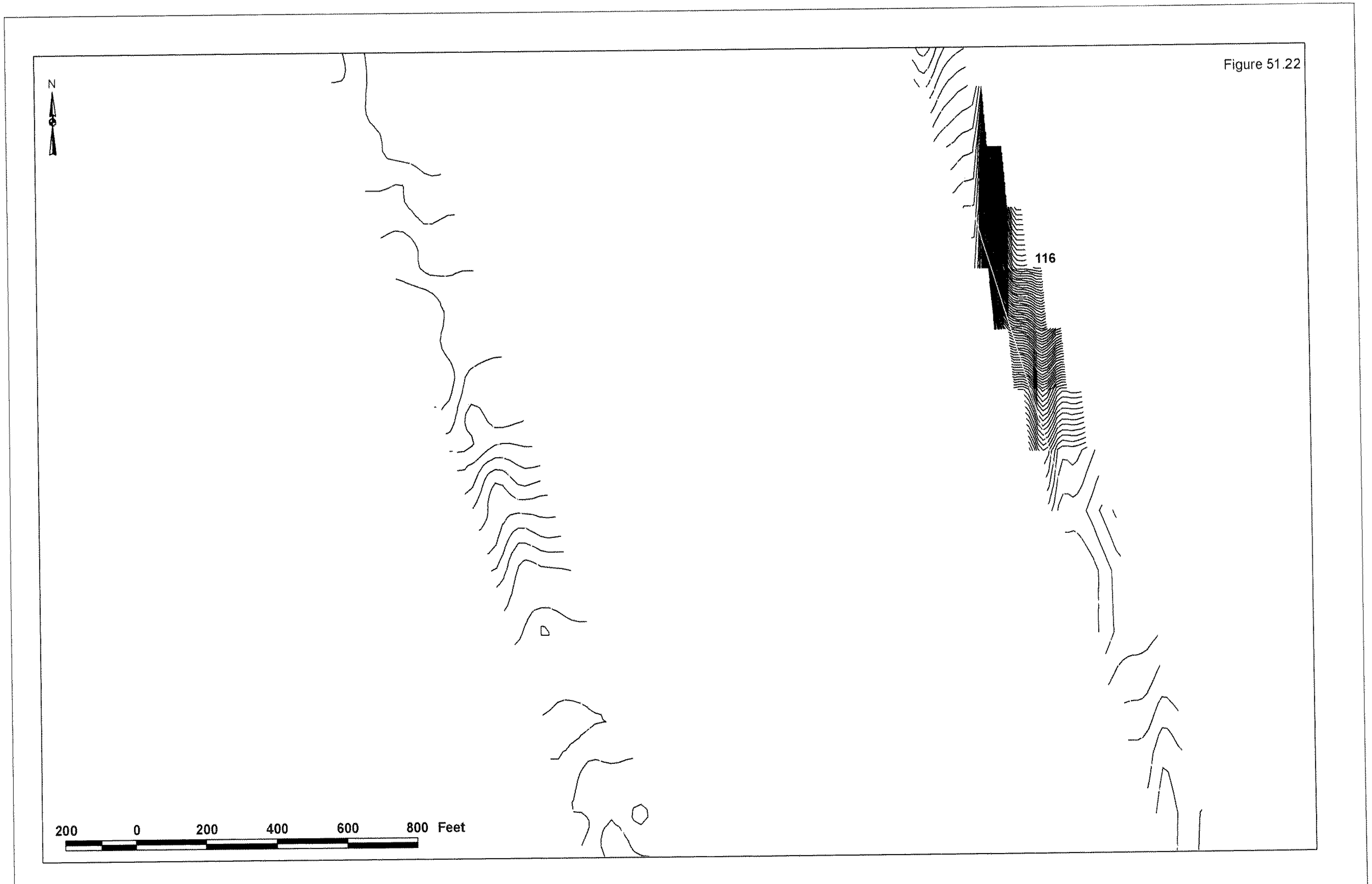

Figure 51.22. Magnetic contour map of the project area.

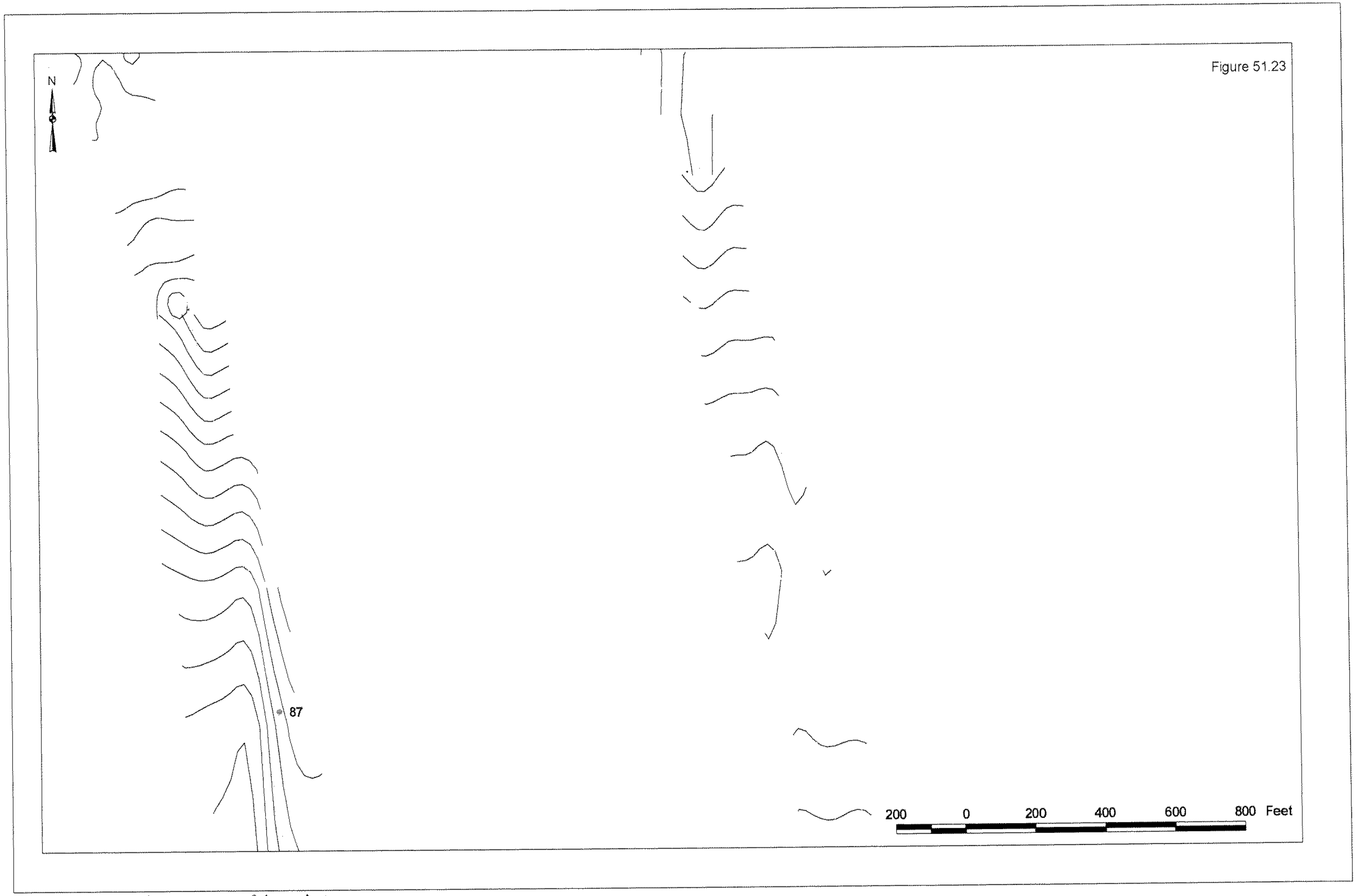

Figure 51.23. Magnetic contour map of the project area.

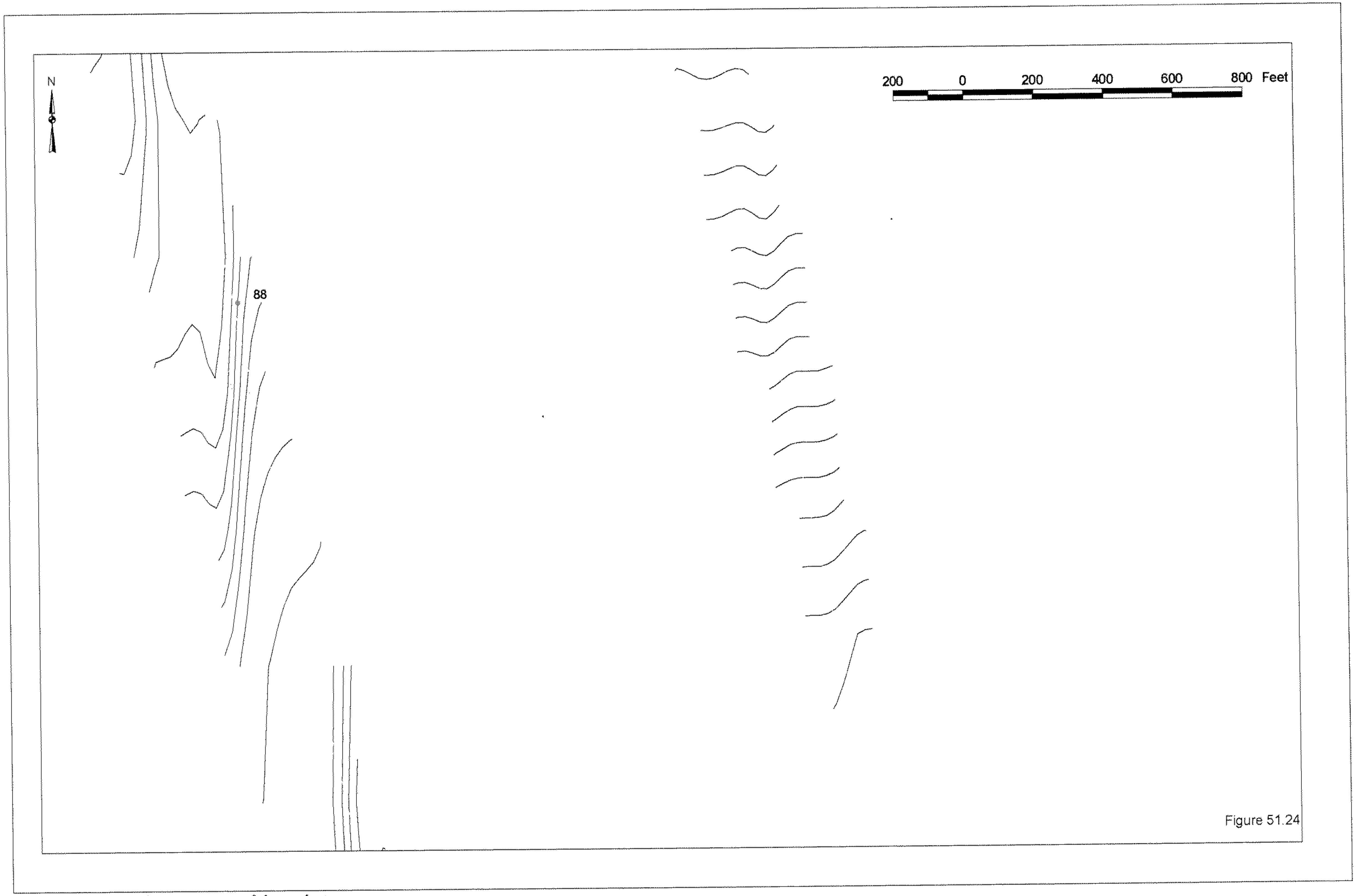

Figure 51.24. Magnetic contour map of the project area.

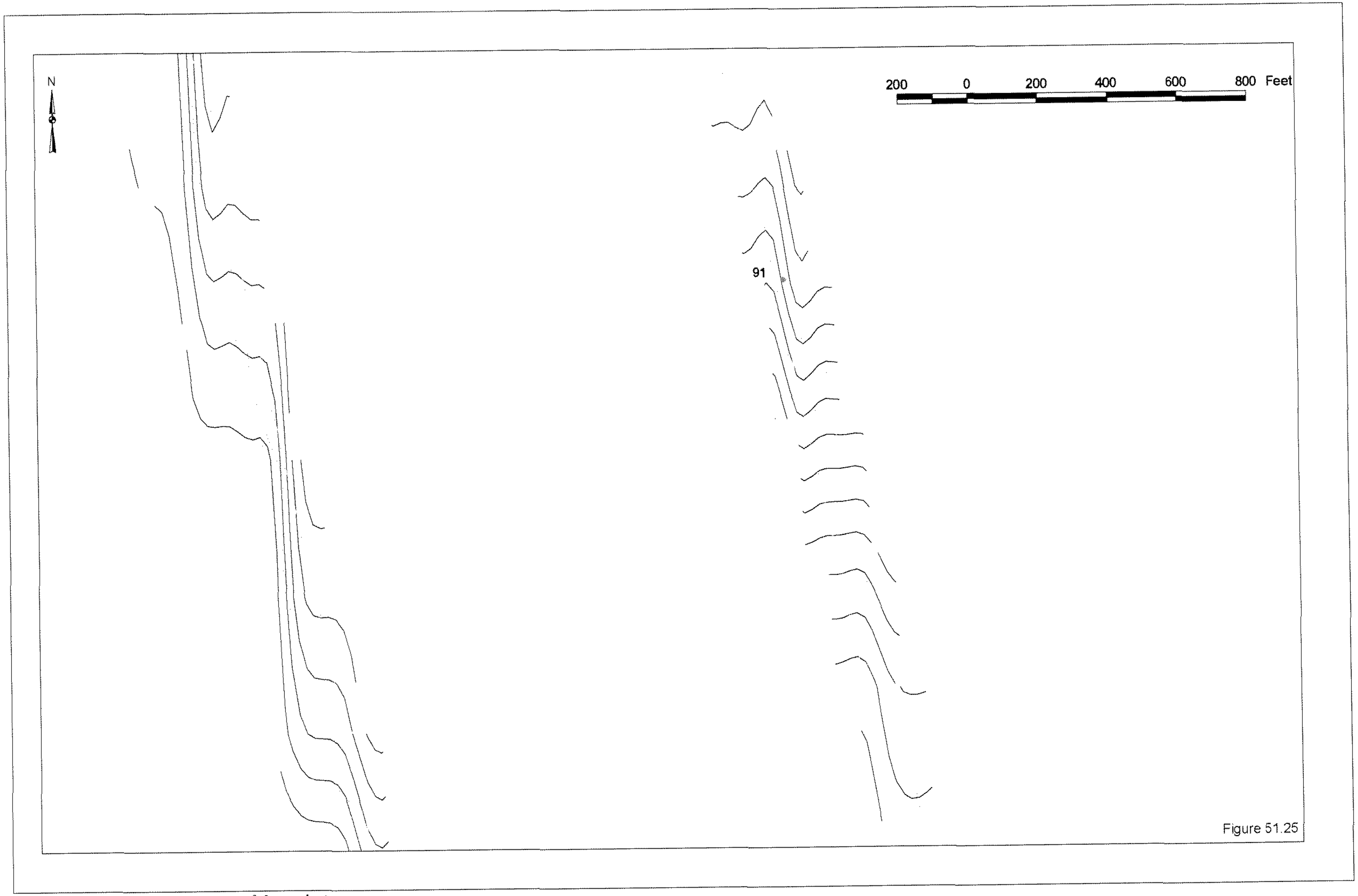

Figure 51.25. Magnetic contour map of the project area.

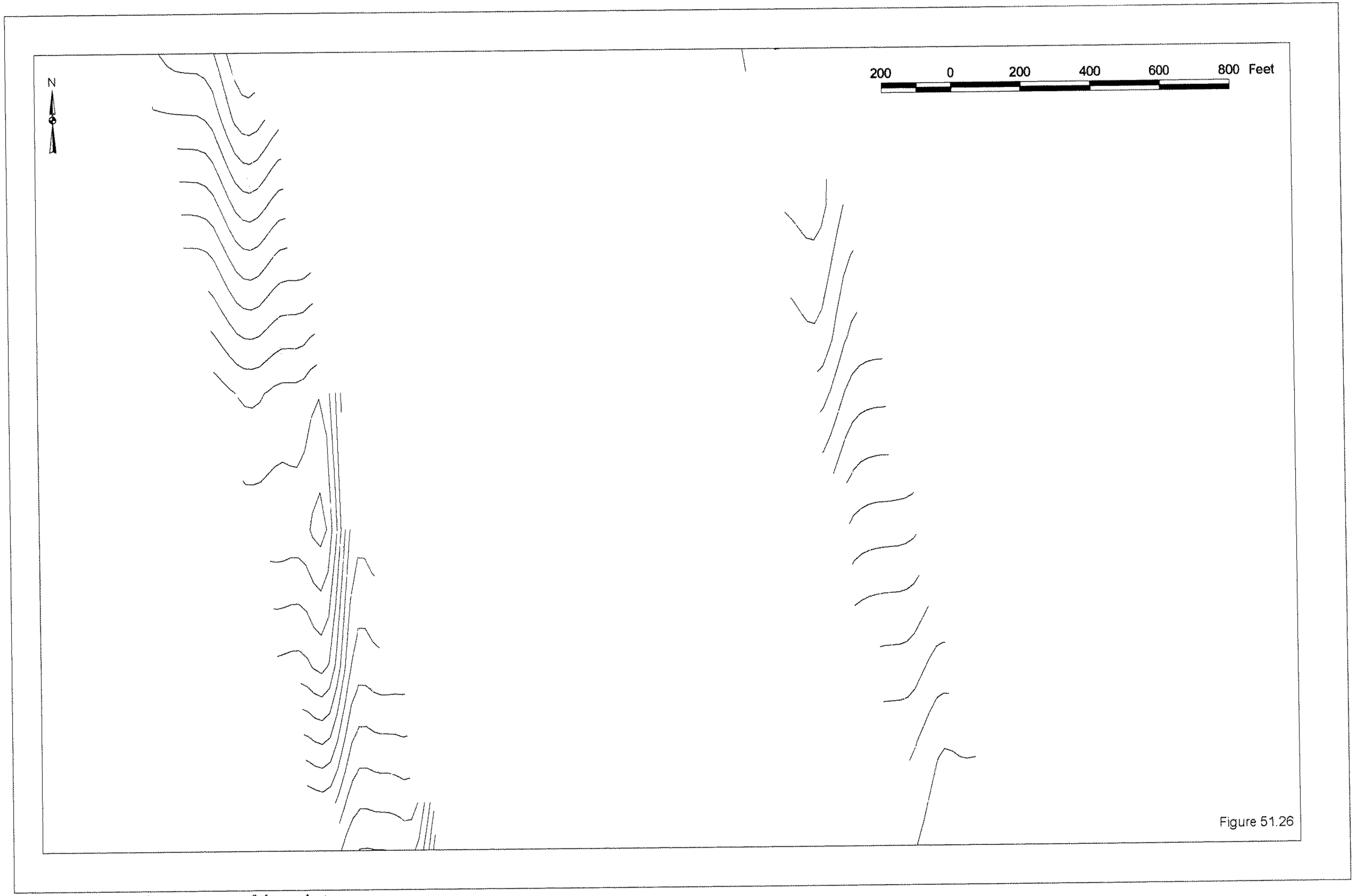

Figure 51.26. Magnetic contour map of the project area.

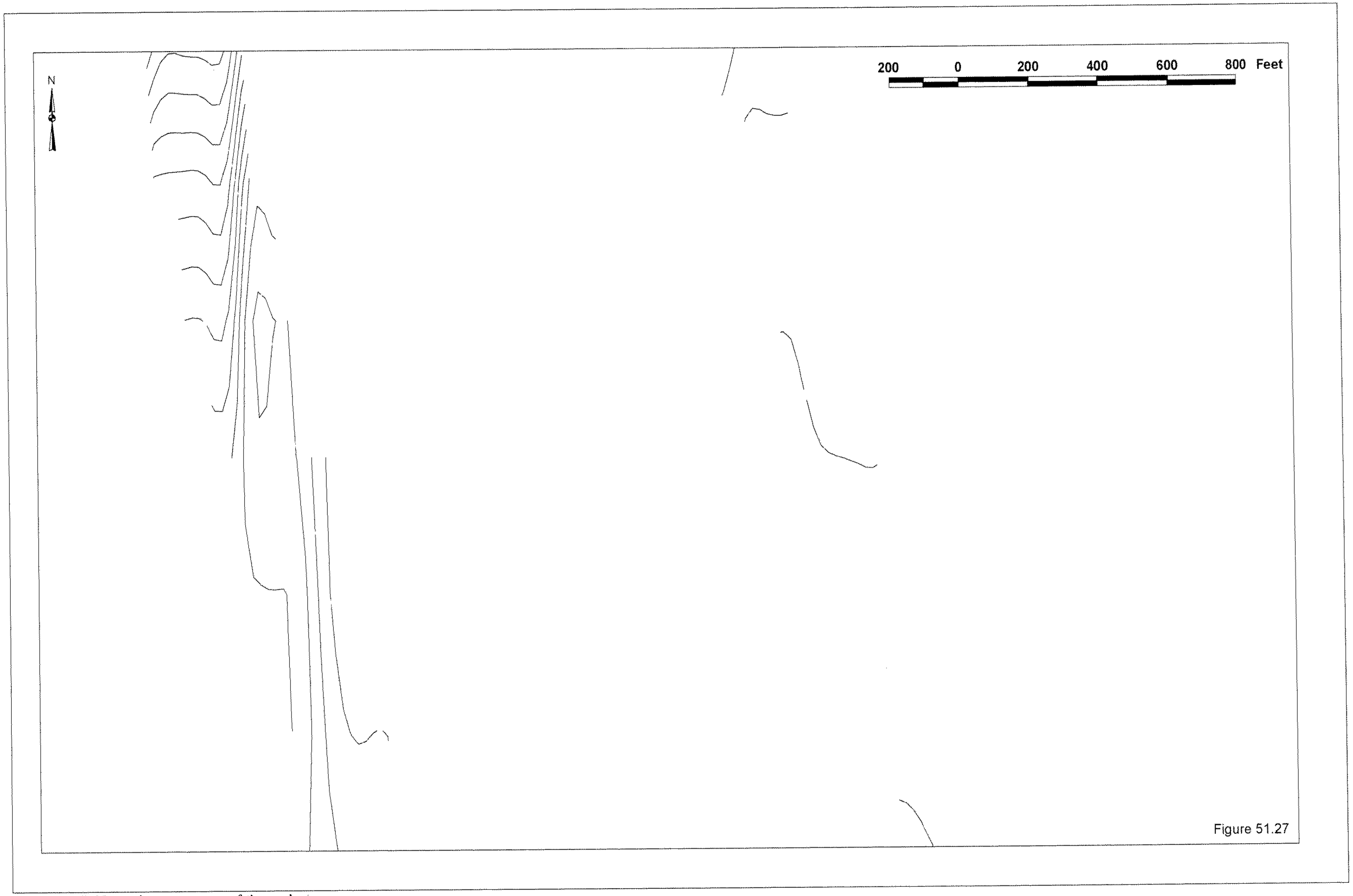

Figure 51.27. Magnetic contour map of the project area.

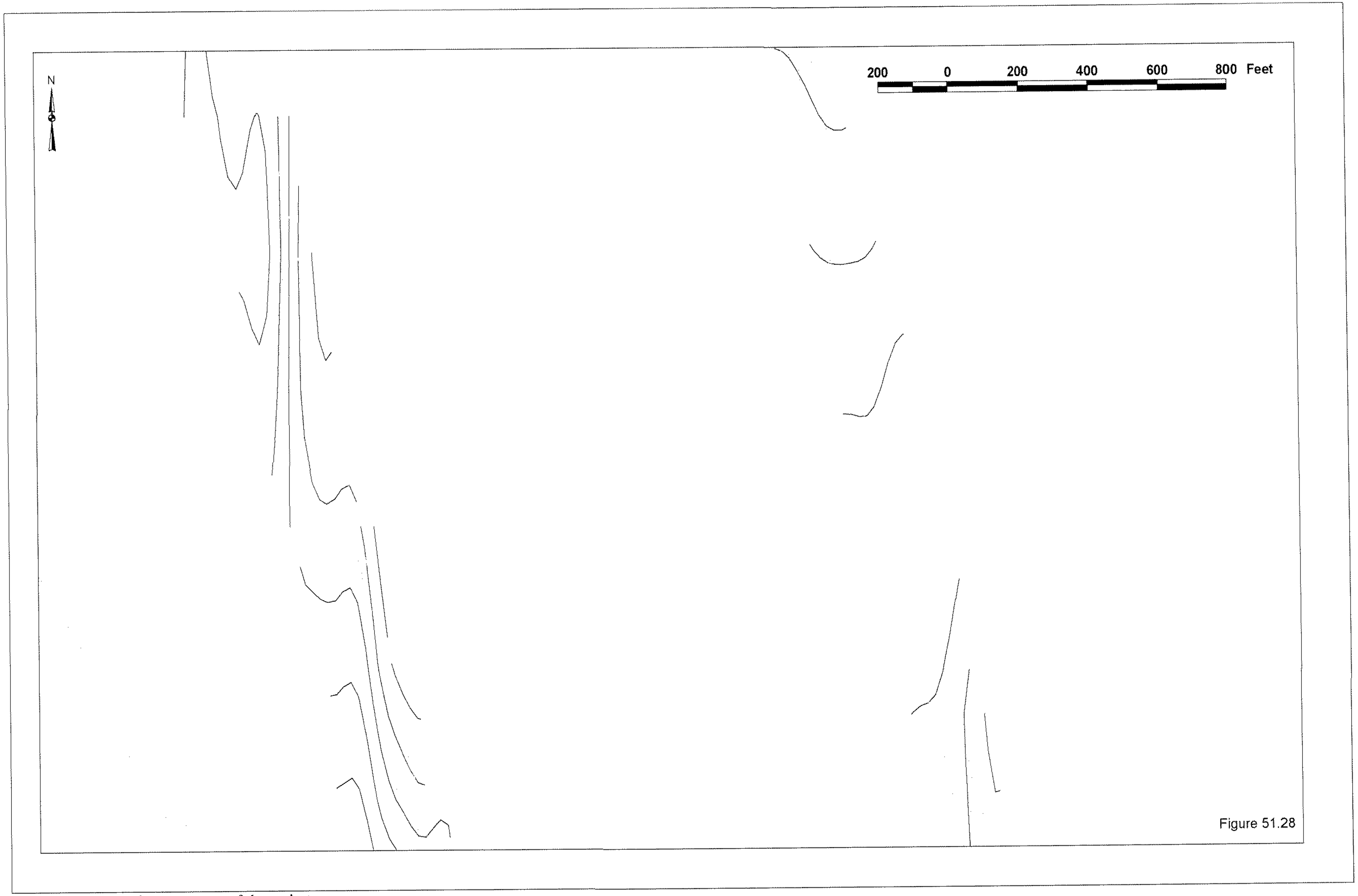

Figure 51.28. Magnetic contour map of the project area.

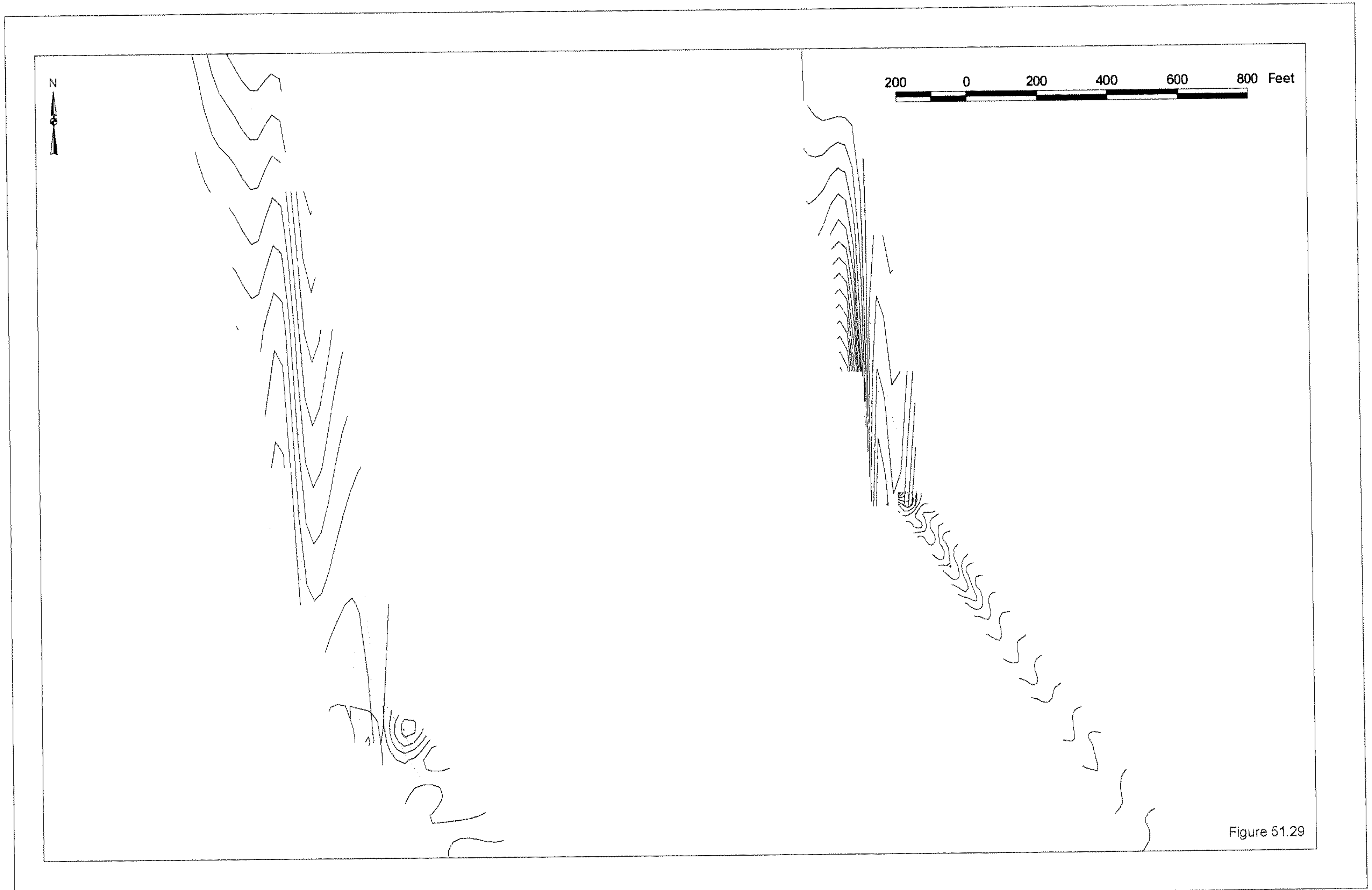

Figure 51.29. Magnetic contour map of the project area.

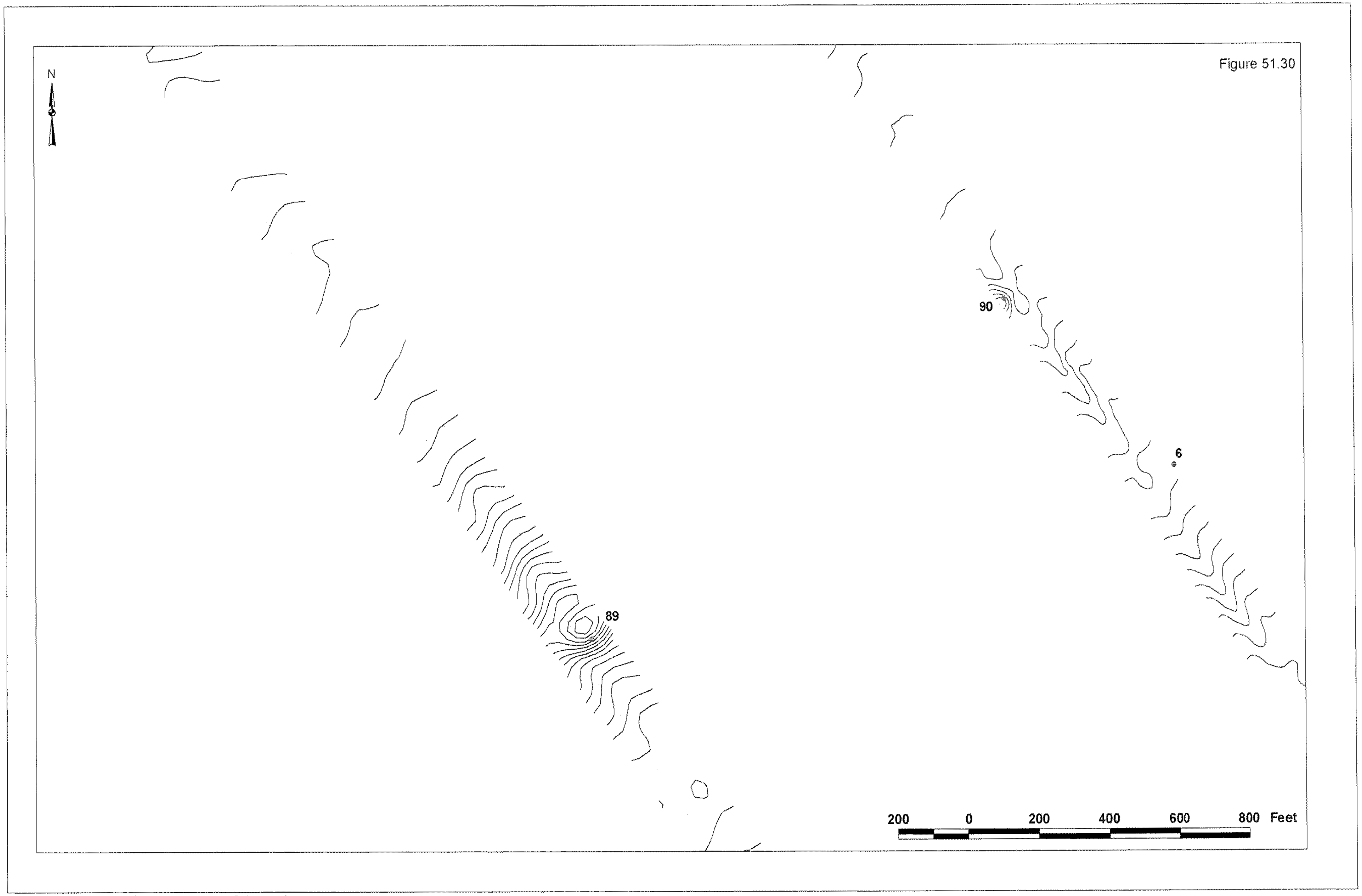

Figure 51.30. Magnetic contour map of the project area.

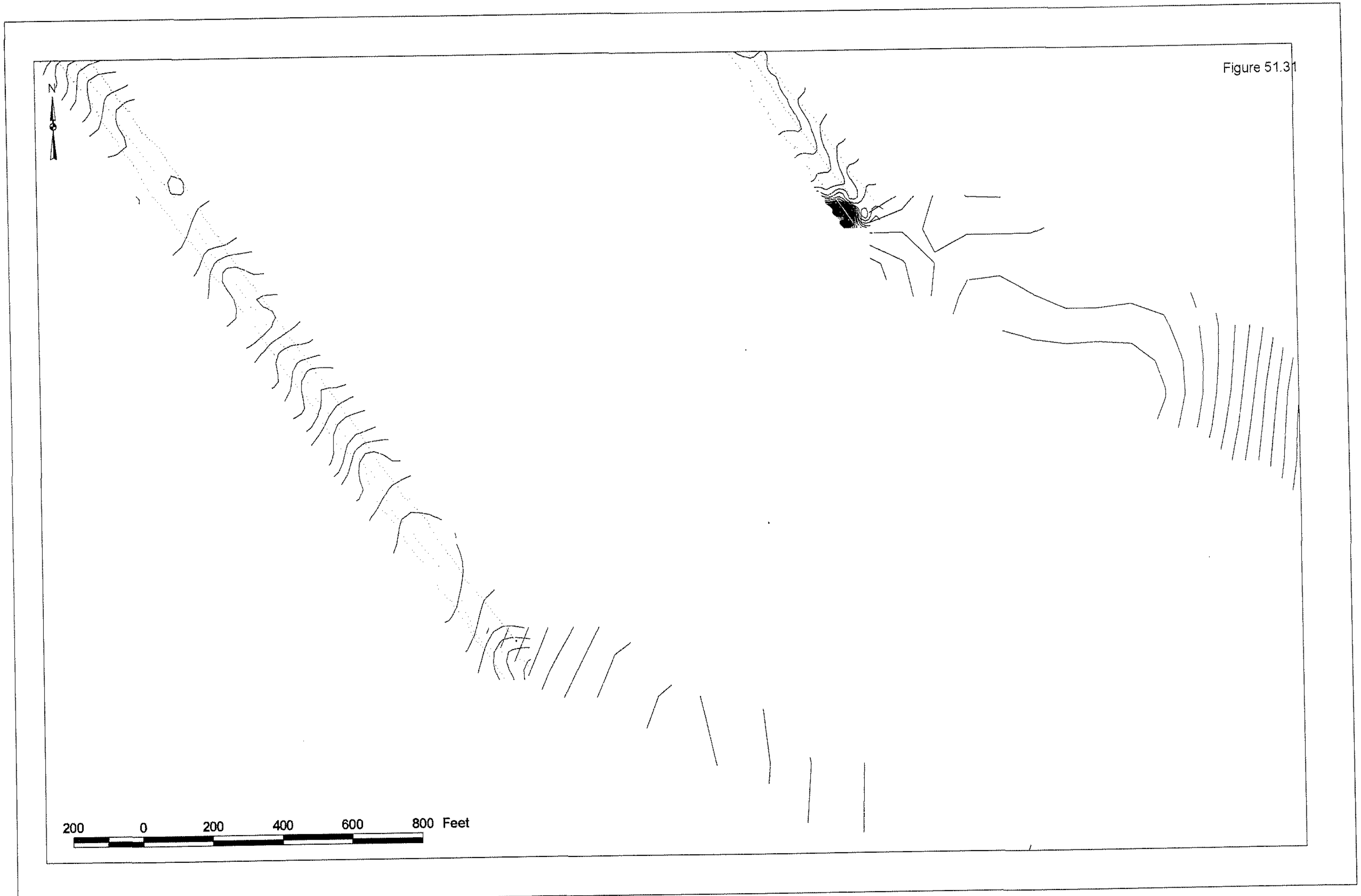

Figure 51.31. Magnetic contour map of the project area.

Figure 51.32. Magnetic contour map of the project area.

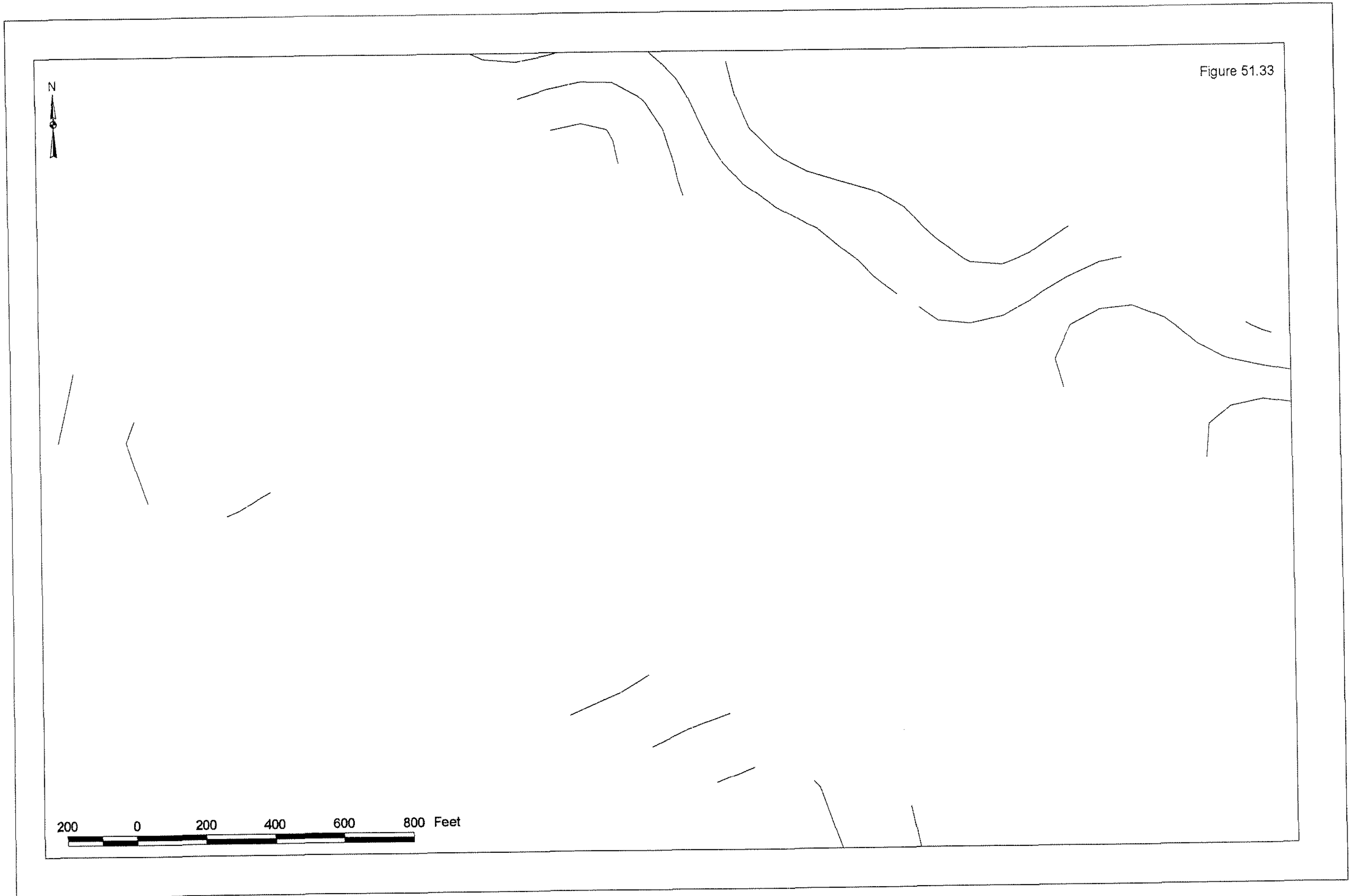

Figure 51.33. Magnetic contour map of the project area.

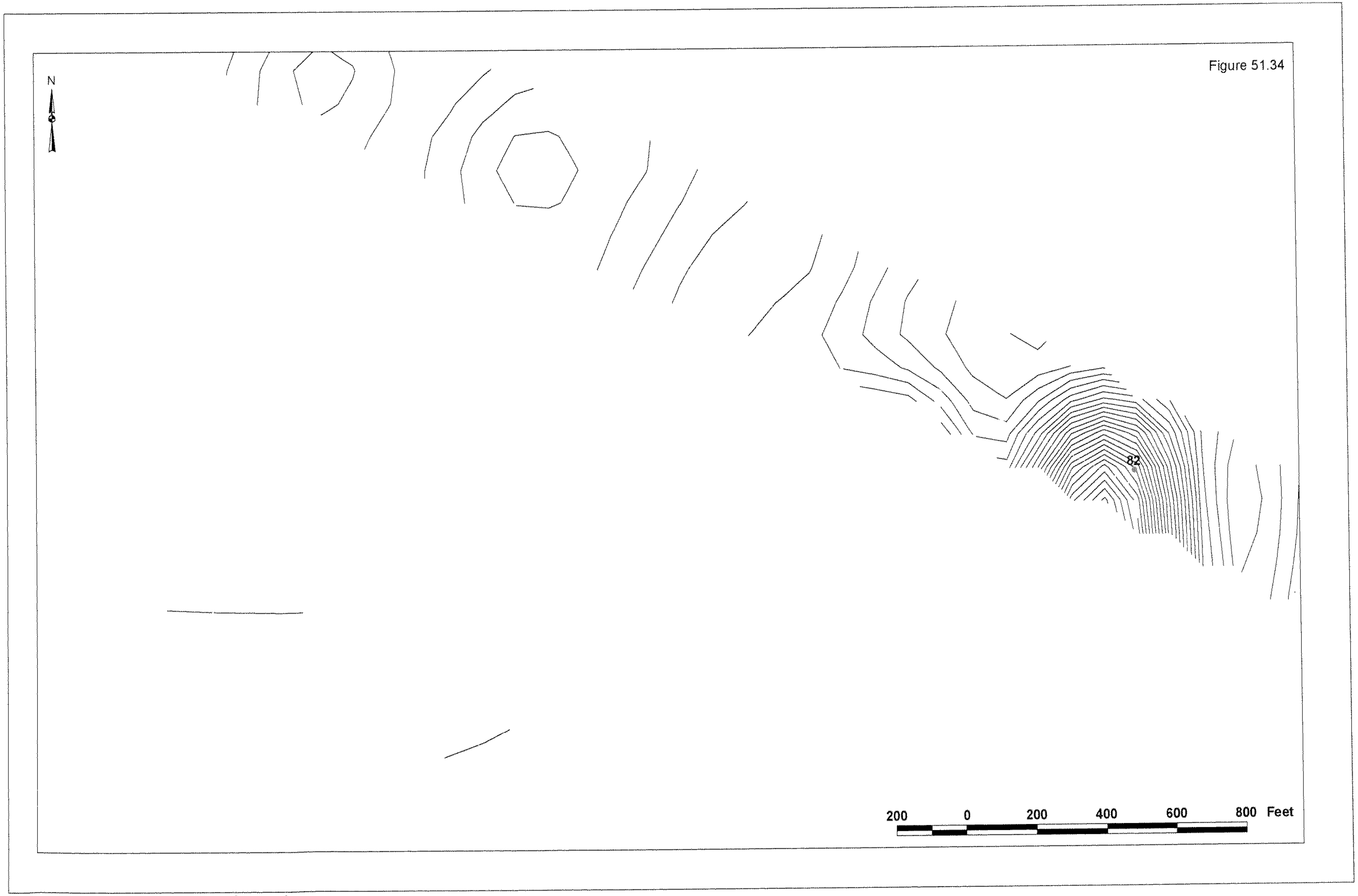

Figure 51.34. Magnetic contour map of the project area.

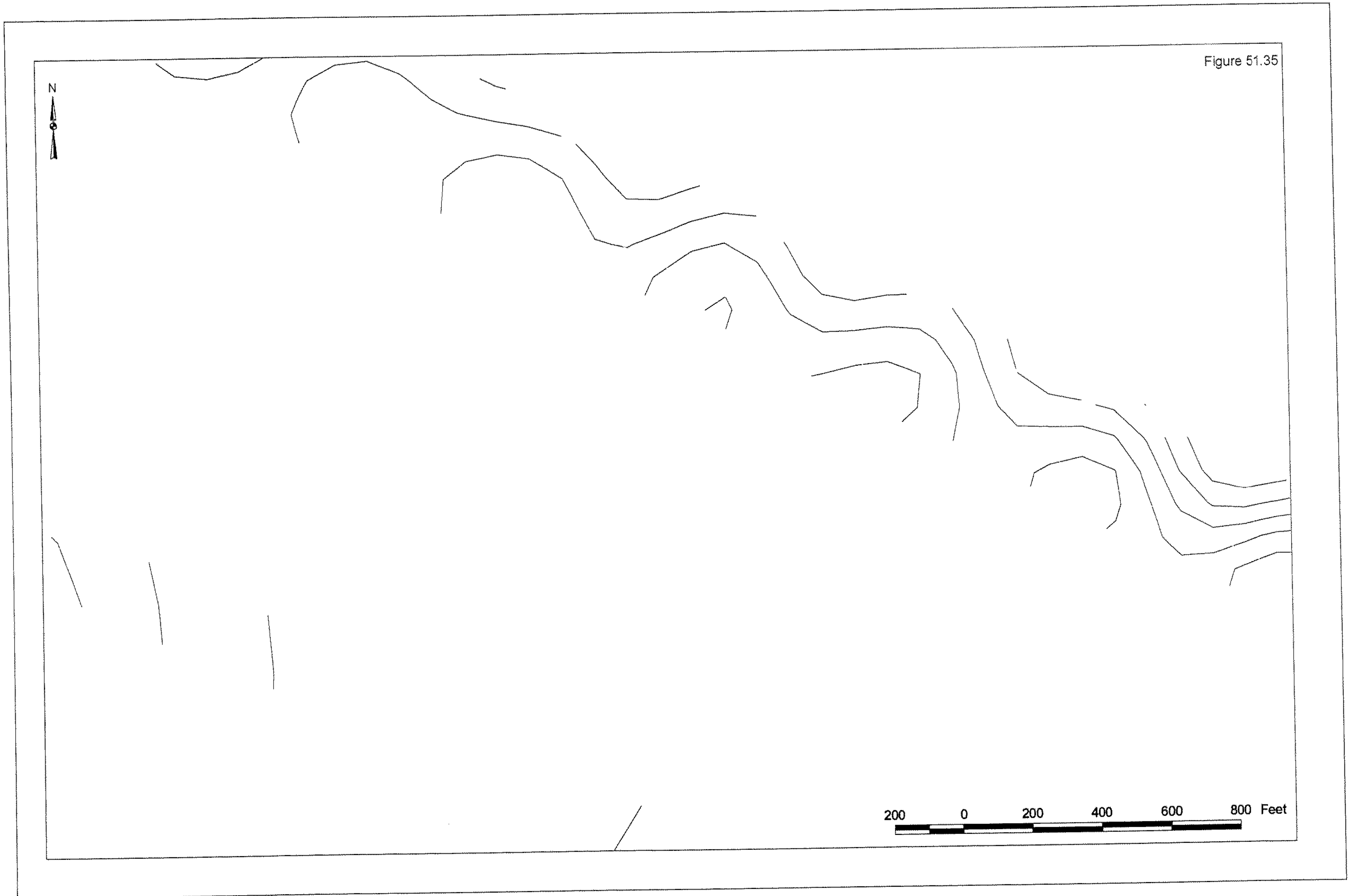

Figure 51.35. Magnetic contour map of the project area.

Figure 51.36. Magnetic contour map of the project area.

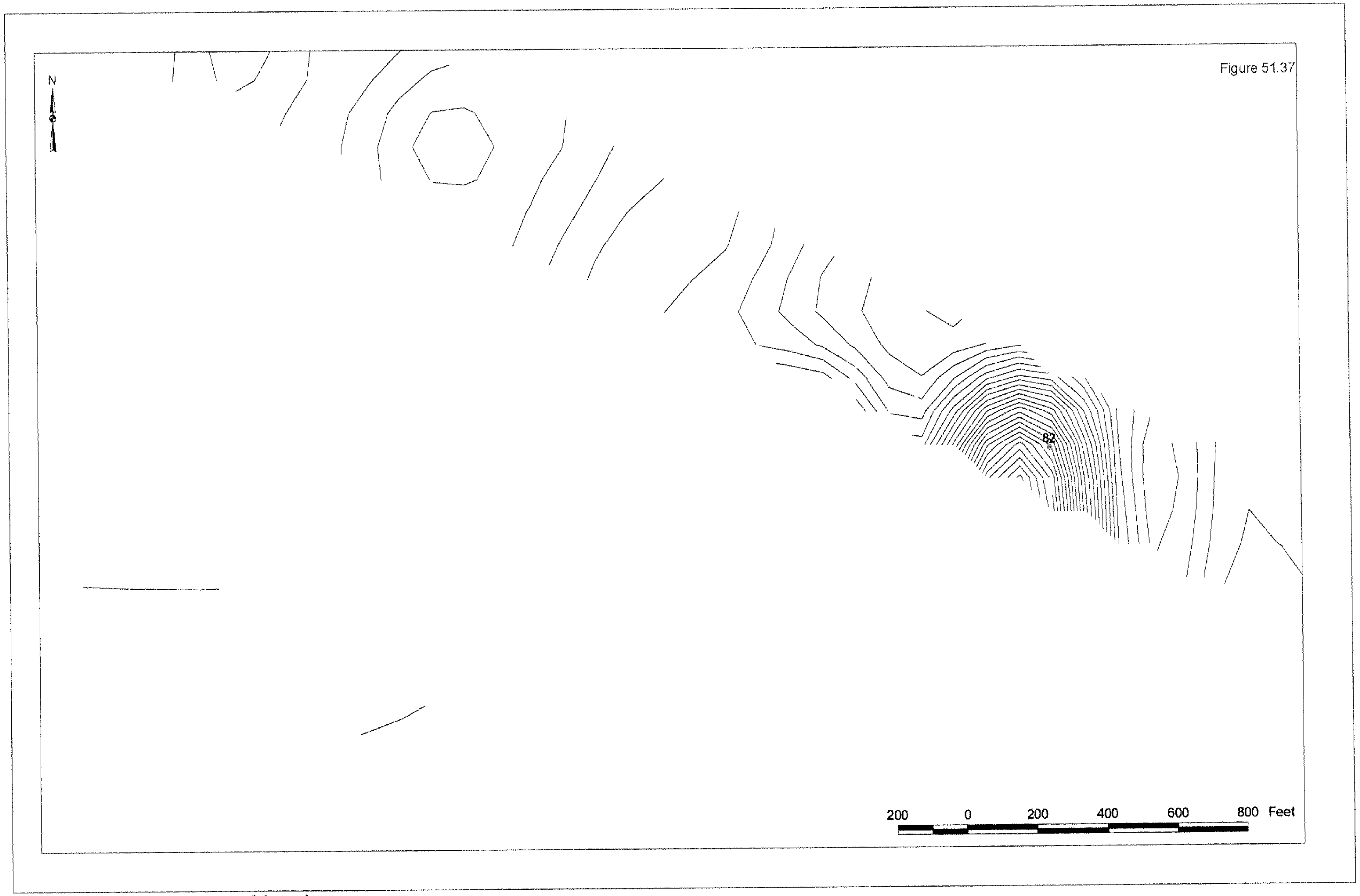

Figure 51.37. Magnetic contour map of the project area.

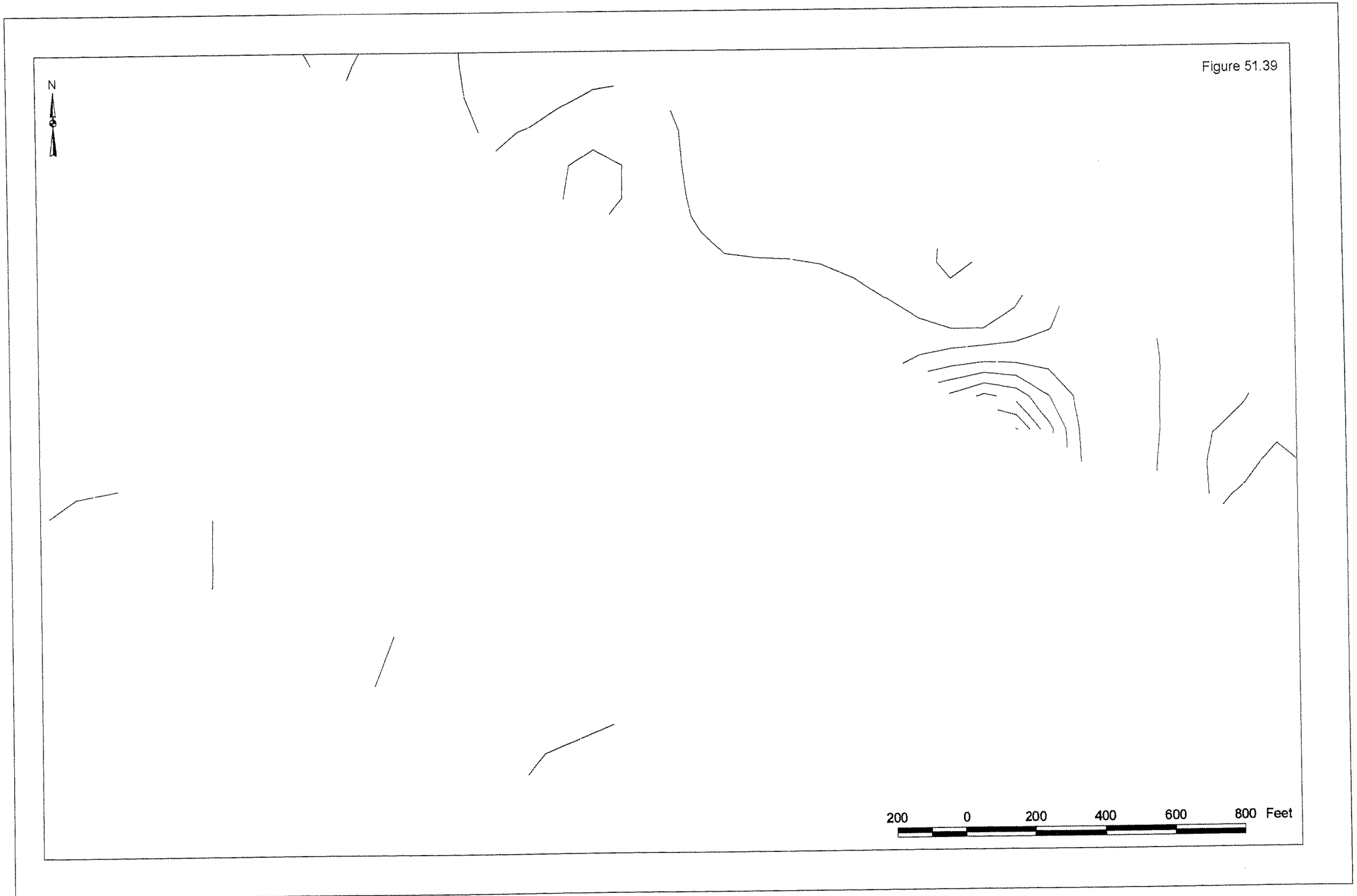

Figure 51.39. Magnetic contour map of the project area.

Figure 51.38. Magnetic contour map of the project area.

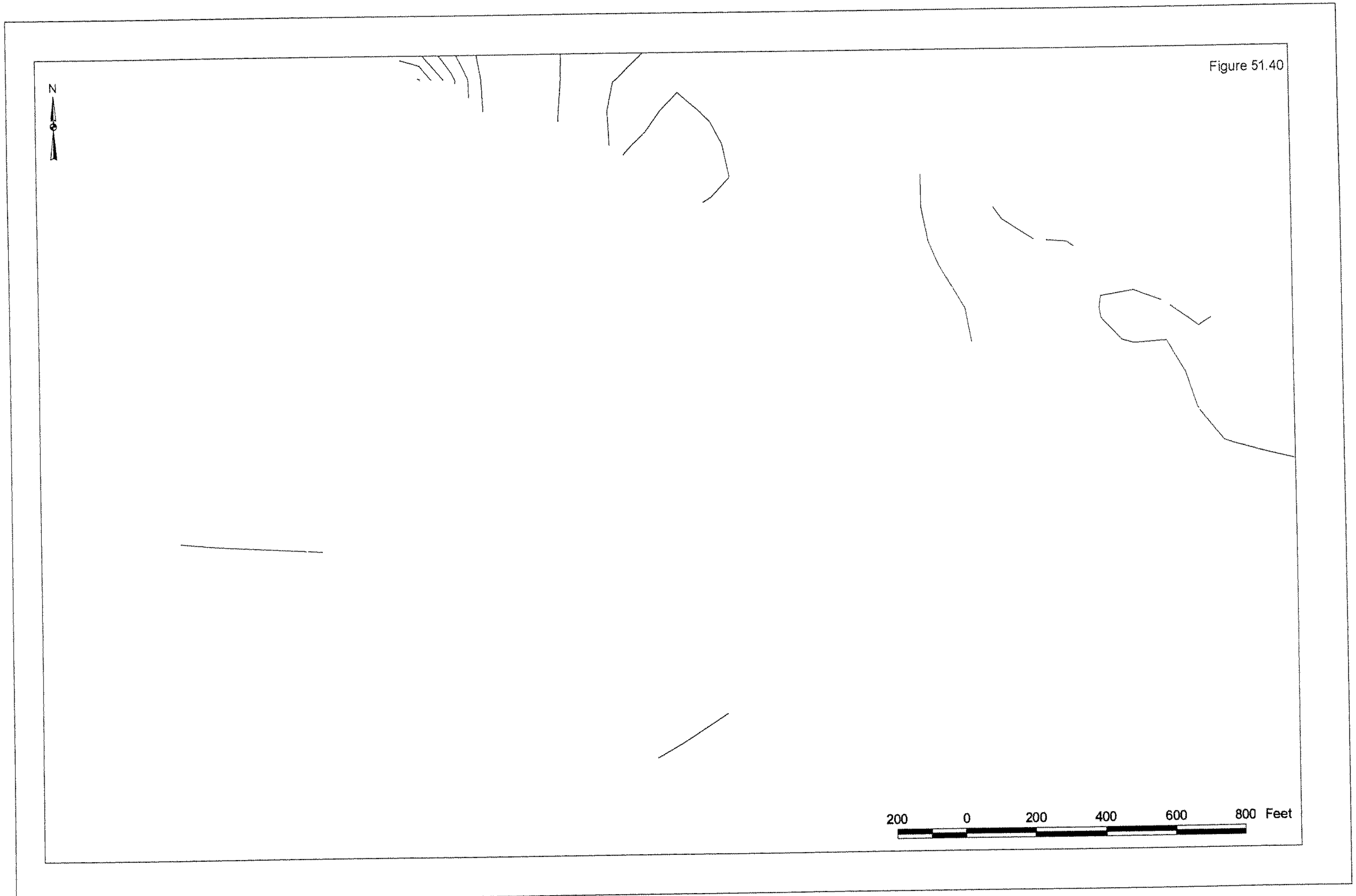

Figure 51.40. Magnetic contour map of the project area.

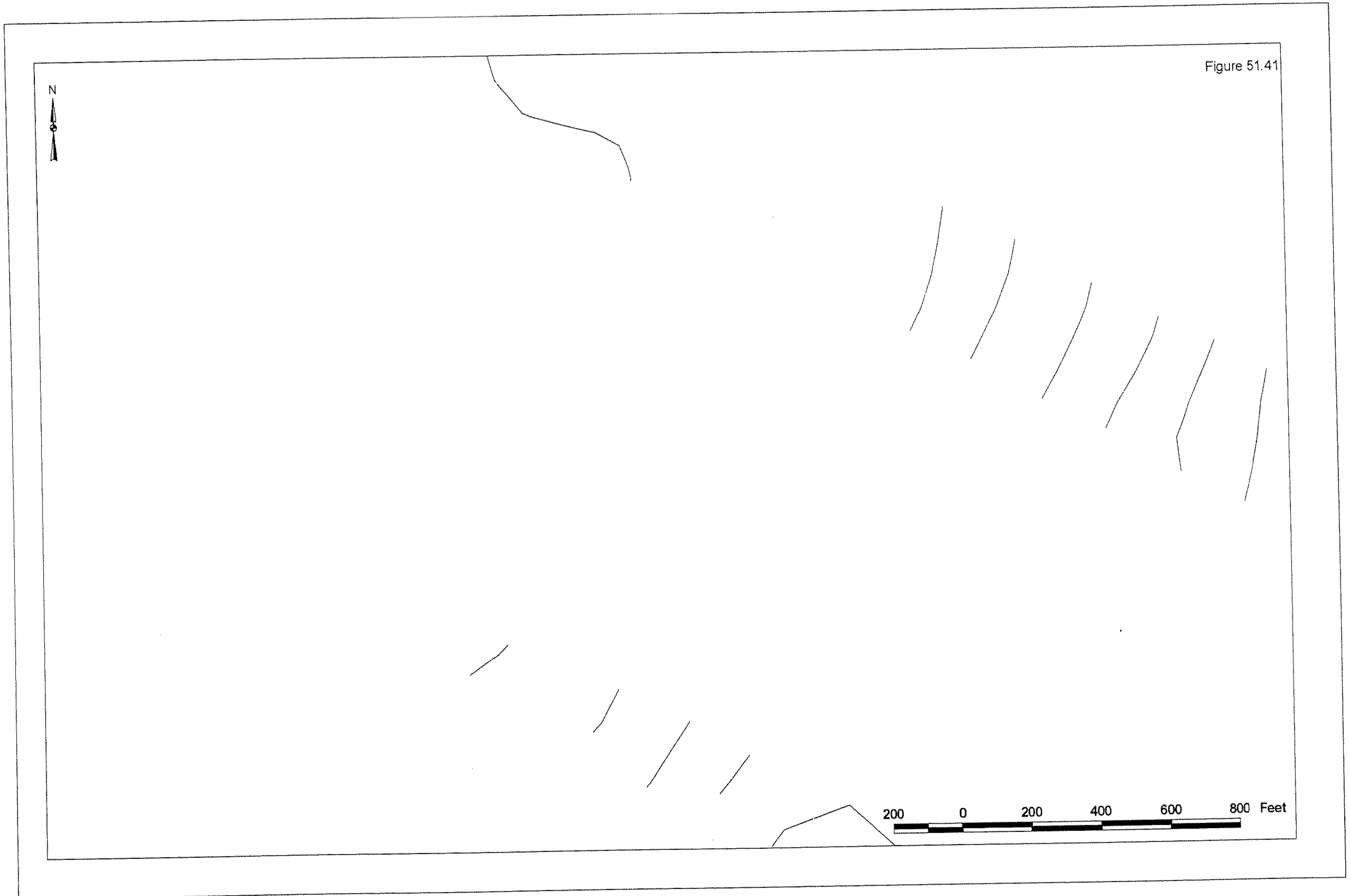

Figure 51.41. Magnetic contour map of the project area.

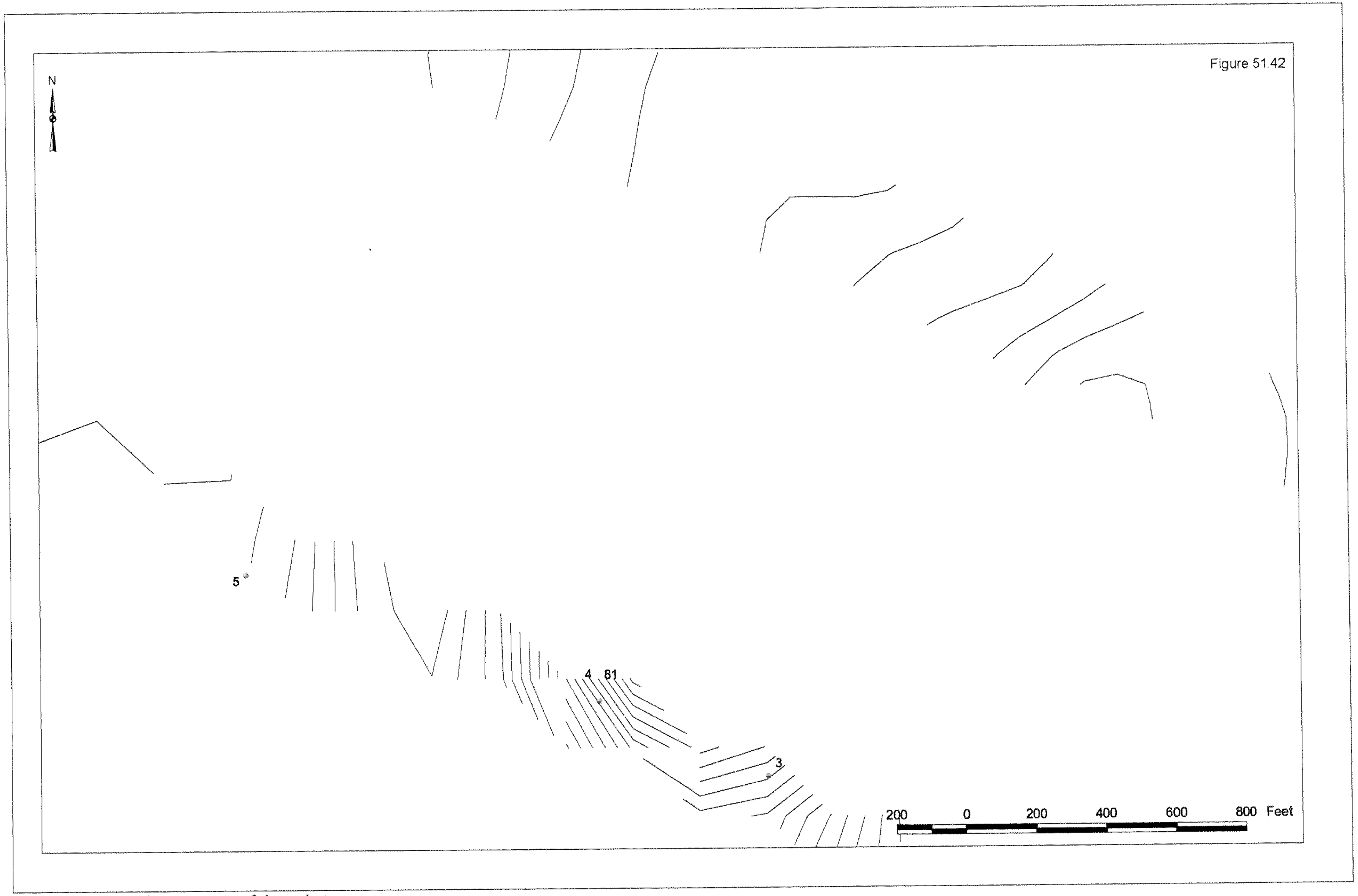

Figure 51.42. Magnetic contour map of the project area.

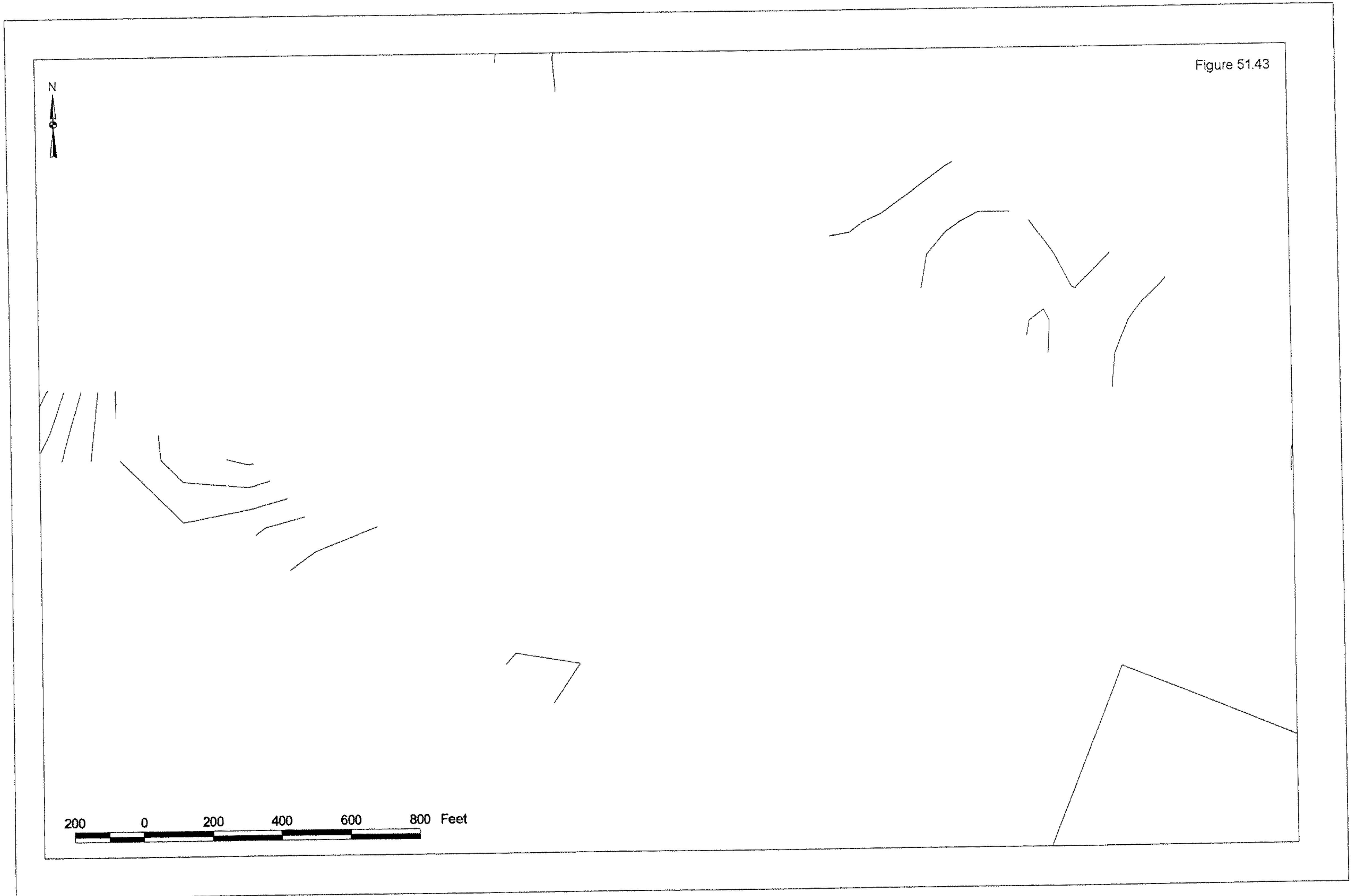

Figure 51.43. Magnetic contour map of the project area.

Figure 51.44. Magnetic contour map of the project area.

Figure 51.45. Magnetic contour map of the project area.

Table 6. Magnetic Anomalies Located in the Project Area.

Anomaly	Easting	Northing	+ gamma	- gamma	Total Strength	Duration (feet)	Description	Further Work	Assoc. SS
3	594579	672215	37	0	37	88	navigation buoy #16	no	
5	595312	674334	38	0	38	88	navigation buoy #18	no	
8	593971	670141	141	4417	4558	51	unknown	yes	
9	594123	670650	281	6890	7171	336	a wreck on the navigation chart	yes	
12	595299	673793	192	26	218	73	unknown	yes	
13	594844	672273	0	154	154	73	unknown	no	
15	595451	674065	104	87	191	175	unknown	yes	
16	593825	669994	large	large	large	long	navigation buoy #14	no	
17	593672	669681	45	21	66	204	unknown	no	
18	593493	669324	0	29	29	131	navigation buoy #12	no	
19	592350	666780	0	99	99	219	navigation buoy #10	no	
20	591637	665292	0	42	42	117	unknown	no	
23	589676	661020	0	2236	2236	292	navigation tower #4	no	
27	590746	663270	274	176	450	153	a wreck on the navigation chart	yes	27
28	590801	663541	7	41	48	88	navigation buoy #6	no	
31	590963	663779	22	10	32	131	unknown	no	
33	590574	662744	63	23	86	234	unknown	yes	
34	590108	661793	0	2531	2531	1285	a collapsed wharf with sheet pile	no	
36	593868	669637	large	large	large	long	bad data	no	
37	589923	660275	large	large	large	long	many small objects	no	
38	576476	657698	very large	very large	very large	long	sheet pilings	no	
39	576833	658171	25	0	25	102	a wreck on the navigation chart	yes	
40	577404	658850	very large	very large	very large	long	an iron barge and sheet piling	no	
41	578909	660160	very large	very large	very large	long	sheet piling	no	
42	580150	660739	very large	very large	very large	long	a park on the shore	no	
43	581591	660921	304	0	304	146	likely a sidescan target	yes	24
45	581994	660863	large	large	large	long	navigation buoy #20	no	
46	582338	660900	35	1606	1641	569	unknown	yes	
47	583243	660930	92	165	257	234	navigation tower #18	no	
44	584456	660984	0	987	987	701	unknown	no	
48	588527	661696	large	large	large	long	navigation buoy #3	no	
49	589176	662578	111	0	111	423	unknown	yes	
50	588844	662168	0	121	121	219	unknown	yes	
51	588710	662020	52	113	165	204	unknown	yes	
52	589250	662729	180	99	279	175	unknown	yes	
53	588931	662335	0	2514	2514	131	unknown	yes	
54	588762	662151	14	212	228	117	unknown	yes	
55	587691	660908	709	25	734	321	unknown	yes	
56	589402	662770	large	large	large	long	navigation buoy #5	no	
58	589898	664027	large	large	large	long	navigation buoy #7	no	
59	589660	663487	59	16	75	175	unknown	no	
61	589315	662875	120	60	180	146	trash	yes	
62	589479	663219	81	493	574	365	unknown	yes	
63	589695	663650	550	45	595	234	debris on bottom	yes	
64	593455	659908	70	16	86	394	a possible wreck on shore	yes	26
65	592788	659711	0	79	79	234	possible wreck	no	
66	592330	659584	large	large	large	long	navigation buoy #12	no	
67	591567	659476	very large	very large	very large	long	Bayonne Bridge	no	
68	590927	659287	large	large	large	long	a passing tug	no	
69	593934	659912	large	large	large	long	navigation buoy #10	no	
71	595208	659708	130	0	130	190	unknown	no	
72	595103	659724	65	0	65	146	unknown	no	
73	595314	659757	0	167	167	102	unknown	yes	
74	594738	659871	154	103	257	219	unknown	no	
75	594139	659937	274	226	500	482	Vessel	no	
78	594024	659984	515	230	745	482	Vessel	no	

Anomaly	Easting	Northing	+ gamma	- gamma	Total Strength	Duration (feet)	Description	Further Work	Assoc. SS
79	664105	598752	26	20	46	219	unknown	no	
80	663556	599252	40	0	40	292	unknown	no	
81	656762	601225	2043	25	2088	599	a wreck on the navigation chart	yes	4
82	644461	609689	0	129	129	730	a passing tanker	no	
83	646849	608449	88	29	117	540	unknown	no	
84	614254	658399	193	0	193	876	unknown	no	
85	618275	651117	323	137	460	511	unknown	yes	
86	618166	651567	112	108	220	292	unknown	yes	
87	619865	638155	96	0	96	161	unknown	no	
88	620165	636886	96	0	96	234	unknown	no	
89	625442	618401	68	45	113	248	navigation buoy #11	no	
90	627030	619684	0	47	47	131	navigation buoy #12	no	
91	622846	634086	0	351	351	336	navigation buoy #20	no	
92	597038	660135	0	291	291	657	several barges	no	
93	595513	659791	40	0	40	175	buried cable	no	
94	595984	658951	0	336	336	876	a sewage treatment plant	no	
95	599501	660220	very large	very large	very large	long	a passing barge	no	
96	598774	659815	0	79	79	380	unknown	no	
97	598891	660000	very large	very large	very large	long	a passing barge	no	
98	600132	660302	very large	very large	very large	long	several barges	no	
99	611407	660845	640	0	640	350	unknown	yes	
100	612240	660479	158	0	158	828	unknown	yes	
101	580587	660159	109	55	164	234	unknown, possibly wrecks	yes	
102	586138	660338	0	124	124	292	a pier and wreck on Shooters Is.	no	17
103	586016	660320	367	0	367	204	a wreck on chart	no	17
104	585780	660349	0	76	76	190	unknown	no	17
105	586494	660239	45	0	45	190	unknown	no	
106	604867	661547	large	large	large	long	navigation buoy #8	no	
110	616361	650135	206	0	206	511	an obstruction on nav. chart	yes	
111	616091	651143	165	0	165	423	a pipeline	no	
112	615498	653508	very large	very large	very large	long	a pipeline	no	
113	614448	657306	101	0	101	307	a pipeline	no	
114	615637	652831	very large	very large	very large	long	ship at anchor	no	
115	617114	647199	very large	very large	very large	long	a passing ship	no	
116	620806	642599	very large	very large	very large	long	an anchored ship	no	
117	582710	660222	130	0	130	80	in vicinity of known wrecks	no	
118	583036	660222	60	20	80	158	in vicinity of known wrecks	no	

ANOMALY 3

Anomaly 3 is located in Newark Bay (see Figure 51.08), and appeared across one trackline. It was located at 594579 East and 672215 North. It had a positive gamma value of 37 and a negative gamma value of zero, with a maximum gamma deflection of 37 and duration of 88 feet. The source of this anomaly is navigation buoy #16. It is not associated with a sidescan target. This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

ANOMALY 5

Anomaly 5 is located in Newark Bay (see Figure 51.09), and appeared across one trackline. It was located at 595312 East and 674334 North. It had a positive gamma value of 38 and a negative gamma value of zero, with a maximum gamma deflection of 38 and duration of 88 feet. The source of this anomaly is navigation buoy #18. It is not associated with a sidescan target.

This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

ANOMALY 8
Anomaly 8 is located in Newark Bay (see Figure 51.08), and appeared across three tracklines. It was located at 593971 East and 670141 North. It had a positive gamma value of 141 and a negative gamma value of 4417, with a maximum gamma deflection of 4558 and duration of 51 feet. The source of this anomaly is unknown. It is not associated with a sidescan target. This anomaly does meet the established criteria for the existence of a shipwreck and is recommended for further investigation.

ANOMALY 9
Anomaly 9 is located in Newark Bay (see Figure 51.08), and appeared across 5 tracklines. It was located at 594123 East and 670650 North. It had a positive gamma value of 281 and a negative gamma value of 6890, with a maximum gamma deflection of 7171 and duration of 336 feet. The source of this anomaly is a wreck on the navigation chart. It is not associated with a sidescan target. This anomaly meets the established criteria for the existence of a shipwreck and is recommended for further investigation.

ANOMALY 12
Anomaly 12 is located in Newark Bay (see Figure 51.09), and appeared across three tracklines. It was located at 595299 East and 673793 North. It had a positive gamma value of 192 and a negative gamma value of 26, with a maximum gamma deflection of 218 and duration of 73 feet. The anomaly's source is unknown; it is not associated with a sidescan target. This anomaly meets the criteria for the existence of a shipwreck and is recommended for further investigation.

ANOMALY 13
Anomaly 13 is located in Newark Bay (see Figure 51.08), and appeared across two tracklines. It was located at 594844 East and 672273 North. It had a positive gamma value of zero and a negative gamma value of 154, with a maximum gamma deflection of 154 and duration of 73 feet. The source of this anomaly is unknown. It is not associated with a sidescan target. This anomaly does not meet the criteria for shipwreck existence; it is not recommended for further study.

ANOMALY 15
Anomaly 15 is located in Newark Bay (see Figure 51.09), and appeared across two tracklines. It was located at 595451 East and 674065 North. It had a positive gamma value of 104 and a negative gamma value of 87, with a maximum gamma deflection of 191 and duration of 175 feet. The source of this anomaly is unknown. It is not associated with a sidescan target. This anomaly does meet the established criteria for the existence of a shipwreck and is recommended for further investigation.

ANOMALY 16
Anomaly 16 is located in Newark Bay (see Figure 51.08), and appeared across one trackline. It was located at 593825 East and 669994 North. It had a large positive and negative gamma value, with a large maximum gamma deflection and duration of many feet. The source of this anomaly is navigation buoy #14. It is not associated with a sidescan target. This anomaly does not meet the criteria for the existence of a shipwreck and is not recommended for further investigation.

ANOMALY 17
Anomaly 17 is located in Newark Bay (see Figure 51.07), and appeared across one trackline. It was located at 593672 East and 669681 North. It had a positive gamma value of 45 and a negative gamma value of 21, with a maximum gamma deflection of 66 and duration of 204 feet. The source of this anomaly is unknown. It is not associated with a sidescan target This anomaly does not meet the criteria for shipwreck existence; it is not recommended for further study.

Anomaly 18
Anomaly 18 is located in Newark Bay (see Figure 51.07), and appeared across one trackline. It was located at 593493 East and 669324 North. It had a positive gamma value of zero and a negative gamma value of 29, with a maximum gamma deflection of 29 and duration of 131 feet. The source of this anomaly is navigation buoy #12. It is not associated with a sidescan target. This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

Anomaly 19
Anomaly 19 is located in Newark Bay (see Figure 51.06), and appeared across three tracklines. It was located at 592350 East and 666780 North. It had a positive gamma value of zero and a negative gamma value of 99, with a maximum gamma deflection of 99 and duration of 219 feet. The source of this anomaly is navigation buoy #10. It is not associated with a sidescan target. This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

Anomaly 20
Anomaly 20 is located in Newark Bay (see Figure 51.06), and appeared across one trackline. It was located at 591637 East and 665292 North. It had a positive gamma value of zero and a negative gamma value of 42, with a maximum gamma deflection of 42 and duration of 117 feet. The source of this anomaly is unknown. It is not associated with a sidescan target. This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

Anomaly 23
Anomaly 23 is located in Newark Bay (see Figure 51.04), and appeared across three tracklines. It was located at 589676 East and 661020 North. It had a positive gamma value of zero and a negative gamma value of 2236, with a maximum gamma deflection of 2236 and duration of 292 feet. The source of this anomaly is navigation tower #4. It is not associated with a sidescan target. This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

Anomaly 27
Anomaly 27 is located in Newark Bay (see Figure 51.05), and appeared across three tracklines. It was located at 590746 East and 663270 North. It had a positive gamma value of 274 and a negative gamma value of 176, with a maximum gamma deflection of 450 and duration of 153 feet. The source of this anomaly is a wreck on the navigation chart, but may also be related to the Central Railroad Bridge that used to exist across Newark Bay in this vicinity (Figure 52). It is associated with a sidescan target (#27). This anomaly meets the established criteria for the existence of a shipwreck and is recommended for further investigation.

Anomaly 28
Anomaly 28 is located in Newark Bay (see Figure 51.05), and appeared across one trackline. It was located at 590801 East and 663541 North. It had a positive gamma value of seven and a negative gamma value of 41, with a maximum gamma deflection of 48 and duration of 88 feet. The source of this anomaly is navigation buoy #6. It is not associated with a sidescan target. This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

Anomaly 31
Anomaly 31 is located in Newark Bay (see Figure 51.05), and appeared across one trackline. It was located at 590963 East and 663779 North. It had a positive gamma value of 22 and a negative gamma value of 10, with a maximum gamma deflection of 32 and duration of 131 feet. The source of this anomaly is unknown, but may be related to the Central Railroad Bridge that

used to exist across Newark Bay in this vicinity (see Figure 52). It is not associated with a sidescan target. This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

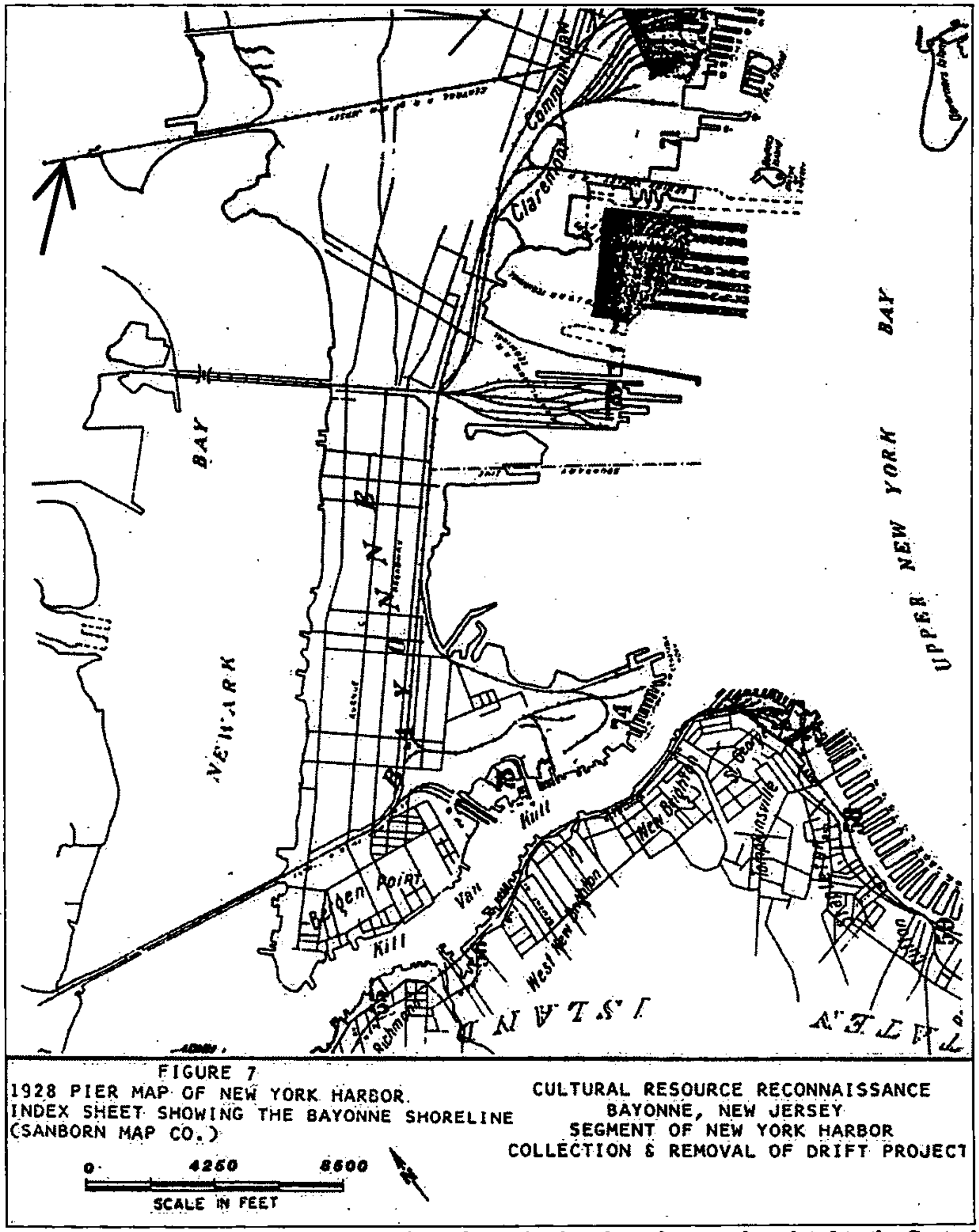

Figure 52. Location of Anomaly 27, a wreck on the navigation chart that may be related to the Central Railroad Bridge (note arrow) that used to exist across Newark Bay (as presented in Kardas and Larrabee 1985:33 [Volume I]).

ANOMALY 33

Anomaly 33 is located in Newark Bay (see Figure 51.05), and appeared across two tracklines. It was located at 590574 East and 662744 North. It had a positive gamma value of 63 and a negative gamma value of 23, with a maximum gamma deflection of 86 and duration of 234 feet. The source of this anomaly is unknown. It is not associated with a sidescan target. This anomaly meets the criteria for the existence of a shipwreck and is recommended for further investigation.

ANOMALY 34

Anomaly 34 is located in Newark Bay (see Figure 51.04), and appeared across three tracklines. It was located at 590108 East and 661793 North. It had a positive gamma value of zero and a negative gamma value of 2531, with a maximum gamma deflection of 2531 and duration of 1285 feet. The source of this anomaly is a collapsed wharf with sheet pile. It is not associated with a sidescan target. This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

ANOMALY 36

Anomaly 36 is located in Newark Bay (see Figure 51.07), and appeared across one trackline. It was located at 593868 East and 669637 North. It had a positive gamma value of zero and a negative gamma value of zero, with a maximum gamma deflection of zero and duration of zero feet. The source of this anomaly is bad data. It is not associated with a sidescan target. This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

ANOMALY 37

Anomaly 37 is located at the intersection of Kill Van Kull and Newark Bay (see Figure 51.04), and appeared across 13 tracklines. It was located at 589923 East and 660275 North. It had a large positive and negative gamma value, with a large maximum gamma deflection and duration of many feet. The source of this anomaly is many small objects. It is not associated with a sidescan target. This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

ANOMALY 38

Anomaly 38 is located in Arthur Kill (see Figure 51.01), and appeared across one trackline. It was located at 576476 East and 657698 North. It had a large positive and negative gamma value, with a large maximum gamma deflection and duration of many feet. The source of this anomaly is sheet pilings. It is not associated with a sidescan target. This anomaly does not meet the criteria for the existence of a shipwreck and is not recommended for further investigation.

ANOMALY 39

Anomaly 39 is located in Arthur Kill (see Figure 51.01), and appeared across one trackline. It was located at 576833 East and 658171 North. It had a positive gamma value of 25 and a negative gamma value of zero, with a maximum gamma deflection of 25 and duration of 102 feet. The source of this anomaly is a wreck on the navigation chart. It is not associated with a sidescan target. This anomaly meets the established criteria for the existence of a shipwreck and is recommended for further investigation.

ANOMALY 40

Anomaly 40 is located in Arthur Kill (see Figure 51.01), and appeared across one trackline. It was located at 577404 East and 658850 North. It had a large positive and negative gamma value, with a large maximum gamma deflection and duration of many feet. The source of this anomaly is an iron barge and sheet piling. It is not associated with a sidescan target. This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

ANOMALY 41
Anomaly 41 is located in Arthur Kill (see Figure 51.01), and appeared across one trackline. It was located at 578909 East and 660160 North. It had a large positive and negative gamma value, with a large maximum gamma deflection and duration of many feet. The source of this anomaly is sheet piling. It is not associated with a sidescan target. This anomaly does not meet the criteria for the existence of a shipwreck and is not recommended for further investigation.

ANOMALY 42
Anomaly 42 is located in Arthur Kill (see Figure 51.02), and appeared across two tracklines. It was located at 580150 East and 660739 North. It had a large positive and negative gamma value, with a large maximum gamma deflection and duration of many feet. The source of this anomaly is a park on the shore. It is not associated with a sidescan target. This anomaly does not meet the criteria for the existence of a shipwreck and is not recommended for further investigation.

ANOMALY 43
Anomaly 43 is located in Arthur Kill (see Figure 51.02), and appeared across two tracklines. It was located at 581591 East and 660921 North. It had a positive gamma value of 304 and a negative gamma value of zero, with a maximum gamma deflection of 304 and duration of 146 feet. The source of this anomaly is likely a sidescan target. It is associated with a sidescan target (#24). This anomaly meets the established criteria for the existence of a shipwreck and is recommended for further investigation.

ANOMALY 44
Anomaly 44 is located in Arthur Kill (see Figure 51.03), and appeared across one trackline. It was located at 584456 East and 660984 North. It had a positive gamma value of zero and a negative gamma value of 987, with a maximum gamma deflection of 987 and duration of 701 feet. The source of this anomaly is likely the remains of three wooden tugs identified and recorded by James (1987) (Figure 53). It is not associated with a sidescan target. This anomaly meets the established criteria for the existence of a shipwreck but is not recommended for further investigation, as the wrecks have already been recorded.

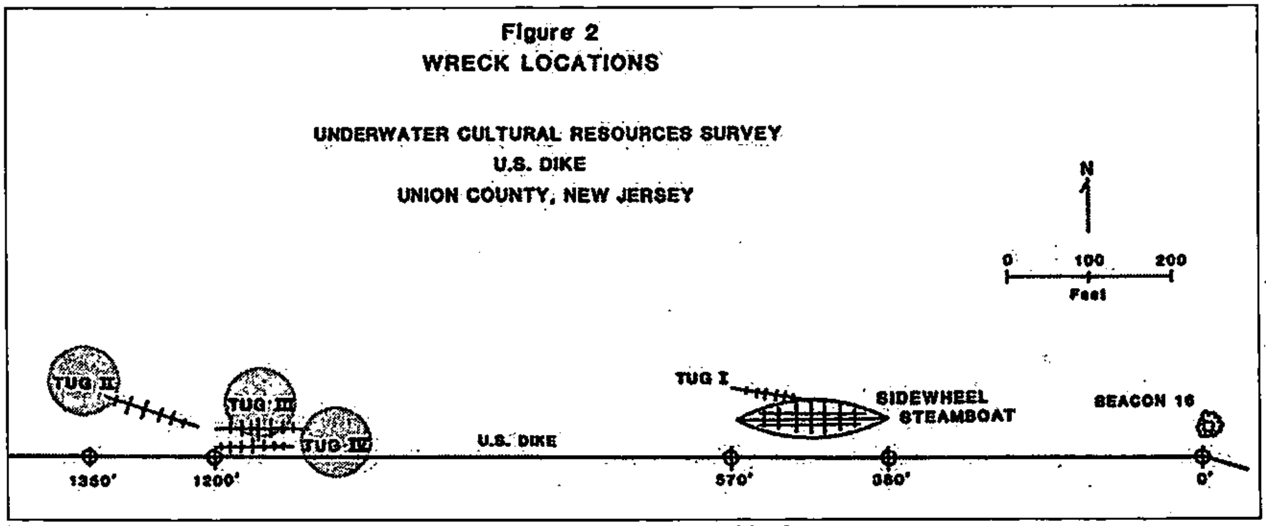

Figure 53. Diagram of three wooden tugs discovered by James (1987:8).

ANOMALY 45
Anomaly 45 is located in Arthur Kill (see Figure 51.02), and appeared across one trackline. It was located at 581994 East and 660863 North. It had a large positive and negative gamma value, with a large maximum gamma deflection and duration of many feet. The source of this anomaly

is navigation buoy #20. It is not associated with a sidescan target. This anomaly does not meet the criteria for the existence of a shipwreck and is not recommended for further investigation.

ANOMALY 46
Anomaly 46 is located in Arthur Kill (see Figure 51.02), and appeared across one trackline. It was located at 582338 East and 660900 North. It had a positive gamma value of 35 and a negative gamma value of 1606, with a maximum gamma deflection of 1641 and duration of 569 feet. The source of this anomaly is unknown. It is not associated with a sidescan target. This anomaly meets the established criteria for the existence of a shipwreck and is recommended for further investigation.

ANOMALY 47
Anomaly 47 is located in Arthur Kill (see Figure 51.02), and appeared across one trackline. It was located at 583243 East and 660930 North. It had a positive gamma value of 92 and a negative gamma value of 165, with a maximum gamma deflection of 257 and duration of 234 feet. The source of this anomaly is navigation tower #18. It is not associated with a sidescan target. This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

ANOMALY 48
Anomaly 48 is located in Newark Bay (see Figure 51.05), and appeared across one trackline. It was located at 588527 East and 661696 North. It had a large positive and negative gamma value, with a large maximum gamma deflection and duration of many feet. The source of this anomaly is navigation buoy #3. It is not associated with a sidescan target. This anomaly does not meet the criteria for the existence of a shipwreck and is not recommended for further investigation.

ANOMALY 49
Anomaly 49 is located in Newark Bay (see Figure 51.05), and appeared across two tracklines. It was located at 589176 East and 662578 North. It had a positive gamma value of 111 and a negative gamma value of zero, with a maximum gamma deflection of 111 and duration of 423 feet. The source of this anomaly is unknown. It is not associated with a sidescan target. This anomaly meets the established criteria for the existence of a shipwreck and is recommended for further investigation.

ANOMALY 50
Anomaly 50 is located in Newark Bay (see Figure 51.05), and appeared across one trackline. It was located at 588844 East and 662168 North. It had a positive gamma value of zero and a negative gamma value of 121, with a maximum gamma deflection of 121 and duration of 219 feet. The source of this anomaly is unknown. It is not associated with a sidescan target. This anomaly meets the criteria for shipwreck existence and is recommended for further investigation.

ANOMALY 51
Anomaly 51 is located in Newark Bay (see Figure 51.05), and appeared across three tracklines. It was located at 588710 East and 662020 North. It had a positive gamma value of 52 and a negative gamma value of 113, with a maximum gamma deflection of 165 and duration of 204 feet. The source of this anomaly is unknown. It is not associated with a sidescan target. This anomaly meets the criteria for shipwreck existence and is recommended for further investigation.

ANOMALY 52
Anomaly 52 is located in Newark Bay (see Figure 51.05), and appeared across one trackline. It was located at 589250 East and 662729 North. It had a positive gamma value of 180 and a negative gamma value of 99, with a maximum gamma deflection of 279 and duration of 175 feet. The source of this anomaly is unknown. It is not associated with a sidescan target. This anomaly meets the criteria for the existence of a shipwreck and is recommended for further investigation.

ANOMALY 53
Anomaly 53 is located in Newark Bay (see Figure 51.05), and appeared across two tracklines. It was located at 588931 East and 662335 North. It had a positive gamma value of zero and a negative gamma value of 2514, with a maximum gamma deflection of 2514 and duration of 131 feet. The source of this anomaly is unknown. It is not associated with a sidescan target. This anomaly meets the established criteria for the existence of a shipwreck and is recommended for further investigation.

ANOMALY 54
Anomaly 54 is located in Newark Bay (see Figure 51.05), and appeared across two tracklines. It was located at 588762 East and 662151 North. It had a positive gamma value of 14 and a negative gamma value of 212, with a maximum gamma deflection of 228 and duration of 117 feet. The source of this anomaly is unknown. It is not associated with a sidescan target. This anomaly meets the established criteria for the existence of a shipwreck and is recommended for further investigation.

ANOMALY 55
Anomaly 55 is located in Newark Bay (see Figure 51.03), and appeared across one trackline. It was located at 587691 East and 660908 North. It had a positive gamma value of 709 and a negative gamma value of 25, with a maximum gamma deflection of 734 and duration of 321 feet. The source of this anomaly is unknown, but it is located in the vicinity of two wrecks marked on the navigation chart. It is not associated with a sidescan target. This anomaly meets the criteria for the existence of a shipwreck and is recommended for further investigation.

ANOMALY 56
Anomaly 56 is located in Newark Bay (see Figure 51.05), and appeared across one trackline. It was located at 589402 East and 662770 North. It had a large positive and negative gamma value, with a large maximum gamma deflection and duration of many feet. The source of this anomaly is navigation buoy #5. It is not associated with a sidescan target. This anomaly does not meet the criteria for the existence of a shipwreck and is not recommended for further investigation.

ANOMALY 58
Anomaly 58 is located in Newark Bay (see Figure 51.06), and appeared across one trackline. It was located at 589898 East and 664027 North. It had a small positive and negative gamma value, with a small maximum gamma deflection and duration of few feet. The source of this anomaly is navigation buoy #7. It is not associated with a sidescan target. This anomaly does not meet the criteria for the existence of a shipwreck and is not recommended for further investigation.

ANOMALY 59
Anomaly 59 is located in Newark Bay (see Figure 51.05), and appeared across two tracklines. It was located at 589660 East and 663487 North. It had a positive gamma value of 59 and a negative gamma value of 16, with a maximum gamma deflection of 75 and duration of 175 feet. The source of this anomaly is unknown. It is not associated with a sidescan target. This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

ANOMALY 61
Anomaly 61 is located in Newark Bay (see Figure 51.05), and appeared across two tracklines. It was located at 589315 East and 662875 North. It had a positive gamma value of 120 and a negative gamma value of 60, with a maximum gamma deflection of 180 and duration of 146 feet. The source of this anomaly is unknown. It is not associated with a sidescan target. This anomaly meets the criteria for the existence of a shipwreck and is recommended for further investigation.

Anomaly 62

Anomaly 62 is located in Newark Bay (see Figure 51.05), and appeared across three tracklines. It was located at 589479 East and 663219 North. It had a positive gamma value of 81 and a negative gamma value of 493, with a maximum gamma deflection of 574 and duration of 365 feet. The source of this anomaly is unknown. It is not associated with a sidescan target. This anomaly meets the established criteria for the existence of a shipwreck and is recommended for further investigation.

Anomaly 63

Anomaly 63 is located in Newark Bay (see Figure 51.05), and appeared across two tracklines. It was located at 589695 East and 663650 North. It had a positive gamma value of 550 and a negative gamma value of 45, with a maximum gamma deflection of 595 and duration of 234 feet. The source of this anomaly is debris on bottom. It is not associated with a sidescan target. This anomaly meets the established criteria for the existence of a shipwreck and is recommended for further investigation.

Anomaly 64

Anomaly 64 is located in Kill Van Kull (see Figure 51.10), and appeared across one trackline. It was located at 593455 East and 659908 North. It had a positive gamma value of 70 and a negative gamma value of 16, with a maximum gamma deflection of 86 and duration of 394 feet. It is associated with a sidescan target (#26). The source of this anomaly is most likely two vessels, referred to as vessels V27b or V28 in Kardas and Larrabee (1985) (Figure 54) and vessel V36 or V37 in Raber (1996d) (Figure 55). Kardas and Larrabee classified them as wooden cargo ships, and recommend no further work, but Raber (1996d:99) classified vessel V36 as an as-built schooner barge, a type for which little documentation exists, and recommended mitigation. The current study concurs with the evaluation of Raber and recommends this anomaly for further investigation.

Anomaly 65

Anomaly 65 is located in Kill Van Kull (see Figure 51.10), and appeared across one trackline. It was located at 592788 East and 659711 North. It had a positive gamma value of zero and a negative gamma value of 79, with a maximum gamma deflection of 79 and duration of 234 feet. It is not associated with a sidescan target. The source of this anomaly is probably vessel V24 or structure S53 from Raber (1996d), who identified V24 as a metal-hulled steamboat, placed by the Henry Steers, Inc. dredging company in 1910-1920 as a breakwater, and S53 as a timber pier, placed by Henry Steers, Inc. around 1925. The vessel and structure were determined to be non-significant by Raber (1996). The source of this anomaly lies outside the project area, and as such is not recommended for further investigation.

Anomaly 66

Anomaly 66 is located in Kill Van Kull (see Figure 51.04), and appeared across two tracklines. It was located at 592330 East and 659584 North. It had a large positive and negative gamma value, with a large maximum gamma deflection and duration of many feet. The source of this anomaly is navigation bouy #12. It is not associated with a sidescan target. This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

Anomaly 67

Anomaly 67 is located in Kill Van Kull (see Figure 51.04), and appeared across two tracklines. It was located at 591567 East and 659476 North. It had a very large positive and negative gamma value, with a very large maximum gamma deflection and duration of many feet. The source of this anomaly is Bayonne Bridge. It is not associated with a sidescan target. This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

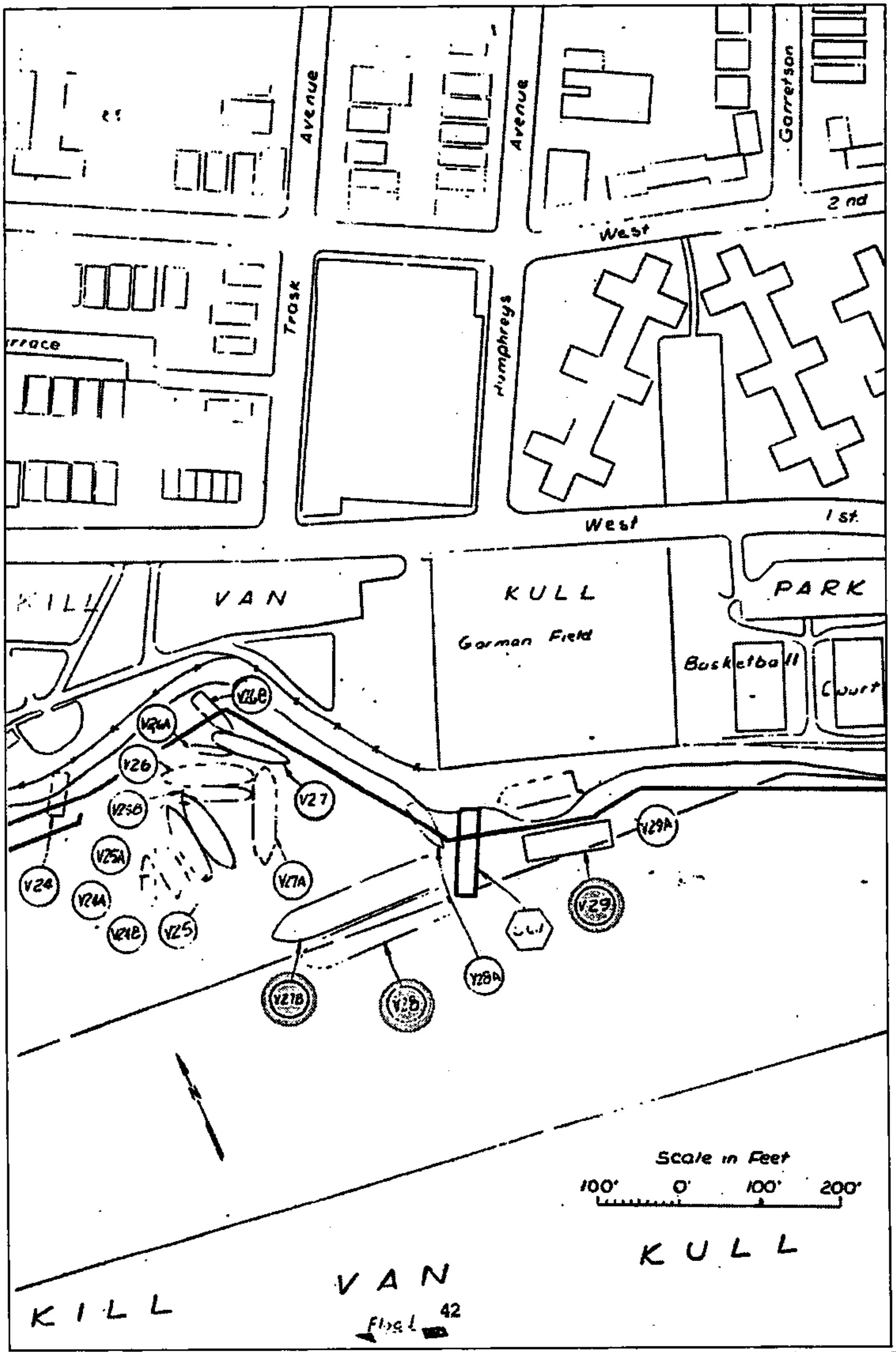

Figure 54. Map showing location of vessels V27b and V28 as presented in Kardas and Larrabee (1985:Volume II).

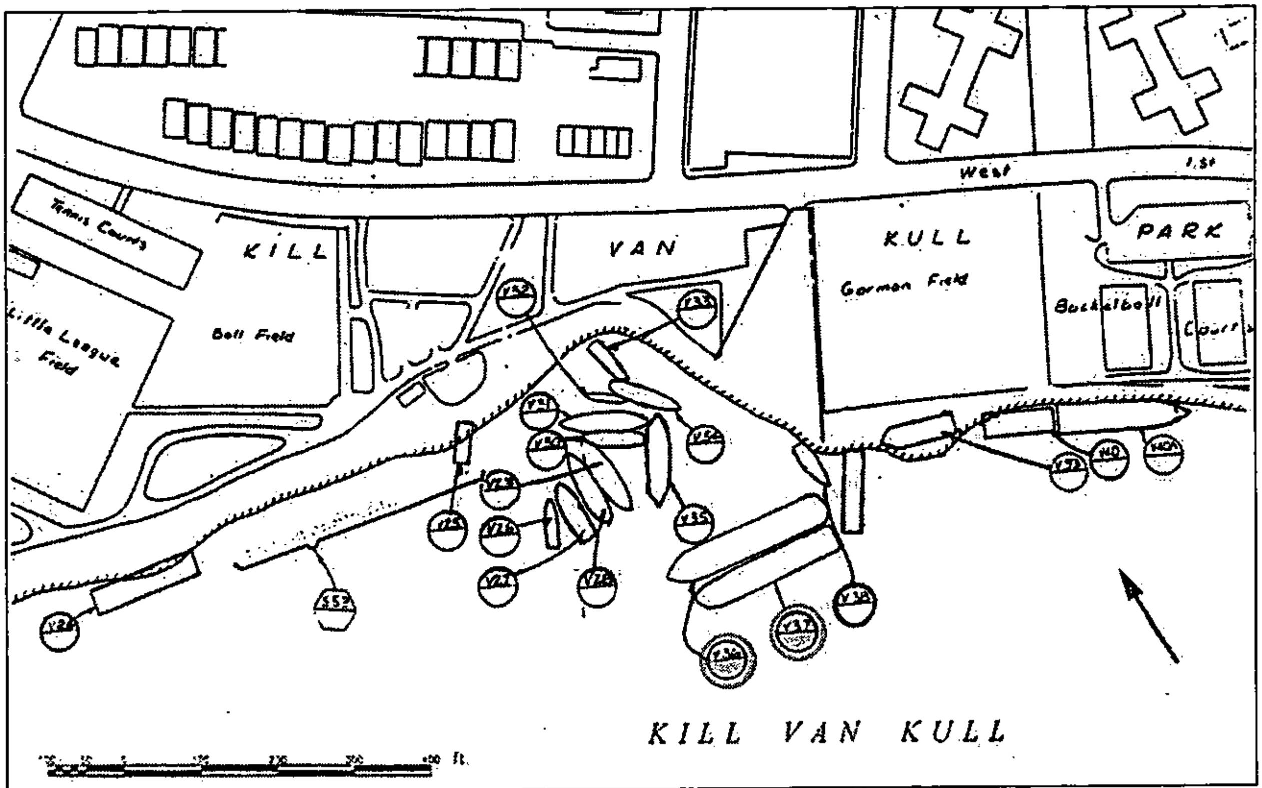

Figure 55. Map showing location of vessels V36 and V37 (as presented in Raber 1996d:17).

ANOMALY 68
Anomaly 68 is located in Kill Van Kull (see Figure 51.04), and appeared across two tracklines. It was located at 590927 East and 659287 North. It had a large positive and negative gamma value, with a large maximum gamma deflection and duration of many feet. The source of this anomaly is a passing tug. It is not associated with a sidescan target. This anomaly does not meet the criteria for the existence of a shipwreck and is not recommended for further investigation.

ANOMALY 69
Anomaly 69 is located in Kill Van Kull (see Figure 51.10), and appeared across one trackline. It was located at 593934 East and 659912 North. It had a large positive and negative gamma value, with a large maximum gamma deflection and duration of many feet. The source of this anomaly is navigation buoy #10. It is not associated with a sidescan target. This anomaly does not meet the criteria for the existence of a shipwreck and is not recommended for further investigation.

ANOMALY 71
Anomaly 71 is located in Kill Van Kull (see Figure 51.10), and appeared across one trackline. It was located at 595208 East and 659708 North. It had a positive gamma value of 130 and a negative gamma value of zero, with a maximum gamma deflection of 130 and duration of 190 feet. Its source is unknown. It is not associated with a sidescan target. This anomaly does not meet the criteria for shipwreck existence; it is not recommended for further study.

ANOMALY 72
Anomaly 72 is located in Kill Van Kull (see Figure 51.10), and appeared across one trackline. It was located at 595103 East and 659724 North. It had a positive gamma value of 65 and a negative gamma value of zero, with a maximum gamma deflection of 65 and duration of 146 feet. Its source is unknown. It is not associated with a sidescan target. This anomaly does not meet the criteria for shipwreck existence; it is not recommended for further study.

ANOMALY 73

Anomaly 73 is located in Kill Van Kull (see Figure 51.10), and appeared across two tracklines. It was located at 595314 East and 659757 North. It had a positive gamma value of zero and a negative gamma value of 167, with a maximum gamma deflection of 167 and duration of 102 feet. The source of this anomaly is unknown. It is not associated with a sidescan target. This anomaly meets the established criteria for the existence of a shipwreck and is recommended for further investigation.

ANOMALY 74

Anomaly 74 is located in Kill Van Kull (see Figure 51.10), and appeared across three tracklines. It was located at 594738 East and 659871 North. It had a positive gamma value of 154 and a negative gamma value of 103, with a maximum gamma deflection of 257 and duration of 219 feet. The source of this anomaly is unknown, but its source is likely located outside the project area. It is not associated with a sidescan target. This anomaly meets the criteria for the existence of a shipwreck, but is not recommended for further investigation as it is outside the project area.

ANOMALY 75

Anomaly 75 is located in Kill Van Kull (see Figure 51.10), and appeared across two tracklines. It was located at 594139 East and 659937 North. It had a positive gamma value of 274 and a negative gamma value of 226, with a maximum gamma deflection of 500 and duration of 482 feet. It is not associated with a sidescan target. The source of this anomaly is unknown, but is probably vessel V40, tentatively identified as a wooden canal boat (Raber 1996d) (Figure 56) and vessel V29, identified as a barge (Kardas and Larrabee 1985) (Figure 57). Neither vessel was recommended for futher investigation. This anomaly meets the criteria for the existence of a shipwreck. However, it is located outside the project area and so is not recommended for further investigation.

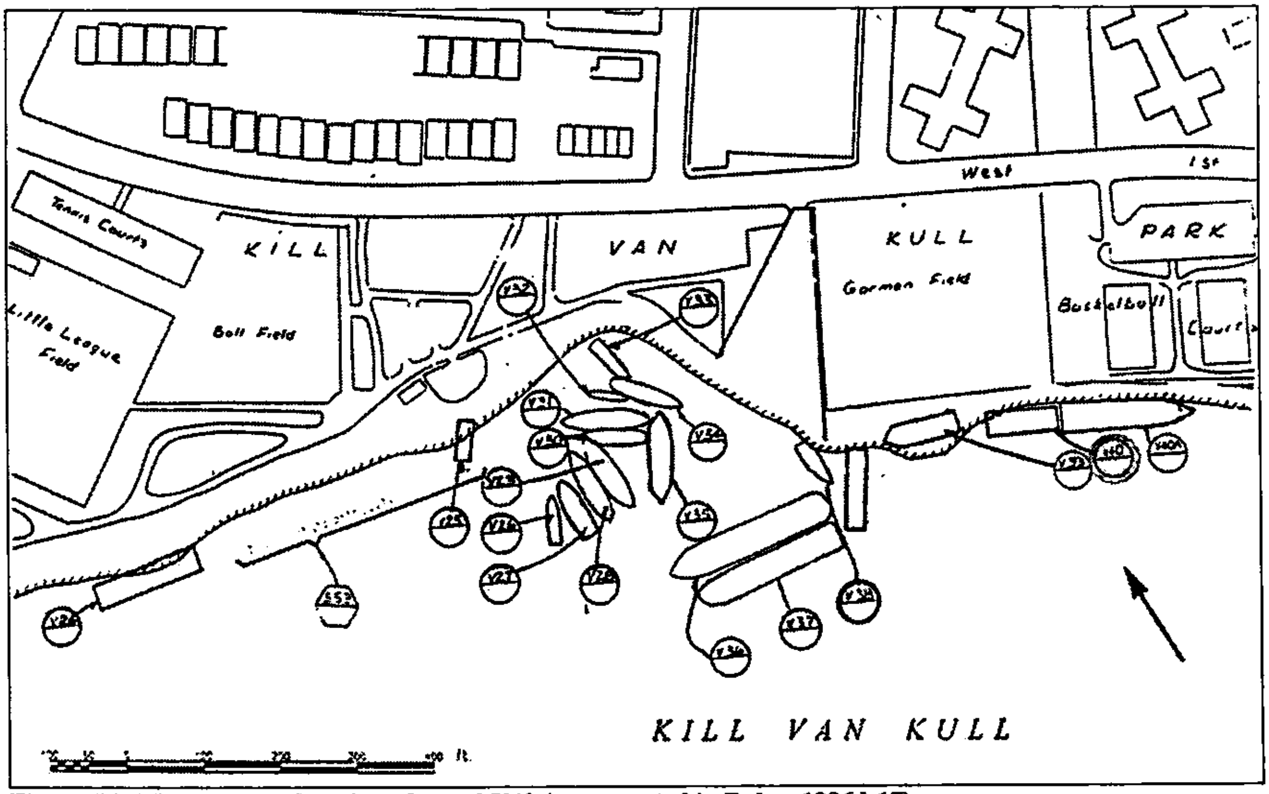

Figure 56. Map showing location of vessel V40 (as presented in Raber 1996d:17).

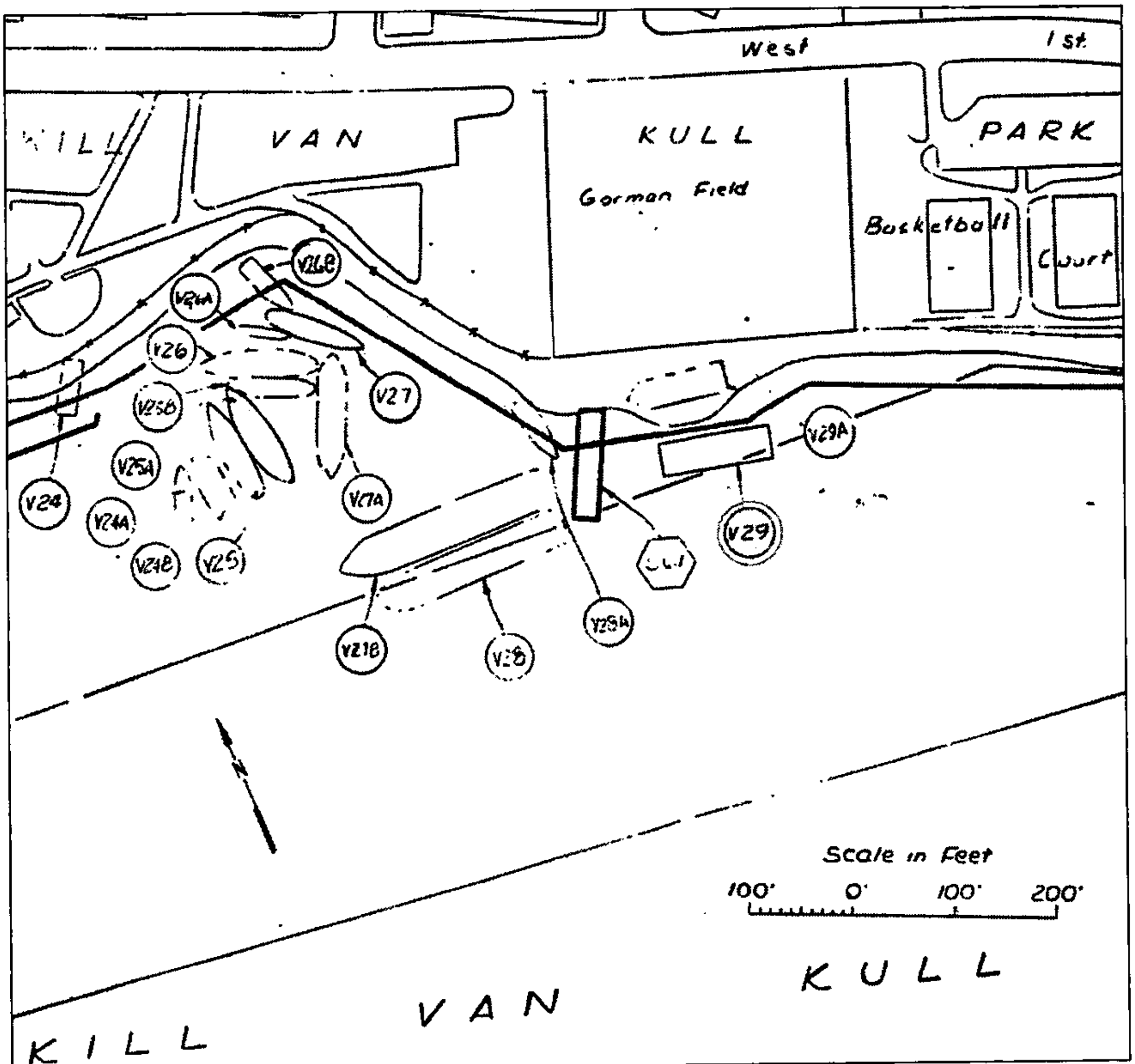

Figure 57. Map showing location of vessel V29 as presented in Kardas and Larrabee (1985:Volume II).

ANOMALY 78
Anomaly 78 is located in Kill Van Kull (see Figure 51.10), and appeared across two tracklines. It was located at 594024 East and 659984 North. It had a positive gamma value of 515 and a negative gamma value of 230, with a maximum gamma deflection of 745 and duration of 482 feet. It is not associated with a sidescan target. The source of this anomaly is unknown, but it is probably vessel V40a, located by Raber (1996d) (Figure 58). The vessel was not identified by Raber. This anomaly meets the established criteria for the existence of a shipwreck. However, the wreckage lies outside the project area, and so it is not recommended for further investigation.

ANOMALY 79
Anomaly 79 is located at the east end of Ambrose Channel (see Figure 51.45), and appeared across three tracklines. It was located at 664105 East and 598752 North. It had a positive gamma value of 26 and a negative gamma value of 20, with a maximum gamma deflection of 46 and duration of 219 feet. Its source is unknown. It is not associated with a sidescan target. This

anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

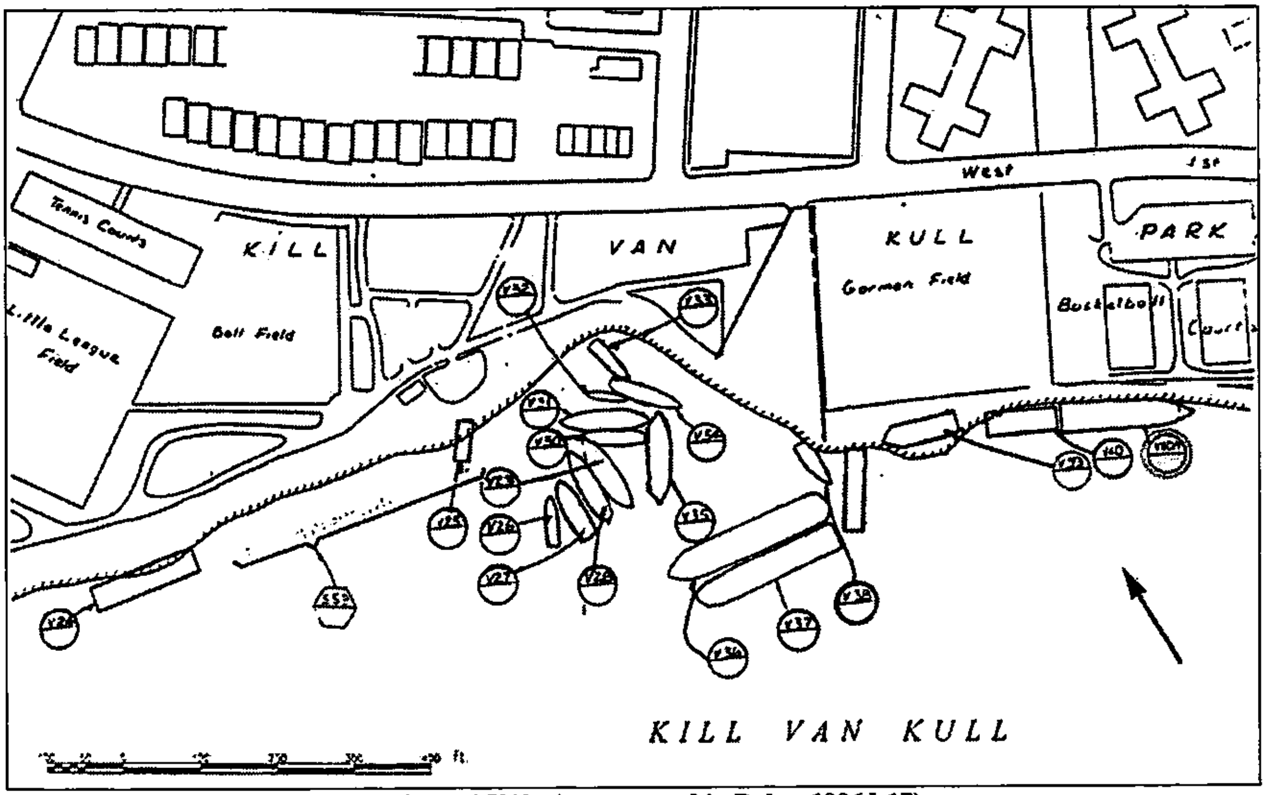

Figure 58. Map showing location of vessel V40a (as presented in Raber 1996d:17).

ANOMALY 80

Anomaly 80 is located at the east end of Ambrose Channel (see Figure 51.45), and appeared across two tracklines. It was located at 663556 East and 599252 North. It had a positive gamma value of 40 and a negative gamma value of zero, with a maximum gamma deflection of 40 and duration of 292 feet. The source of this anomaly is unknown. It is not associated with a sidescan target. This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

ANOMALY 81

Anomaly 81 is located in Ambrose Channel (see Figure 51.42), and appeared across three tracklines. It was located at 656762 East and 601225 North. It had a positive gamma value of 2043 and a negative gamma value of 25, with a maximum gamma deflection of 2088 and duration of 599 feet. The source of this anomaly is a wreck on chart. It is not associated with a sidescan target. This anomaly meets the established criteria for the existence of a shipwreck and is recommended for further investigation.

ANOMALY 82

Anomaly 82 is located in Ambrose Channel (see Figure 51.34), and appeared across one trackline. It was located at 644461 East and 609689 North. It had a positive gamma value of zero and a negative gamma value of 129, with a maximum gamma deflection of 129 and duration of 730 feet. The source of this anomaly is a passing tanker. It is not associated with a sidescan target. This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

Anomaly 83

Anomaly 83 is located in Ambrose Channel (see Figure 51.38), and appeared across one trackline. It was located at 646849 East and 608449 North. It had a positive gamma value of 88 and a negative gamma value of 29, with a maximum gamma deflection of 117 and duration of 540 feet. The source of this anomaly is unknown. It is not associated with a sidescan target. This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

Anomaly 84

Anomaly 84 is located in Anchorage Channel (see Figure 51.16), and appeared across three tracklines. It was located at 614254 East and 658399 North. It had a positive gamma value of 193 and a negative gamma value of zero, with a maximum gamma deflection of 193 and duration of 876 feet. The source of this anomaly is unknown. It is not associated with a sidescan target. This anomaly meets the established criteria for the existence of a shipwreck but is not recommended for further investigation.

Anomaly 85

Anomaly 85 is located in Anchorage Channel (see Figure 51.19), and appeared across three tracklines. It was located at 618275 East and 651117 North. It had a positive gamma value of 323 and a negative gamma value of 137, with a maximum gamma deflection of 460 and duration of 511 feet. The source of this anomaly is unknown. It is not associated with a sidescan target. This anomaly does meet the established criteria for the existence of a shipwreck and is recommended for further investigation.

Anomaly 86

Anomaly 86 is located in Anchorage Channel (see Figure 51.19), and appeared across three tracklines. It was located at 618166 East and 651567 North. It had a positive gamma value of 112 and a negative gamma value of 108, with a maximum gamma deflection of 220 and duration of 292 feet. Its source is unknown. It is not associated with a sidescan target. This anomaly meets the criteria for the existence of a shipwreck and is recommended for further investigation.

Anomaly 87

Anomaly 87 is located in Ambrose Channel (see Figure 51.23), and appeared across one trackline. It was located at 619865 East and 638155 North. It had a positive gamma value of 96 and a negative gamma value of zero, with a maximum gamma deflection of 96 and duration of 161 feet. The source of this anomaly is unknown. It is not associated with a sidescan target. This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

Anomaly 88

Anomaly 88 is located in Ambrose Channel (see Figure 51.24), and appeared across one trackline. It was located at 620165 East and 636886 North. It had a positive gamma value of 96 and a negative gamma value of zero, with a maximum gamma deflection of 96 and duration of 234 feet. The source of this anomaly is unknown. It is not associated with a sidescan target. This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

Anomaly 89

Anomaly 89 is located in Ambrose Channel (see Figure 51.30), and appeared across one trackline. It was located at 625442 East and 618401 North. It had a positive gamma value of 68 and a negative gamma value of 45, with a maximum gamma deflection of 113 and duration of 248 feet. Its source is navigation buoy #11. It is not associated with a sidescan target. This anomaly does not meet the criteria for shipwreck existence; it is not recommended for further investigation.

Anomaly 90

Anomaly 90 is located in Ambrose Channel (see Figure 51.30), and appeared across one trackline. It was located at 627030 East and 619684 North. It had a positive gamma value of zero and a negative gamma value of 47, with a maximum gamma deflection of 47 and duration of 131 feet. The source of this anomaly is navigation buoy #12. It is not associated with a sidescan target. This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

Anomaly 91

Anomaly 91 is located in Ambrose Channel (see Figure 51.25), and appeared across one trackline. It was located at 622846 East and 634086 North. It had a positive gamma value of zero and a negative gamma value of 351, with a maximum gamma deflection of 351 and duration of 336 feet. The source of this anomaly is navigation buoy #20. It is not associated with a sidescan target. This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

Anomaly 92

Anomaly 92 is located in Kill Van Kull (see Figure 51.11), and appeared across three tracklines. It was located at 597038 East and 660135 North. It had a positive gamma value of zero and a negative gamma value of 291, with a maximum gamma deflection of 291 and duration of 657 feet. The source of this anomaly is several modern barges. It is not associated with a sidescan target. This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

Anomaly 93

Anomaly 93 is located in Kill Van Kull (see Figure 51.10), and appeared across three tracklines. It was located at 595513 East and 659791 North. It had a positive gamma value of 40 and a negative gamma value of zero, with a maximum gamma deflection of 40 and duration of 175 feet. The source of this anomaly is buried cable. It is not associated with a sidescan target. This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

Anomaly 94

Anomaly 94 is located in Kill Van Kull (see Figure 51.10), and appeared across three tracklines. It was located at 595984 East and 658951 North. It had a positive gamma value of zero and a negative gamma value of 336, with a maximum gamma deflection of 336 and duration of 876 feet. The source of this anomaly is a sewage treatment plant. It is not associated with a sidescan target. This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

Anomaly 95

Anomaly 95 is located in Kill Van Kull (see Figure 51.11), and appeared across one trackline. It was located at 599501 East and 660220 North. It had a very large positive and negative gamma value, with a very large maximum gamma deflection and duration of many feet. The source of this anomaly is a passing barge. It is not associated with a sidescan target. This anomaly does not meet the criteria for the existence of a shipwreck and is not recommended for further study.

Anomaly 96

Anomaly 96 is located in Kill Van Kull (see Figure 51.11), and appeared across two tracklines. It was located at 598774 East and 659815 North. It had a positive gamma value of zero and a negative gamma value of 79, with a maximum gamma deflection of 79 and duration of 380 feet. Its source is unknown, but it is likely that the source lies outside the project area. It is not associated with a sidescan target. This anomaly does not meet the criteria for shipwreck existence, and is not recommended for further study as the source lies outside the project area.

ANOMALY 97

Anomaly 97 is located in Kill Van Kull (see Figure 51.11), and appeared across one trackline. It was located at 598891 East and 660000 North. It had a very large positive and negative gamma value, with a very large maximum gamma deflection and duration of many feet. Its source is a passing barge. It is not associated with a sidescan target. This anomaly does not meet the criteria for the existence of a shipwreck and is not recommended for further investigation.

ANOMALY 98

Anomaly 98 is located in Kill Van Kull (see Figure 51.11), and appeared across three tracklines. It was located at 600132 East and 660302 North. It had a very large positive and negative gamma value, with a very large maximum gamma deflection and duration of many feet. The source of this anomaly is several barges. It is not associated with a sidescan target. This anomaly does not meet the criteria for the existence of a shipwreck and is not recommended for further study.

ANOMALY 99

Anomaly 99 is located in Kill Van Kull (see Figure 51.14), and appeared across three tracklines. It was located at 611407 East and 660845 North. It had a positive gamma value of 640 and a negative gamma value of zero, with a maximum gamma deflection of 640 and duration of 350 feet. Its source is unknown. It is not associated with a sidescan target. This anomaly meets the criteria for the existence of a shipwreck and is recommended for further investigation.

ANOMALY 100

Anomaly 100 is located in Kill Van Kull (see Figure 51.14), and appeared across three tracklines. It was located at 612240 East and 660479 North. It had a positive gamma value of 158 and a negative gamma value of zero, with a maximum gamma deflection of 158 and duration of 828 feet. Its source is unknown. It is not associated with a sidescan target. This anomaly meets the criteria for shipwreck existence and is recommended for further investigation.

ANOMALY 101

Anomaly 101 is located in Arthur Kill (see Figure 51.02), and appeared across two tracklines. It was located at 580587 East and 660159 North. It had a positive gamma value of 109 and a negative gamma value of 55, with a maximum gamma deflection of 164 and duration of 234 feet. The source of this anomaly is unknown, but it is in the vicinity of several known wrecks, including V233, V234, and V235 from Raber 1996c (Figure 59). It is not associated with a sidescan target. This anomaly meets the established criteria for the existence of a shipwreck. Raber does not discuss the vessels thought to be represented by this anomaly, and makes no recommendation. Based on this, Anomaly 101 is recommended for further investigation.

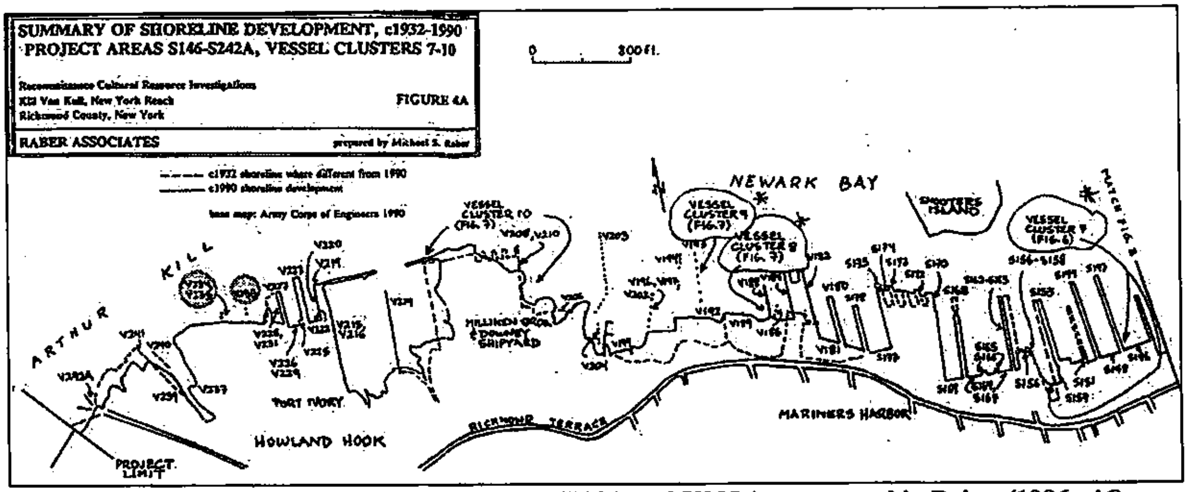

Figure 59. Map showing location of vessels V233, V234, and V235 (as presented in Raber (1996c:46).

ANOMALY 102
Anomaly 102 is located in Arthur Kill (see Figure 51.03), and appeared across two tracklines. It was located at 586138 East and 660338 North. It had a positive gamma value of zero and a negative gamma value of 124, with a maximum gamma deflection of 124 and duration of 292 feet. The source of this anomaly is a pier and wreck that are part of the group of derelict vessels at the west end of Shooter's Island (Figure 60). It is associated with a sidescan target (#17). This anomaly is part of Cluster 1, and recommendations are discussed in the cluster section below.

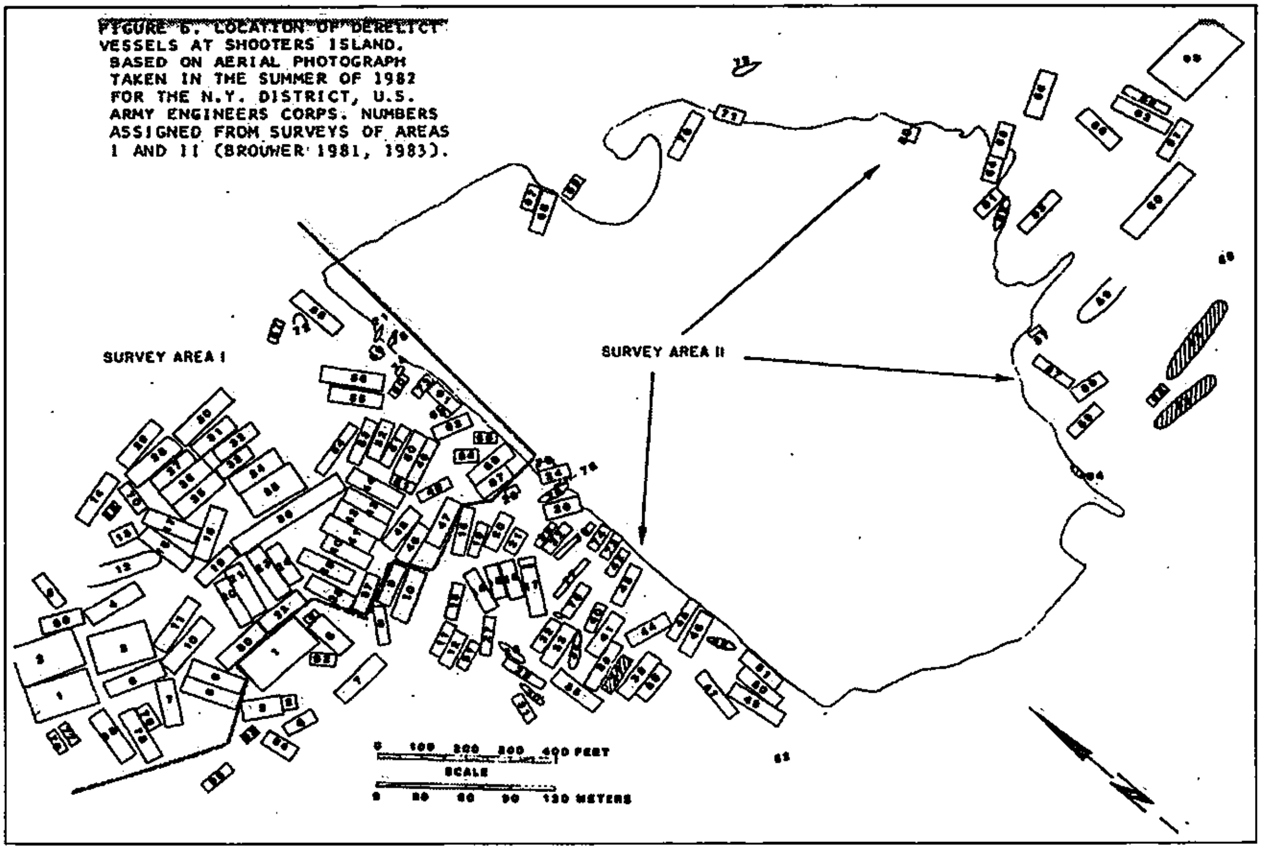

Figure 60. Location of Anomaly 102, a pier and wreck that are part of the group of derelict vessels at the west end of Shooter's Island (as presented in Kardas and Larrabee 1985b:9).

ANOMALY 103
Anomaly 103 is located in Arthur Kill (see Figure 51.03), and appeared across two tracklines. It was located at 586016 East and 660320 North. It had a positive gamma value of 367 and a negative gamma value of zero, with a maximum gamma deflection of 367 and duration of 204 feet. The source of this anomaly is thought to be a wreck on the navigation chart. This wreck is part of the group of derelict vessels at the west end of Shooter's Island. It is associated with a sidescan target (#17). This anomaly is part of Cluster 1, and recommendations are discussed in the cluster section below.

ANOMALY 104
Anomaly 104 is located in Arthur Kill (see Figure 51.03), and appeared across two tracklines. It was located at 585780 East and 660349 North. It had a positive gamma value of zero and a negative gamma value of 76, with a maximum gamma deflection of 76 and duration of 190 feet. Its source is unknown, but it is thought to be associated with the group of derelict vessels at the west end of Shooter's Island. It is associated with a sidescan target (#17). This anomaly is part of Cluster 1, and recommendations are discussed in the cluster section below.

ANOMALY 105

Anomaly 105 is located in Arthur Kill (see Figure 51.03), and appeared across one trackline. It was located at 586494 East and 660239 North. It had a positive gamma value of 45 and a negative gamma value of zero, with a maximum gamma deflection of 45 and duration of 190 feet. The source of this anomaly is unknown. It is not associated with a sidescan target. This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

ANOMALY 106

Anomaly 106 is located in Kill Van Kull (see Figure 51.12), and appeared across two tracklines. It was located at 604867 East and 661547 North. It had a large positive and negative gamma value, with a large maximum gamma deflection and duration of many feet. The source of this anomaly is navigation buoy #8. It is not associated with a sidescan target. This anomaly does not meet the criteria for shipwreck existence and is not recommended for further investigation.

ANOMALY 110

Anomaly 110 is located in Anchorage Channel (see Figure 51.19), and appeared across three tracklines. It was located at 616361 East and 650135 North. It had a positive gamma value of 206 and a negative gamma value of zero, with a maximum gamma deflection of 206 and duration of 511 feet. The source of this anomaly is an obstruction on navigation chart. It is not associated with a sidescan target. This anomaly meets the criteria for the existence of a shipwreck and is recommended for further investigation.

ANOMALY 111

Anomaly 111 is located in Anchorage Channel (see Figure 51.19), and appeared across three tracklines. It was located at 616091 East and 651143 North. It had a positive gamma value of 165 and a negative gamma value of zero, with a maximum gamma deflection of 165 and duration of 423 feet. The source of this anomaly is a pipeline. It is not associated with a sidescan target. This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

ANOMALY 112

Anomaly 112 is located in Anchorage Channel (see Figure 51.18), and appeared across three tracklines. It was located at 615498 East and 653508 North. It had a very large positive and negative gamma value, with a very large maximum gamma deflection and duration of many feet.. The source of this anomaly is a pipeline. It is not associated with a sidescan target. This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

ANOMALY 113

Anomaly 113 is located in Anchorage Channel (see Figure 51.17), and appeared across three tracklines. It was located at 614448 East and 657306 North. It had a positive gamma value of 101 and a negative gamma value of zero, with a maximum gamma deflection of 101 and duration of 307 feet. The source of this anomaly is a pipeline. It is not associated with a sidescan target. This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

ANOMALY 114

Anomaly 114 is located in Anchorage Channel (see Figure 51.18), and appeared across three tracklines. It was located at 615637 East and 652831 North. It had a very large positive and negative gamma value, with a very large maximum gamma deflection and duration of many feet.. The source of this anomaly is a ship at anchor. It is not associated with a sidescan target. This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

ANOMALY 115
Anomaly 115 is located in Anchorage Channel (see Figure 51.20), and appeared across one trackline. It was located at 617114 East and 647199 North. It had a very large positive and negative gamma value, with a very large maximum gamma deflection and duration of many feet. The source of this anomaly is a passing ship. It is not associated with a sidescan target. This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

ANOMALY 116
Anomaly 116 is located in Anchorage Channel (see Figure 51.22), and appeared across three tracklines. It was located at 620806 East and 642599 North. It had a very large positive and negative gamma value, with a very large maximum gamma deflection and duration of many feet. The source of this anomaly is an anchored ship. It is not associated with a sidescan target. This anomaly does not meet the established criteria for the existence of a shipwreck and is not recommended for further investigation.

ANOMALY 117
Anomaly 117 is located in Arthur Kill (see Figure 51.02), and appeared across two tracklines. It was located at 582710 East and 660222 North. It had a positive gamma value of 130 and a negative gamma value of zero, with a maximum gamma deflection of 130 and duration of 180 ft. It is not associated with a sidescan target. The source of this anomaly is thought to be Vessel V152 from Raber (1996c) (Figure 61), which was identified by James (1999) as an offshore tug abandoned in 1947. This vessel was classified as potentially significant by Raber (1996c). This anomaly meets the established criteria for the existence of a shipwreck. However, James (1999) determined that it is not a good representative of the vessel type, and did not recommend it for further investigation. The current study concurs with this recommendation and the anomaly is not recommended for further investigation.

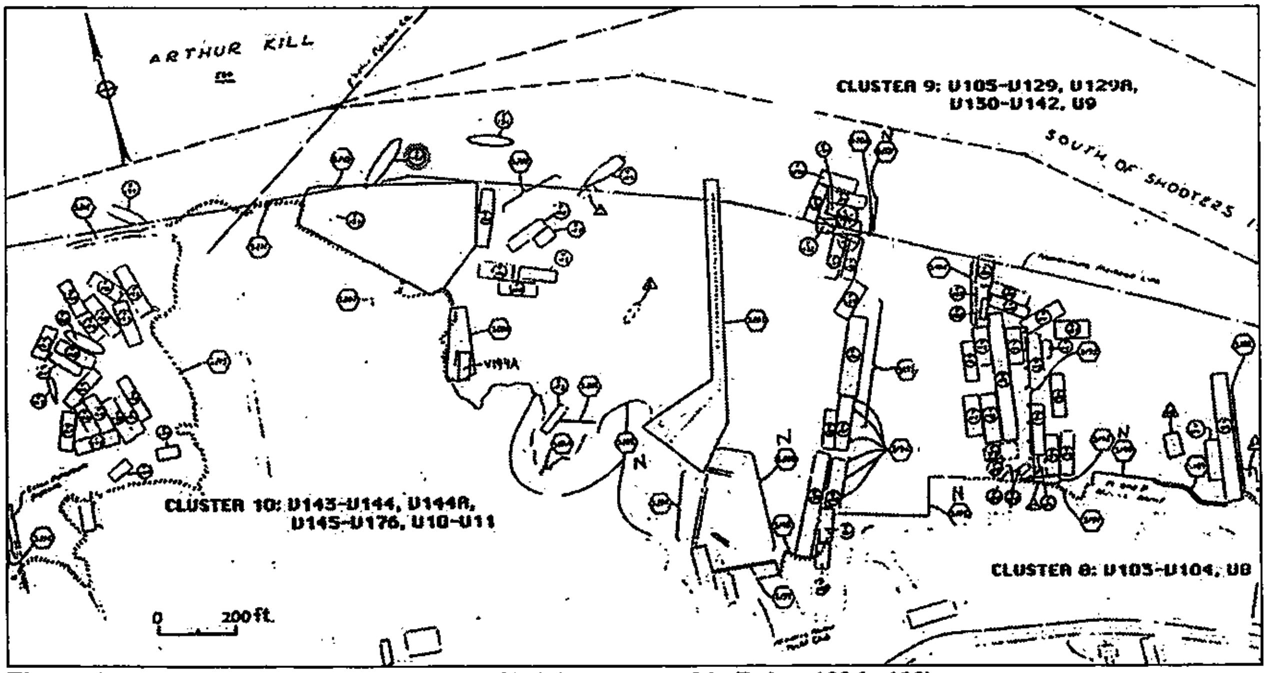

Figure 61. Map showing location of vessel V152 (as presented in Raber 1996c:133).

ANOMALY 118
Anomaly 118 is located in Arthur Kill (see Figure 51.02), and appeared across two tracklines. It was located at 583036 East and 660222 North. It had a positive gamma value of 60 and a

negative gamma value of 20, with a maximum gamma deflection of 80 and duration of 158 ft. It is not associated with a sidescan target. The source of this anomaly is thought to be Vessel V151 from Raber (1996c) which was identified by James (1999) as an offshore tug abandoned in 1947. This anomaly meets the established criteria for the existence of a shipwreck. However, James (1999) determined that it is not a good representative of the vessel type, and did not recommend it for further investigation. The current study concurs with this recommendation and the anomaly is not recommended for further investigation.

SIDESCAN SONAR SURVEY RESULTS

The sidescan sonar survey successfully covered the project area and included multiple overlap of adjacent transects. The acoustic images collected with the sidescan sonar revealed 24 targets whose characteristics warranted further investigation. Of these 24 targets, four had associated magnetics and five are associated with ship graveyards at Shooter's Island. Eleven targets, including the three associated with strong magnetic signatures, are recommended for further investigation. The targets are shown in Figure 51, presented on page 107, and Table 7 and are discussed below (Figure 51 is an index map showing the locations of submaps 51.01–51.45. All maps shown in Figure 51 are presented together for the reader's convenience; see pages 109-197). The target numbers are not sequential because a number of targets tentatively identified during preliminary analysis were subsequently discarded.

Table 7. Sidescan Targets Located in the New York Harbor Project Area.

Target	Northing	Easting	Assoc. Mag.	Description	Comments	Further Work
1	639561	612287		3 linear features	outside project area	no
2	648181	607901		an oddly shaped object	outside project area	no
3	657412	600934		3 parallel linear objects	close to a wreck on the navigation chart	yes
4	656762	601225		16 m linear feature		yes
5	655399	601713		4 linear features	outside project area	no
6	627677	619055		2 linear features	outside project area	no
7	612428	660439		an area of trash and debris	does not look like a wreck	no
8	612787	660201		unknown		no
9	606618	661731		a tall thin object	outside project area	no
11	600924	660453		rectangular wreckage w/frames		yes
13	597090	659063		a diamond shaped wreckage	in vicinity of V28 (James 1999), who reported it as having been removed	yes
14	597935	660633		square wreckage with frames	outside project area	no
15	599475	661384		derelicts on shore	7 Port Johnson wrecks (James 1991), outside project area	no
16	587579	659553		at least three derelicts	just outside project area, possibly wrecks 89 & 90 from Kardas and Larrabee (1985)	yes
17	585883	660226	102, 103, 104	wreckage and derelicts	part of Cluster 1. Wrecks 14,29,30,57,58,72 from Kardas and Larrabee (1985)	no
18	585280	660200		derelict drydocks	part of Cluster 1	no
19	582151	660191		a boat shaped object	wooden harbor tug, probably V154 from Raber 1996c	yes
22	585155	660137		a large debris field	part of Cluster 1, wrecks 14,29,30,57,58,72 from Kardas and Larrabee (1985)	no
24	581668	660989	43	a magnetic anomaly		yes
25	589478	663390		unknown	outside project area	no
26	593559	659955	64	a boat shaped object	derelict visible at low tide, V36 & V37 (Raber 1996d), outside project area	yes
27	590881	663231	27	a debris field	vicinity of wreck on chart	yes
28	590309	662041		a round turret looking object		yes
29	590743	663018		an uneven bottom, with possible exposed frames	parts are inside project area	yes

TARGET 1

Figure 62 shows the acoustic image captured during the survey. It is located in Ambrose Channel at 639561 East and 612287 North (Figure 51.36). It is not associated with a magnetic anomaly. The source of the acoustic return is thought to be three linear features. This target is not recommended for further investigation.

Figure 62. Acoustic image of Target 1.

TARGET 2

Figure 63 shows the acoustic image captured during the survey. It is located in Ambrose Channel at 648181 East and 607901 North (Figure 51.38). It is not associated with a magnetic anomaly. Its source is thought to be an oddly shaped object. This target is not recommended for further investigation, as it is outside the project area.

TARGET 3

Figure 64 shows the acoustic image captured during the survey. It is located in Ambrose Channel at 657412 East and 600934 North (Figure 51.42). It is not associated with a magnetic anomaly. The source of the acoustic return is thought to be three parallel linear objects. This target is recommended for further investigation.

TARGET 4

Figure 65 shows the acoustic image captured during the survey. It is located in Ambrose Channel at 656762 East and 601225 North (Figure 51.42). It is not associated with a magnetic anomaly. The source of the acoustic return is thought to be a 16m linear feature. This target is recommended for further investigation.

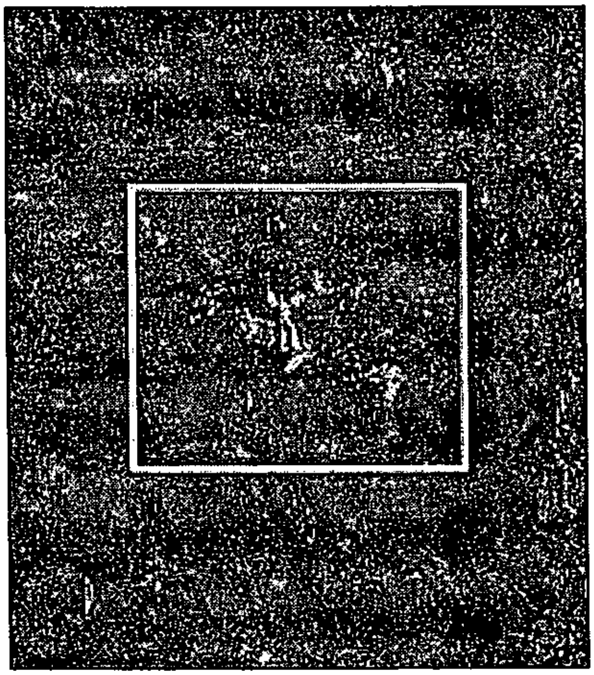

Figure 63. Acoustic image of Target 2.

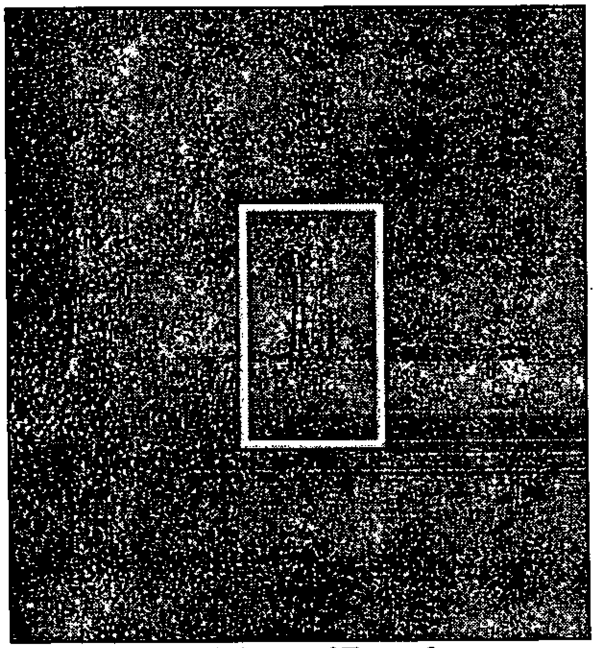

Figure 64. Acoustic image of Target 3.

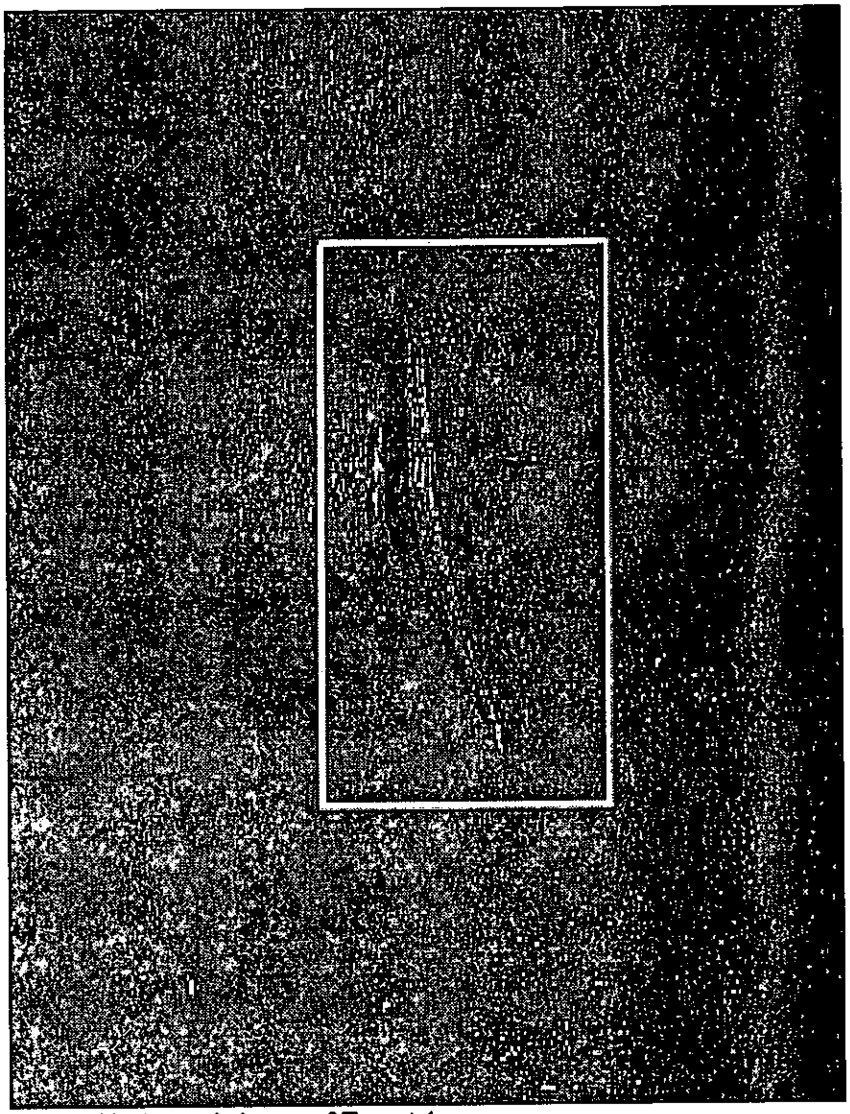

Figure 65. Acoustic image of Target 4.

TARGET 5

Figure 66 shows the acoustic image captured during the survey. It is located in Ambrose Channel at 655399 East and 601713 North (Figure 51.42). It is not associated with a magnetic anomaly. The source of the acoustic return is thought to be four linear features. This target is not recommended for further investigation, as it is located outside the project area.

TARGET 6

Figure 67 shows the acoustic image captured during the survey. It is located in Ambrose Channel at 627677 East and 619055 North (Figure 51.30). It is not associated with a magnetic anomaly. The source of the acoustic return is thought to be two linear features. This target is not recommended for further investigation, as it is outside the project area.

TARGET 7

Figure 68 shows the acoustic image captured during the survey. It is located in Kill Van Kull at 612428 East and 660439 North (Figure 51.14). It is not associated with a magnetic anomaly. The source of the acoustic return is thought to be an area of trash and debris. This target is not recommended for further investigation.

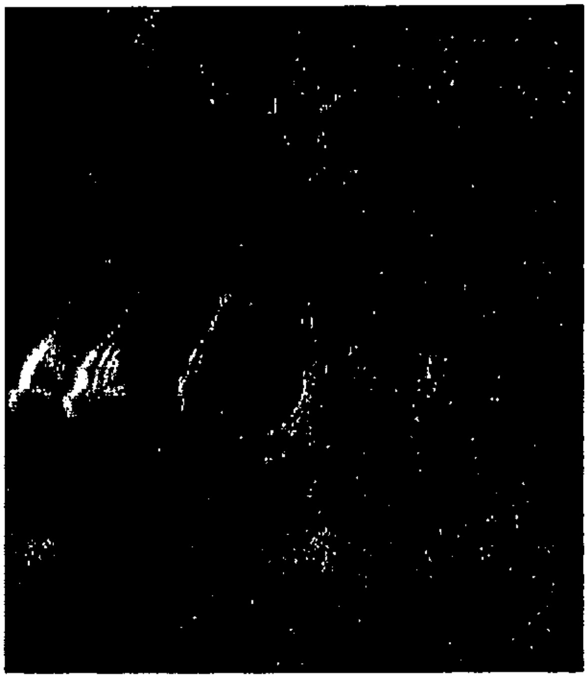

Figure 66. Acoustic image of Target 5.

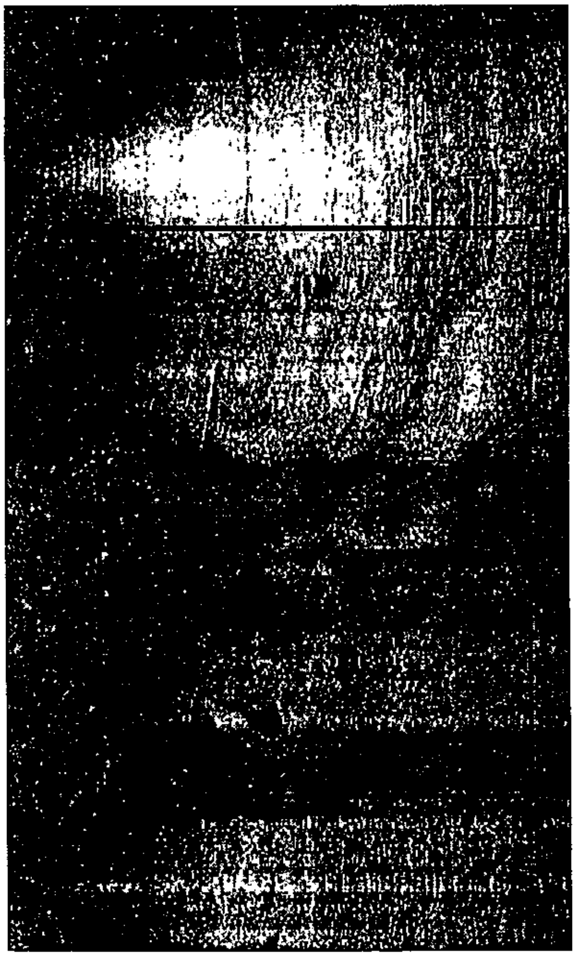

Figure 68. Acoustic image of Target 7.

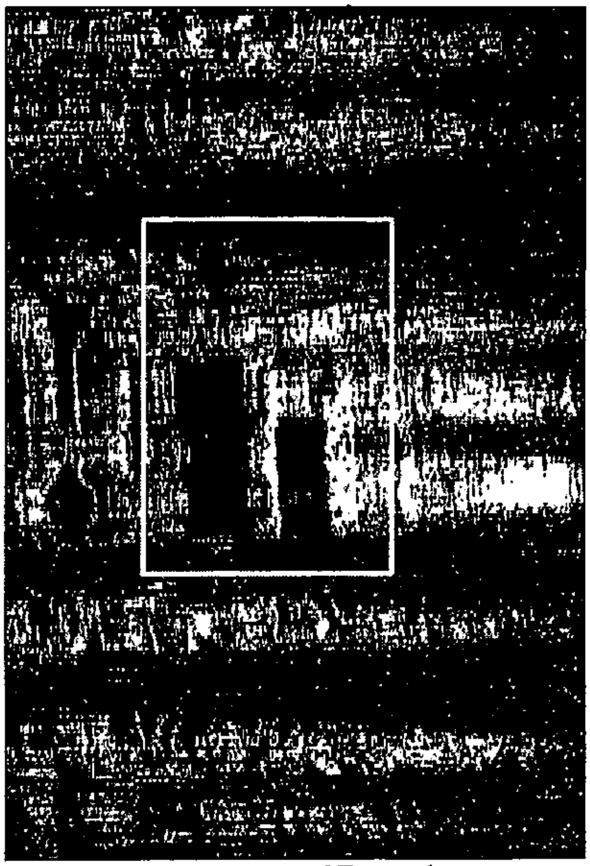

Figure 67. Acoustic image of Target 6.

TARGET 8

Figure 69 shows the acoustic image captured during the survey. It is located in Kill Van Kull at 612787 East and 660201 North (Figure 51.14). It is not associated with a magnetic anomaly. The source of the acoustic return unknown. This target is not recommended for further investigation.

TARGET 9

Figure 70 shows the acoustic image captured during the survey. It is located in Kill Van Kull at 606618 East and 661731 North (Figure 51.13). It is not associated with a magnetic anomaly. The source of the acoustic return is thought to be a tall, thin object. This target is not recommended for further investigation, as it is located outside the project area.

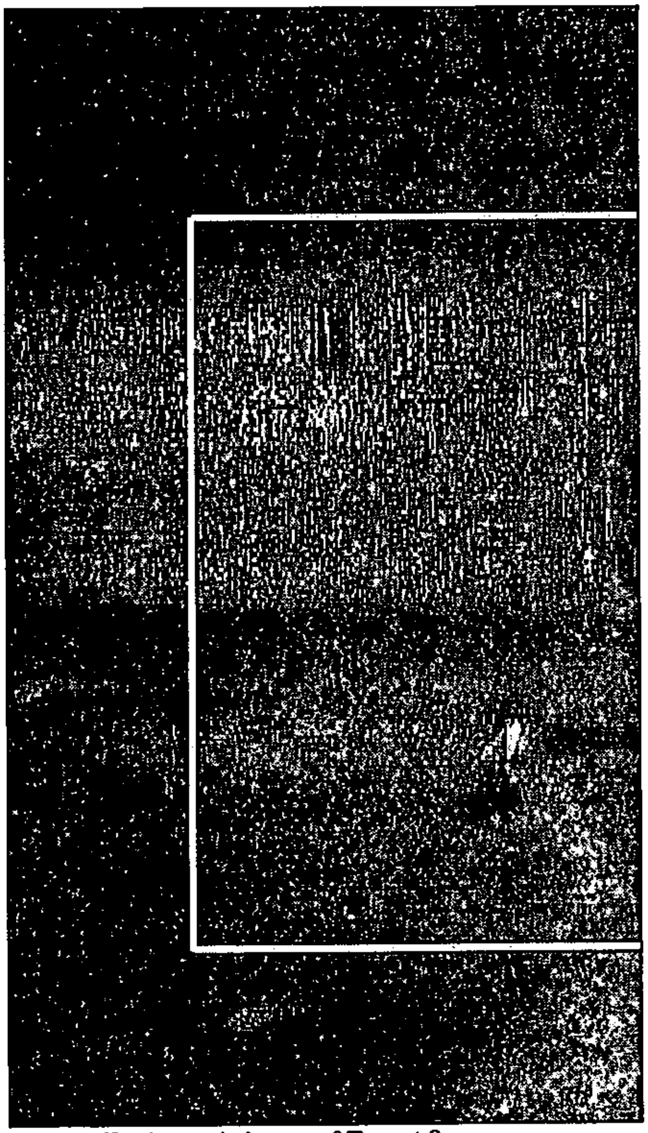

Figure 69. Acoustic image of Target 8.

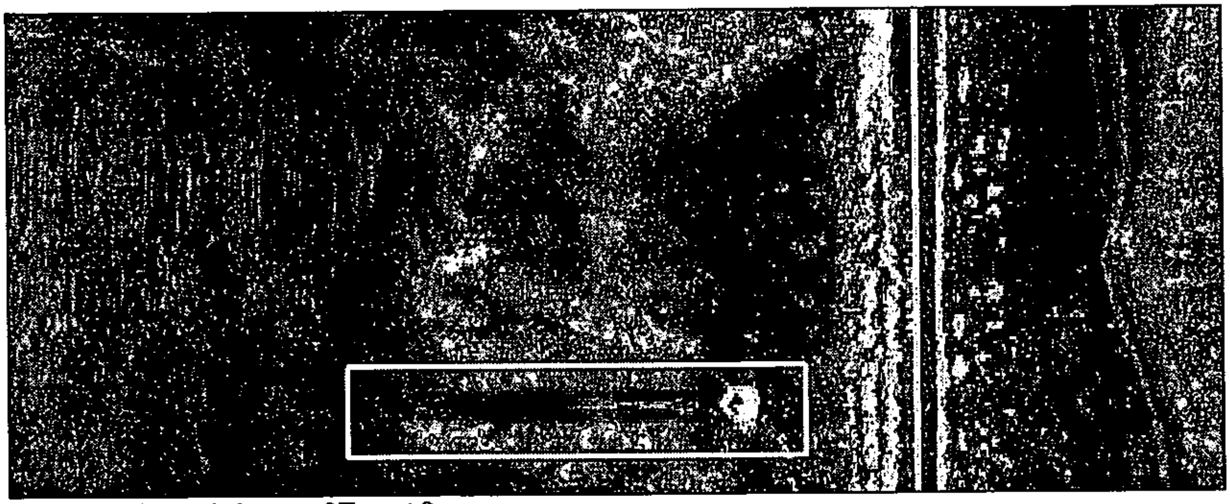

Figure 70. Acoustic image of Target 9.

TARGET 11

Figure 71 shows the acoustic image captured during the survey. It is located in Kill Van Kull at 600924 East and 660453 North (Figure 51.11). It is not associated with a magnetic anomaly. The source of the acoustic return is thought to be rectangular wreckage with frames. This target is recommended for further investigation.

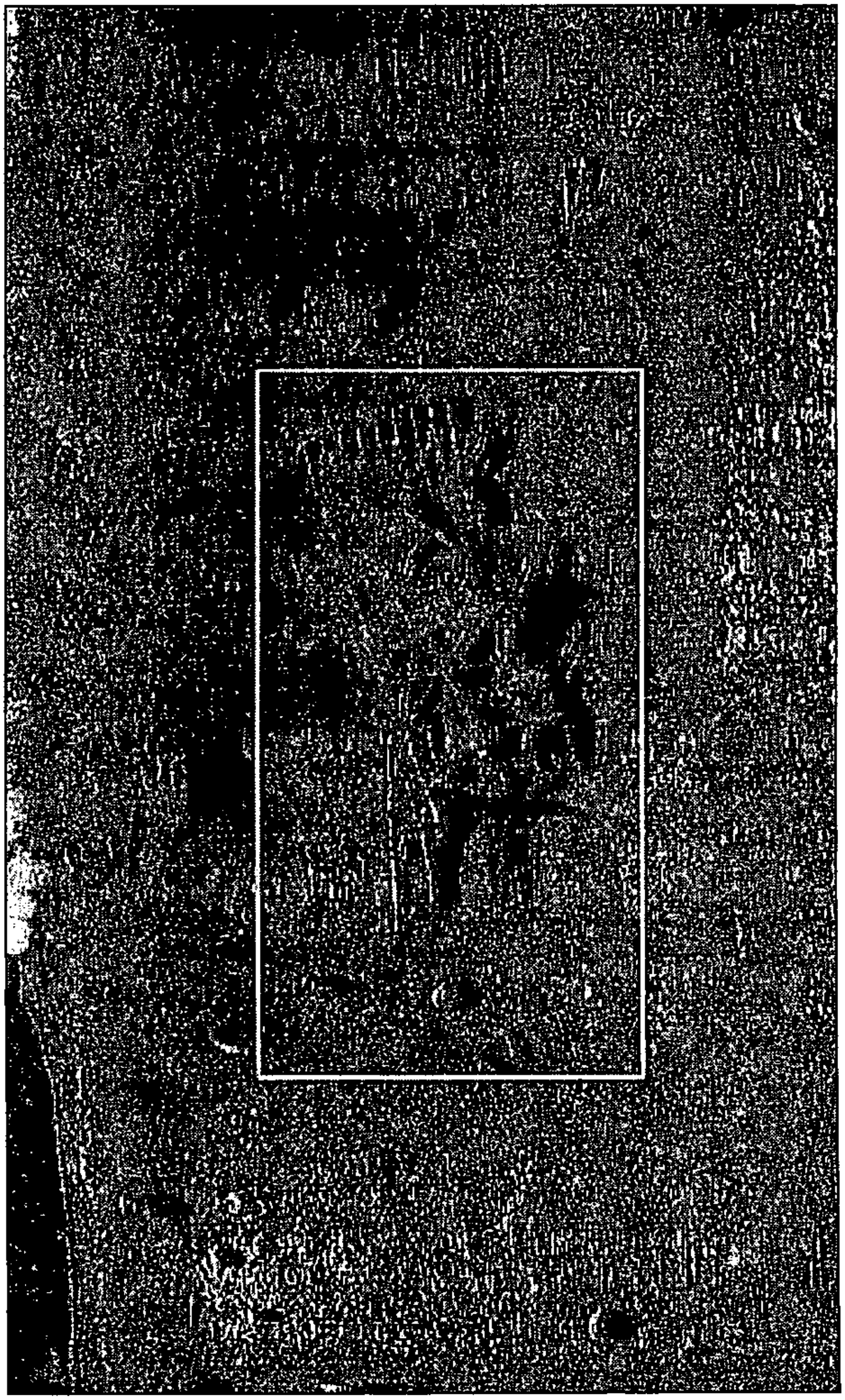

Figure 71. Acoustic image of Target 11.

Target 13

Figure 72 shows the acoustic image captured during the survey. It is located in Kill Van Kull at 597090 East and 659063 North (Figure 51.11). It is not associated with a magnetic anomaly. The source of the acoustic return, a diamond-shaped piece of wreckage, is thought to coincide with the location of the iron-hulled steam lighter *Blairstown* (referred to as vessel V28 in James 1999; Figure 73). This vessel was supposedly removed between 1995 and 1997. This target is recommended for further investigation.

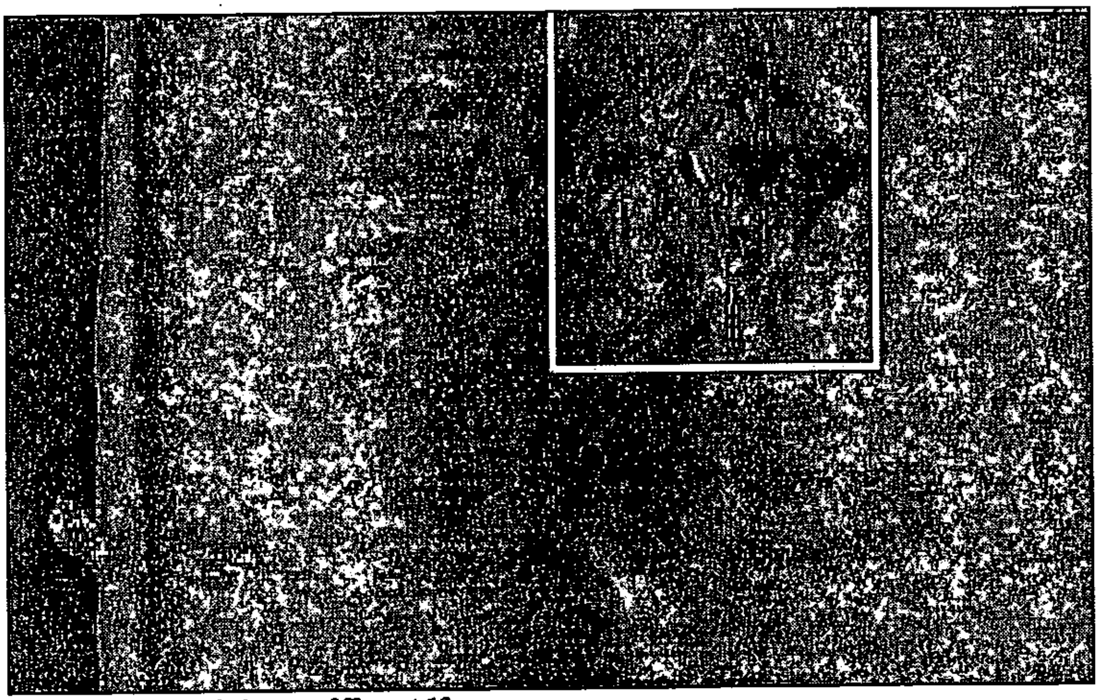

Figure 72. Acoustic image of Target 13.

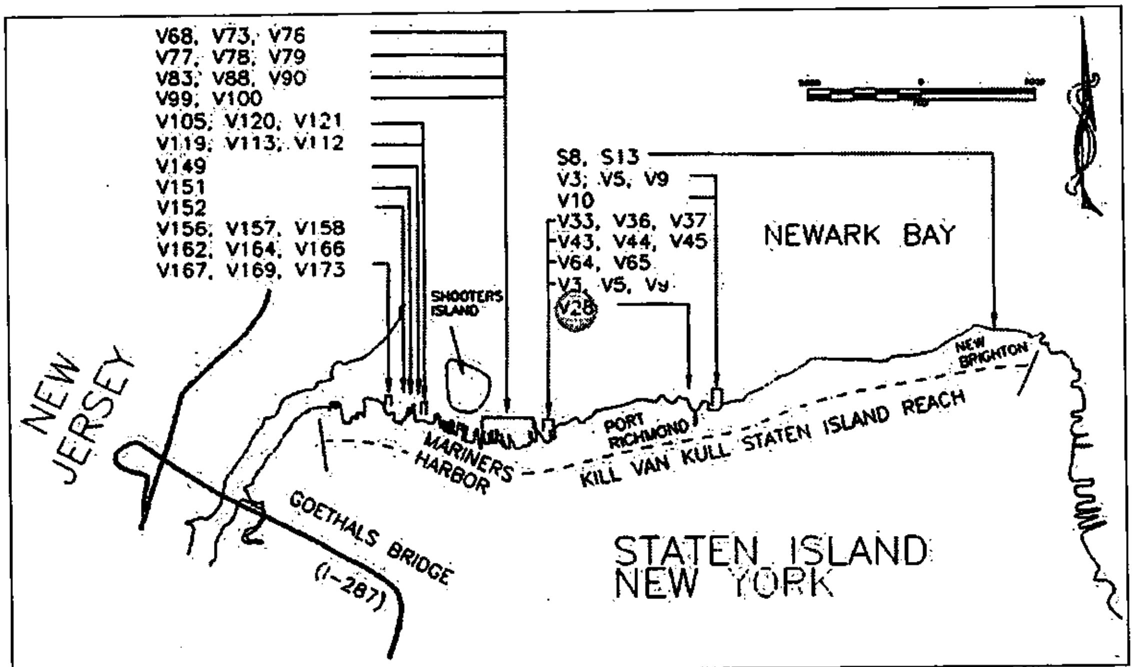

Figure 73. Map showing location of vessel V28 (as presented in James 1999:15).

Target 14

Figure 74 shows the acoustic image captured during the survey. It is located in Kill Van Kull at 597935 East and 660633 North (Figure 51.11). It is not associated with a magnetic anomaly. The source of the acoustic return is thought to be square wreckage with frames. This target is not recommended for further investigation, as it is located outside the project area.

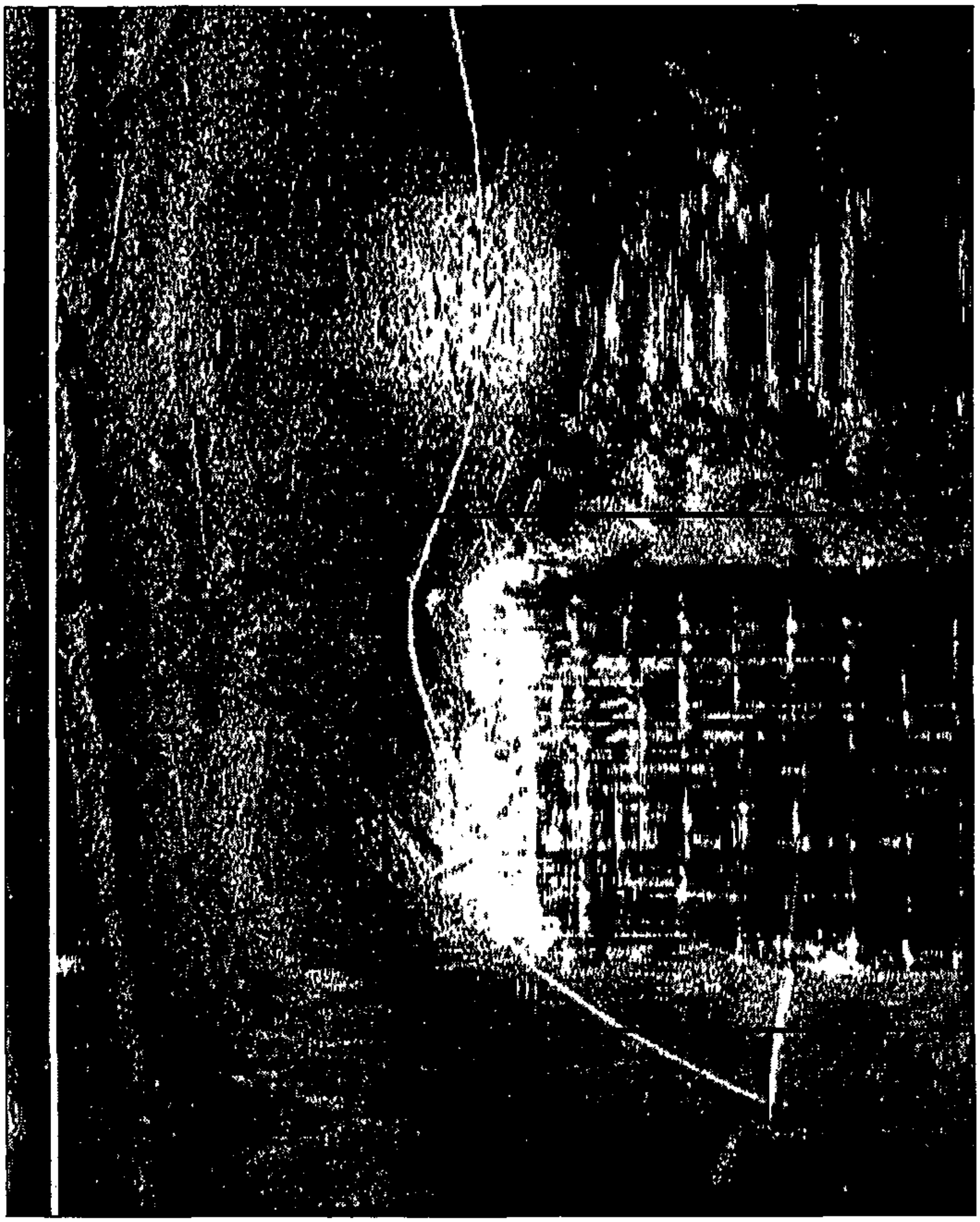

Figure 74. Acoustic image of Target 14.

Target 15

Figure 75 shows the acoustic image captured during the survey. It is located in Kill Van Kull at 599475 East and 661384 North (Figure 51.11). It is not associated with a specific magnetic anomaly, as the entire area was characterized by an extreme magnetic field caused by industrial activity nearby. This field made it impossible to distinguish smaller anomalies that might indicate submerged cultural resources. The source of the acoustic return is thought to be the seven Port Johnson sailing vessels, including *Maceratta, Estelle Krieger, Occidental, Penrose, Molfetta, James Howard*, and *City of Austin* (Figures 76 and 77). These vessels have been determined to be eligible for listing on the NRHP, and were examined in 1984 (Kardas and Larrabee 1985) and1990 (James 1991). These vessels are not recommended for further work as part of this study as they are located outside the project area.

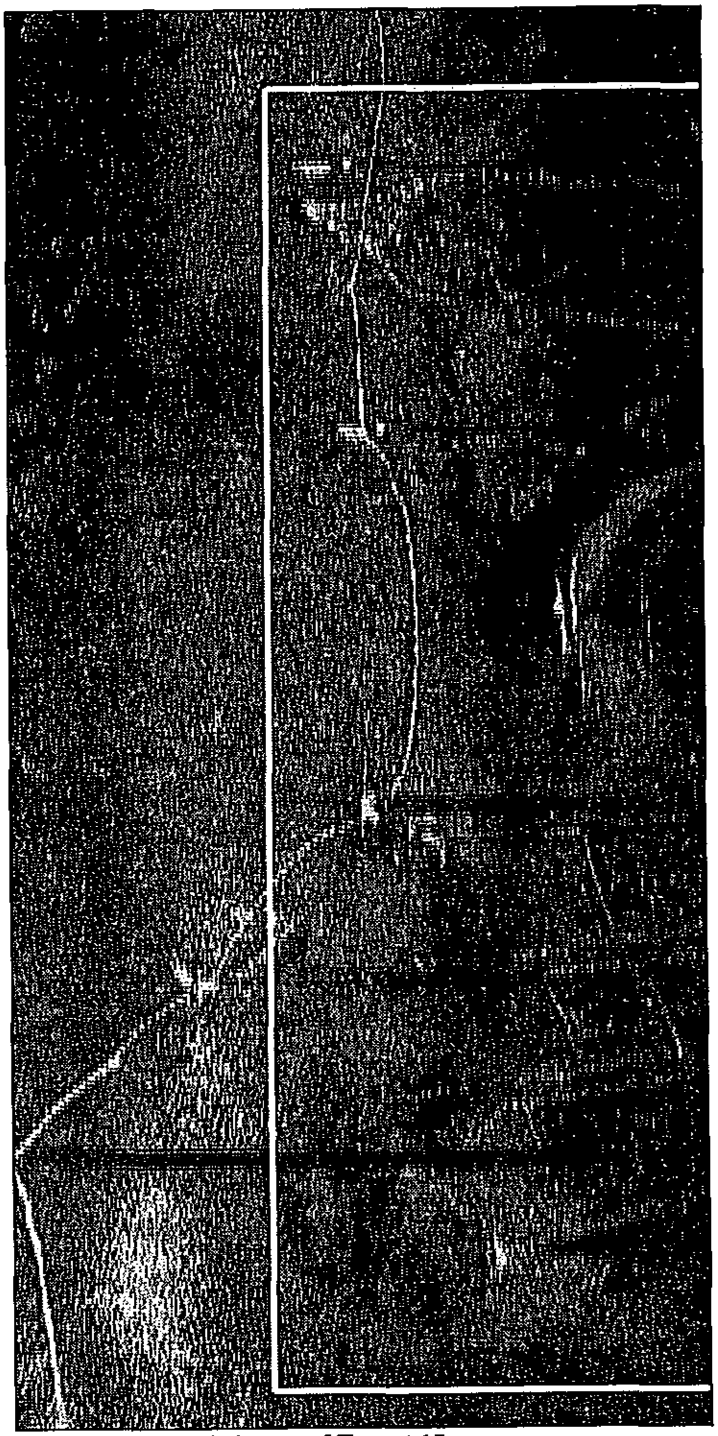

Figure 75. Acoustic image of Target 15.

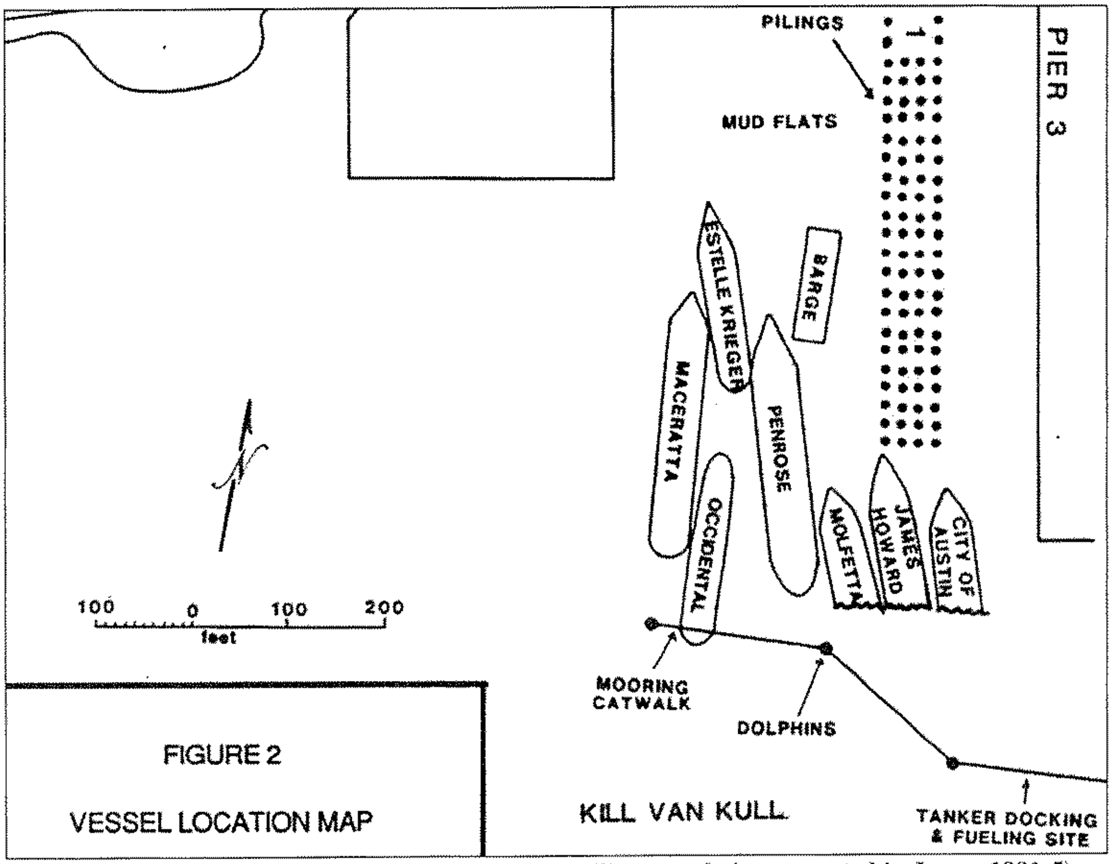

Figure 76. Map showing location of Port Johnson sailing vessels (as presented in James 1991:5).

Figure 77. Photograph of Port Johnson sailing vessels as observed during the current survey.

TARGET 16

Figure 78 shows the acoustic image captured during the survey. It is located at the east end of Shooter's Island, at 587579 East and 659553 North (Figure 51.03). It is not associated with a magnetic anomaly. Its source is what appears to be at least three, possibly five, vessels and a pier. Two of the vessels are possibly 89 and 90 from both Kardas and Larrabee (1985) and Brower (1981, 1983)(Figure 79). This target is recommended for further investigation.

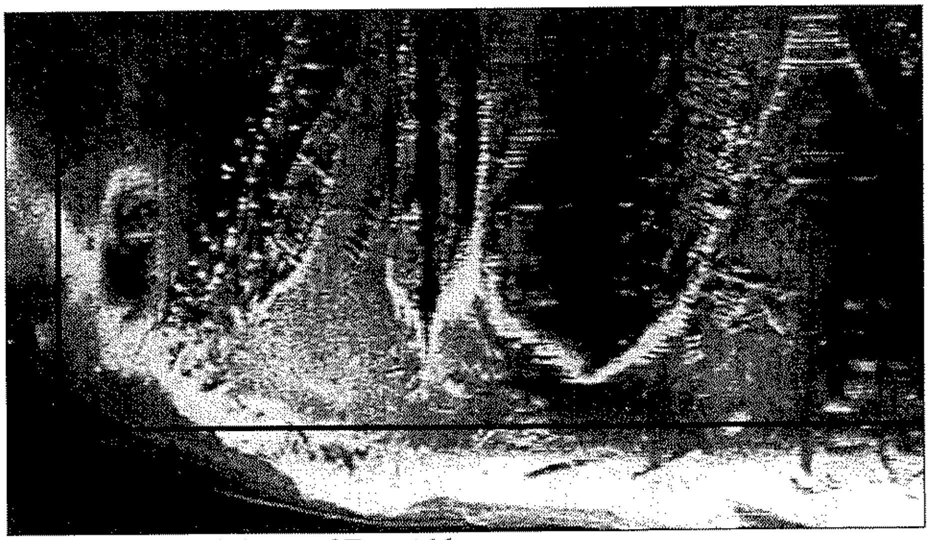

Figure 78. Acoustic image of Target 16.

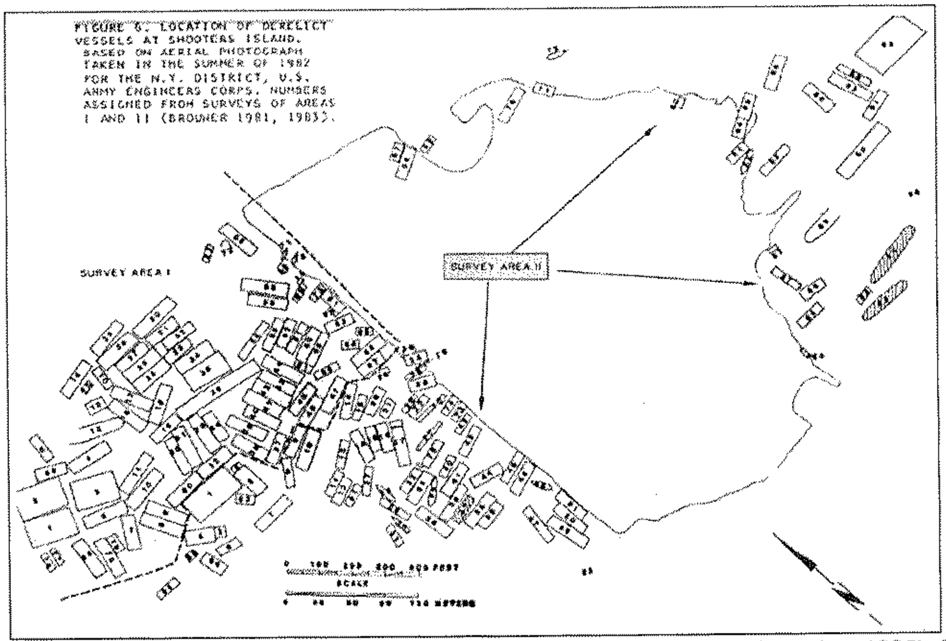

Figure 79. Location of vessels 89 and 90 (as presented in Kardas and Larrabee 1985b:9).

TARGET 17

Figure 80 shows the acoustic image captured during the survey. It is located in Arthur Kill at 585883 East and 660226 North (Figure 51.03). It is associated with three magnetic anomalies (102, 103, 104). The source of the acoustic return is a number of vessels that are part of the ship graveyard at the west end of Shooter's Island (see Figure 60). This target is part of Cluster 1, and recommendations are discussed in the cluster section below.

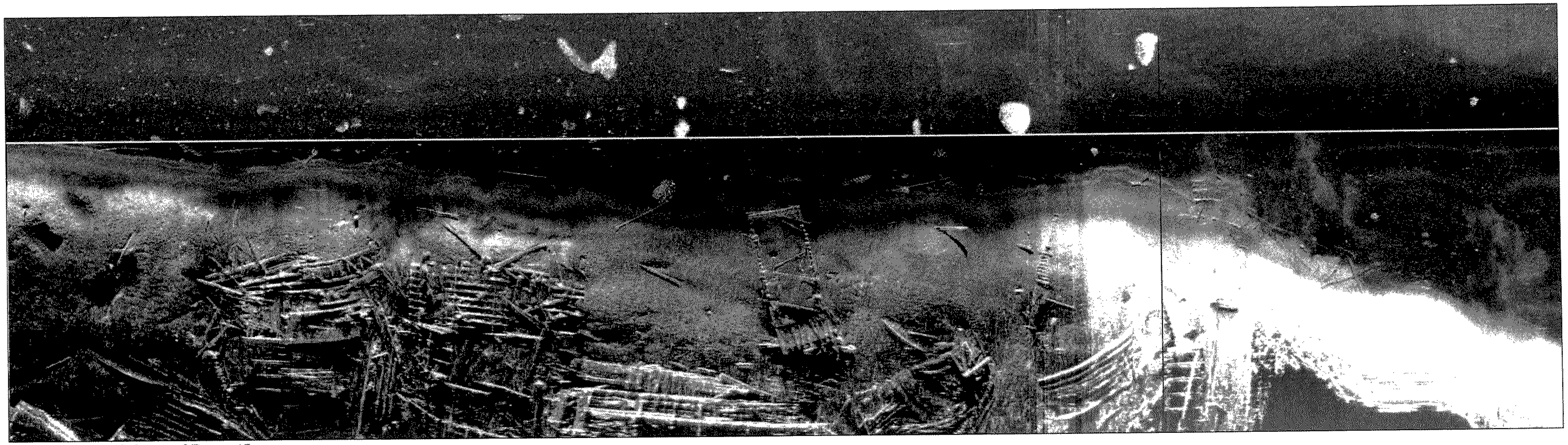

Figure 80. Acoustic image of Target 17.

TARGET 18

Figure 81 shows the acoustic image captured during the survey. It is located in Arthur Kill at 585280 East and 660200 North (Figure 51.03). It is not associated with a magnetic anomaly. The source of the acoustic return is a number of vessels that are part of the ship graveyard on the west end of Shooter's Island (see Figure 60). This target is part of Cluster 1, and recommendations are discussed in the cluster section below.

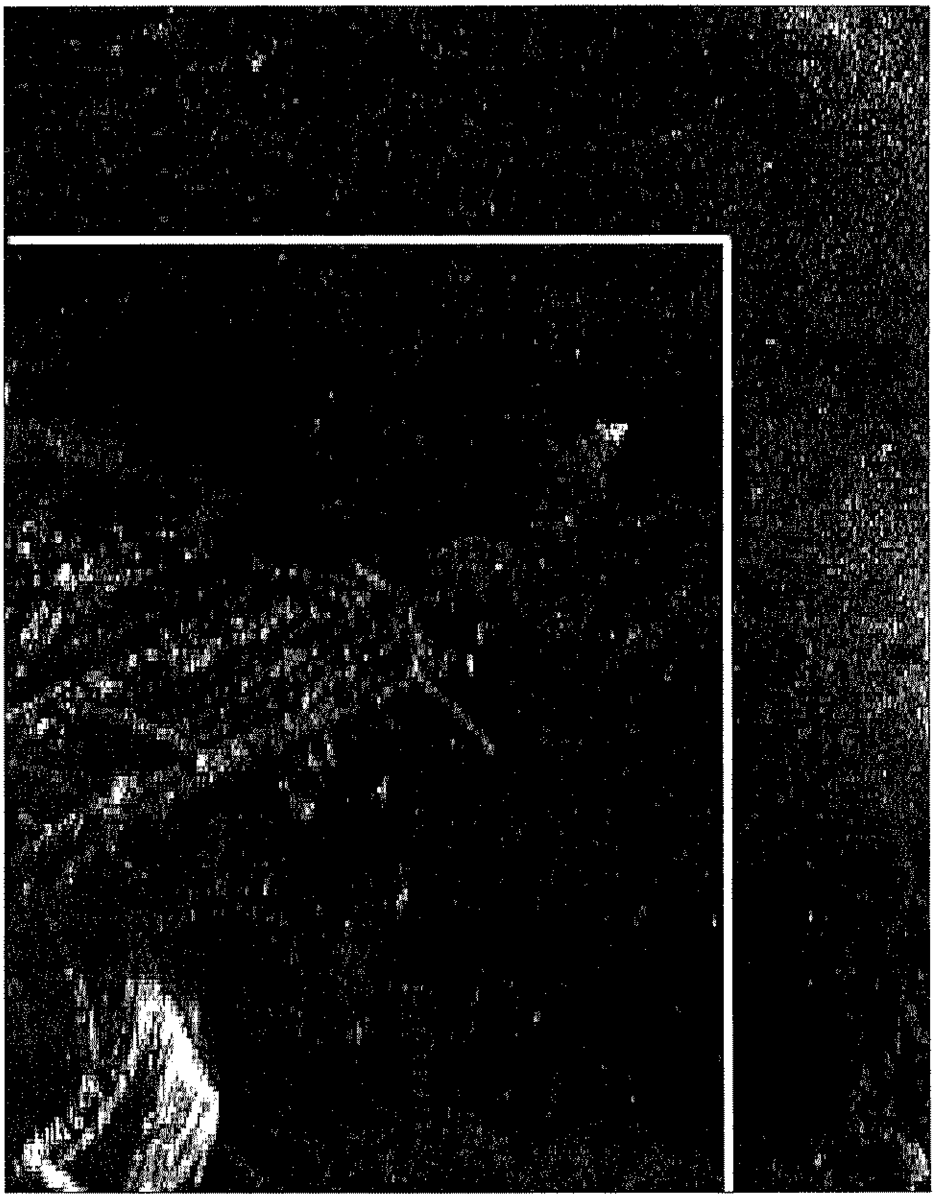

Figure 81. Acoustic image of Target 18.

TARGET 19

Figure 82 shows the acoustic image captured during the survey. It is located in Arthur Kill at 582151 East and 660191 North (Figure 51.02). It is not associated with a magnetic anomaly. The source of the acoustic return is a boat-shaped object. This target may be vessel V154 from Raber (1996c) (see Figure 61), who identified it as a screw harbor tug. Raber classified it as non-significant and did not recommend further investigation. However, since it is not conclusive that the side scan target is indeed V154, further work is recommended.

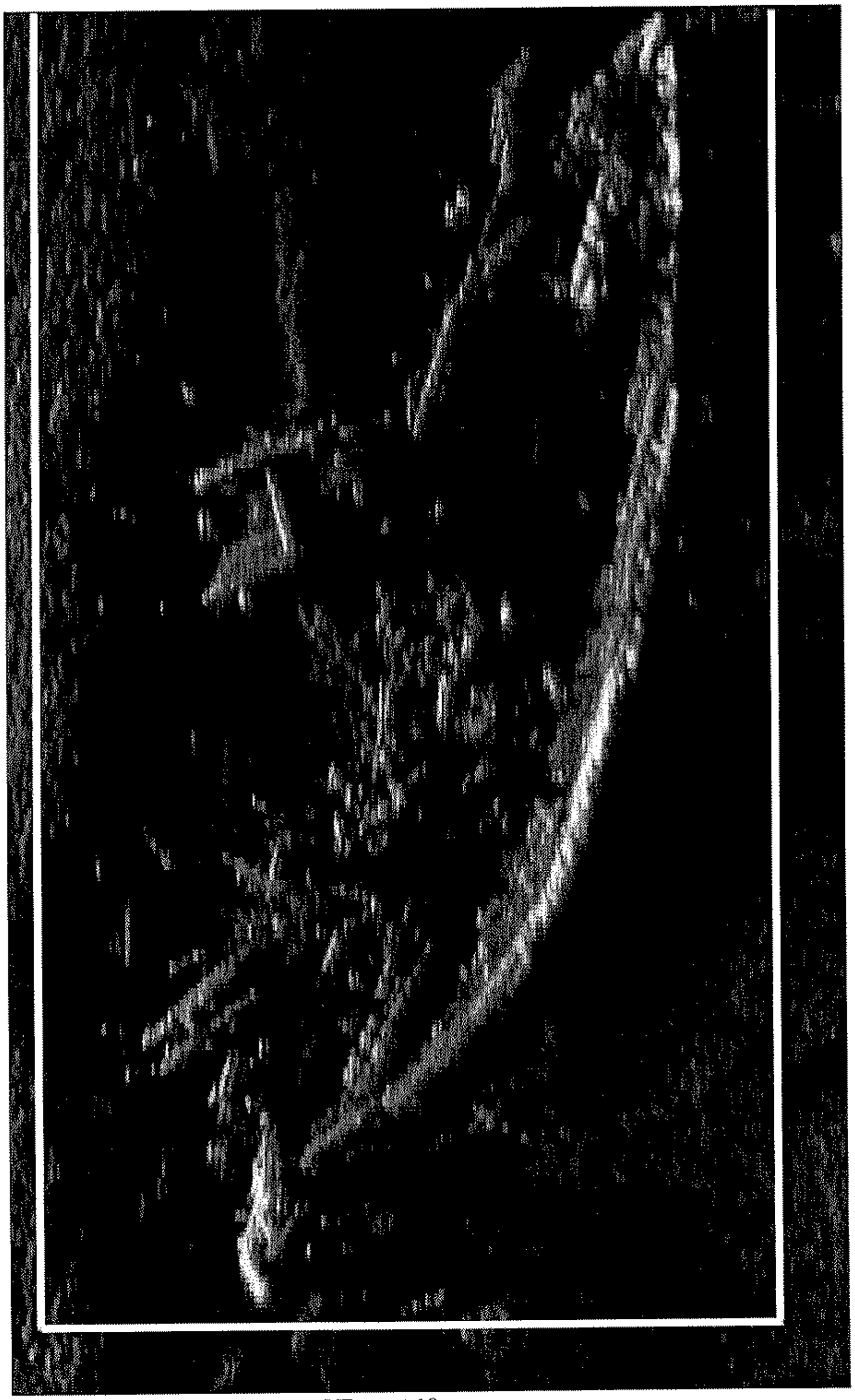

Figure 82. Acoustic image of Target 19.

TARGET 22

Figure 83 shows the acoustic image captured during the survey. It is located in Arthur Kill at 585155 East and 660137 North (Figure 51.03). It is not associated with a magnetic anomaly. The source of the acoustic return is a number of vessels that are part of the group of derelict vessels at the west end of Shooter's Island. This target is part of Cluster 1, and recommendations are discussed in the cluster section below.

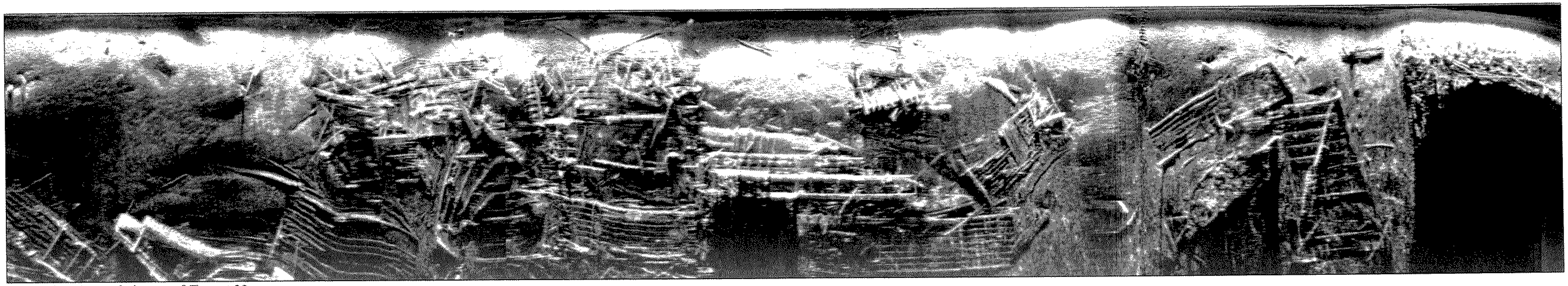

Figure 83. Acoustic image of Target 22.

TARGET 24

Figure 84 shows the acoustic image captured during the survey. It is located in Arthur Kill at 581668 East and 660989 North (Figure 51.02). It is associated with a magnetic anomaly (#43). The source of the acoustic return is thought to be the magnetic anomaly. This target is recommended for further investigation.

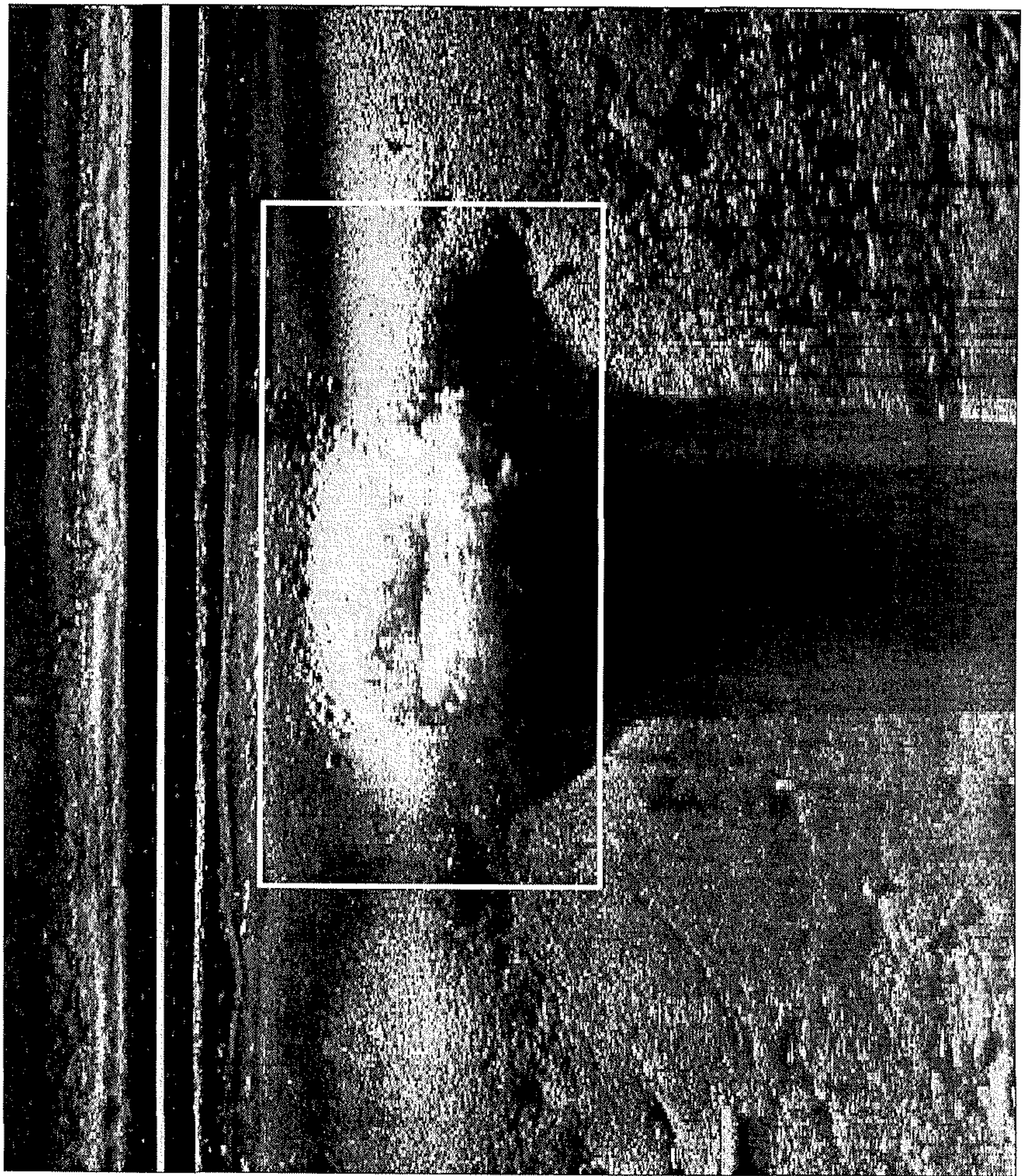

Figure 84. Acoustic image of Target 24.

TARGET 25

Figure 85 shows the acoustic image captured during the survey. It is located in Newark Bay at 589478 East and 663390 North (Figure 51.05). It is not associated with a magnetic anomaly. The source of the acoustic return is unknown. This target is not recommended for further investigation.

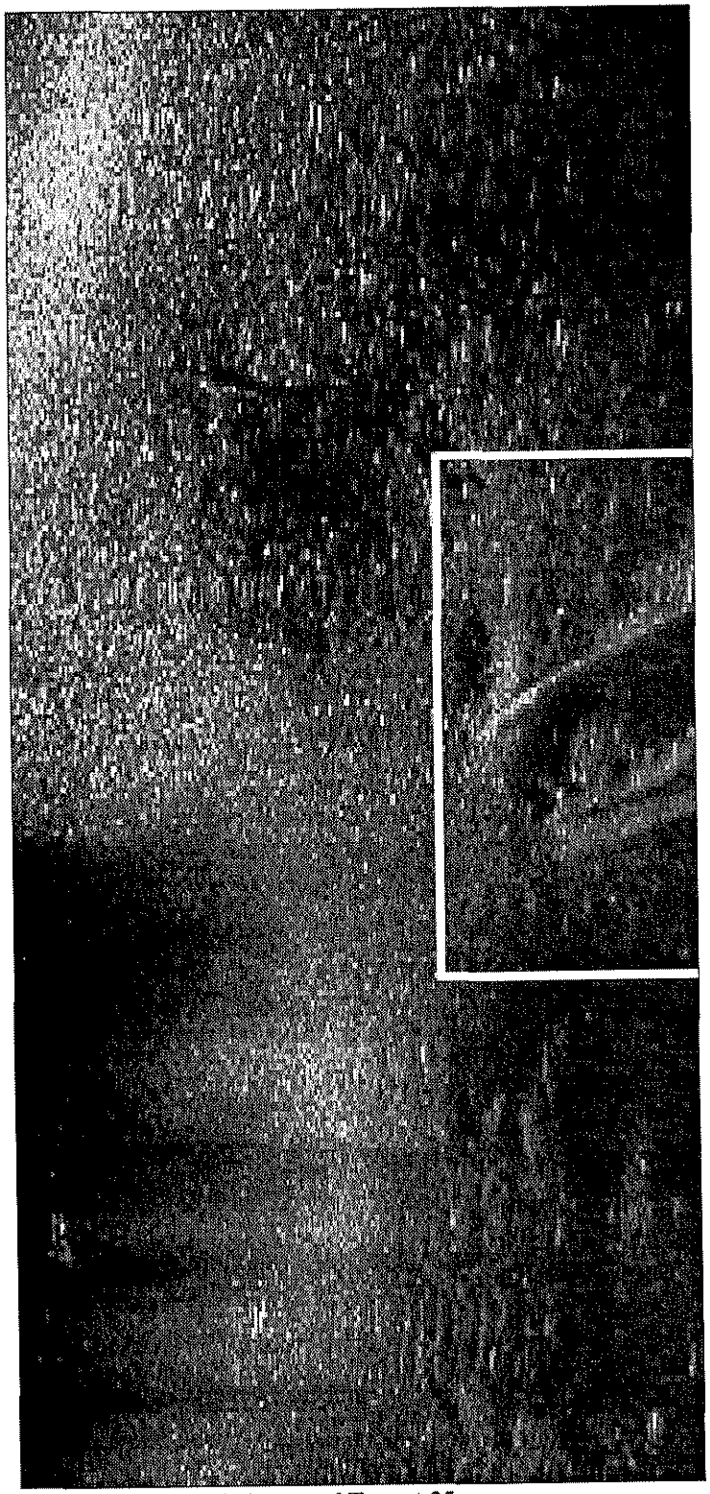

Figure 85. Acoustic image of Target 25.

TARGET 26
Figure 86 shows the acoustic image captured during the survey. It is located in Kill Van Kull at 593559 East and 659955 North (Figure 51.10). It is associated with a magnetic anomaly (#64). The source of the acoustic return is thought to be either vessel V27B or V28, from Kardas and Larrabee (1985)(see Figure 54), also identified as vessels V36 and V37 in Raber (1996d). Kardas and Larrabee (1986) examined this vessel and determined it is not eligible for NRHP status (Vol. 2:55). However, Raber (1996d:42) determined Vessel 36 (Kardas and Larrabee Vessel 27B), to be an as-built schooner barge, and as such is potentially eligible for NRHP status and recommendeded futher investigation. This study concurs with the recommendation of Raber (1996d), and the target is recommended for further investigation.

TARGET 27
Figure 87 shows the acoustic image captured during the survey. It is located in Newark Bay at 590881 East and 663231 North (Figure 51.05). It is associated with a magnetic anomaly (#27). The source of the acoustic return is thought to be a debris field, possibly related to the Central Railroad Bridge that used to exist across Newark Bay in this vicinity (see Figure 52). This target is recommended for further investigation.

TARGET 28
Figure 88 shows the acoustic image captured during the survey. It is located in Newark Bay at 590309 East and 662041 North (Figure 51.05). It is not associated with a magnetic anomaly. The source of the acoustic return is thought to be a round object resembling a turret. Magnetic association cannot be determined due to the masking effect of the large amount of iron sheet pile in the vicinity. This target is recommended for further investigation.

TARGET 29
Figure 89 shows the acoustic image captured during the survey. It is located in Newark Bay at 590743 East and 663018 North (Figure 51.05). It is not associated with a magnetic anomaly. The source of the acoustic return is thought to be an uneven bottom, with possible exposed frames. This target is recommended for further investigation.

Figure 86. Acoustic image of Target 26.

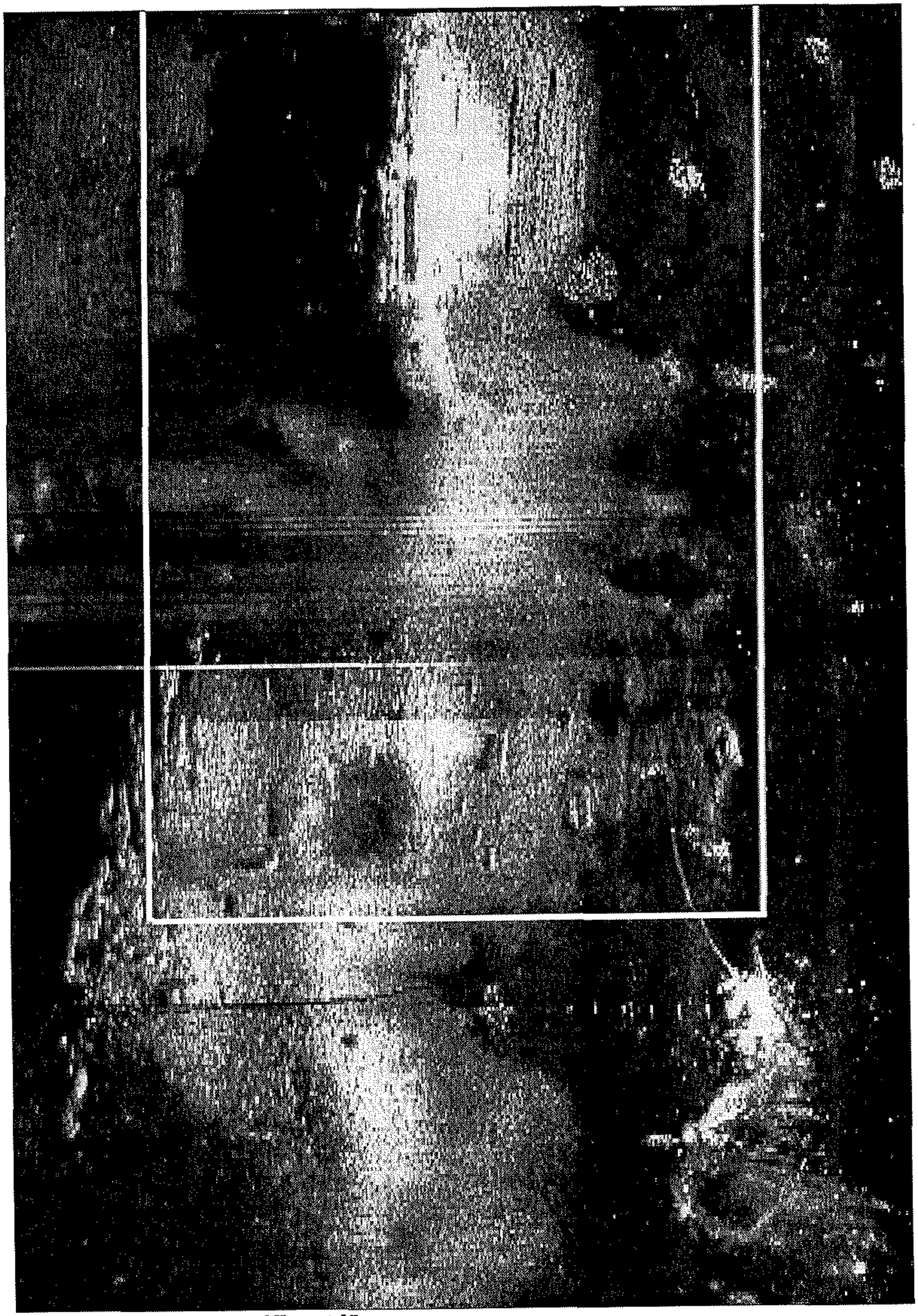

Figure 87. Acoustic image of Target 27.

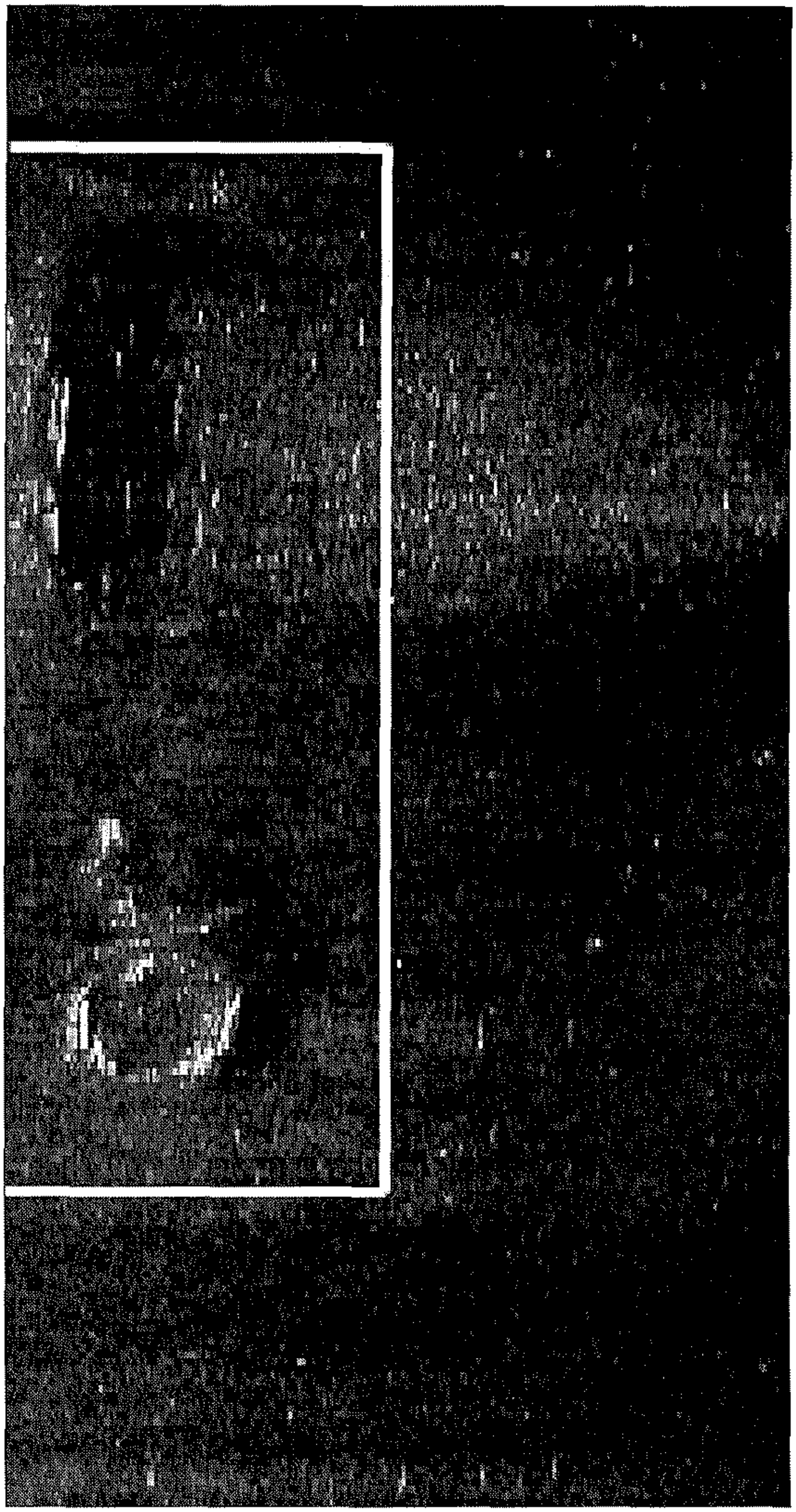

Figure 88. Acoustic image of Target 28.

Figure 89. Acoustic image of Target 29.

CLUSTERS

A number of the sidescan targets and anomalies discussed above appeared to be associated with one another, and so were grouped into a cluster. This cluster is discussed below, and all recommendations pertaining to individual targets or anomalies are included. Cluster 1 is shown in Figure 51.03.

Cluster 1. Cluster 1 is located on the west end of Shooters Island, and coincides with Survey Area 1 from Kardas and Larrabee (1985). Included in this cluster are anomalies 102-104 (see Figure 60) and sidescan targets 17, 18, and 22 (see Figures 80, 81, and 83). These targets and anomalies coincide with numerous wrecks listed by Kardas and Larrabee (1985) and Brouwer (1990, 1993) in the vicinity of Shooter's Island. These vessels are potentially significant cultural resources. However, most are outside the current project area. All sidescan targets are located outside the project area. While the three anomalies were detected within the project area, their sources likely are located outside the project area. This cluster, and all the anomalies and sidescan targets within, is not recommended for further investigation because it is outside the project area. However, as with all potentially significant cultural resources in close proximity to a project area, care should be taken not to disturb them.

SUB-BOTTOM PROFILER SURVEY

Sub-bottom profile data were collected to assist in identifying buried cables in the cable crossing area in the New York Harbor entrance channel south of the Verrazano Bridge. The data were collected along 12 lines oriented approximately north-south and analyzed for point targets in the upper 10 meters of the sub-bottom. Targets were classified as having good or weak signatures and are presented in plan view on Figure 90 and tabulated in Table 8. The tabulated data also contains the burial depth of the target.

Table 8. Analysis of Subbottom Data.

Target	North Degrees	North Minutes	North Seconds	West Degrees	West Minutes	West Seconds	Burial Depth (meters)
1B	40	34	01.824	74	01	41.682	3.2
1C	40	34	06.156	74	01	42.090	2.1
1D	40	34	07.068	74	01	42.294	1.0
1E	40	34	00.870	74	01	41.268	5.3
2A	40	34	10.818	74	01	45.492	3.9
3A	40	34	02.982	74	01	46.746	5.1
3B	40	34	03.360	74	01	46.836	4.5
3C	40	34	03.888	74	01	46.926	4.0
3D	40	34	17.070	74	01	49.266	7.0
3E	40	34	04.722	74	01	47.070	2.1
4A	40	34	18.360	74	01	52.374	1.1
4B	40	34	13.494	74	01	51.612	0.4
4C	40	34	09.456	74	01	50.556	0.4
4D	40	34	15.504	74	01	51.990	0.6
4E	40	34	04.254	74	01	49.446	0.4
4F	40	34	03.300	74	01	49.296	0.4
5A	40	34	03.768	74	01	52.020	0.2
5B	40	34	05.970	74	01	52.494	0.2
5C	40	34	07.038	74	01	52.698	0.4
6A	40	34	11.958	74	01	56.652	0.4
6B	40	34	10.452	74	01	56.328	0.4

Target	North Degrees	North Minutes	North Seconds	West Degrees	West Minutes	West Seconds	Burial Depth (meters)
6C	40	34	01.776	74	01	54.600	0.8
6E	40	34	22.842	74	01	58.968	0.5
7A	40	34	04.914	74	01	57.528	7.1
7B	40	34	05.718	74	01	57.708	0.9
7C	40	34	20.994	74	02	00.666	0.6
8A	40	34	16.398	74	02	02.508	0.8
8B	40	34	02.874	74	02	00.198	2.0
8C	40	34	00.576	74	01	59.754	4.4
8D	40	34	16.986	74	02	02.718	1.1
9A	40	34	03.534	74	02	02.922	2.6
10A	40	34	23.046	74	02	09.276	0.4
10B	40	34	20.952	74	02	08.574	3.8
10C	40	34	12.528	74	02	07.140	6.6
10E	40	34	02.526	74	02	05.118	3.4
10F	40	34	25.482	74	02	10.068	1.0
11A	40	34	01.032	74	02	07.200	3.8
11B	40	34	04.650	74	02	07.902	0.8
11C	40	34	14.478	74	02	10.068	7.5
12A	40	34	22.812	74	02	14.052	0.9
12B	40	34	57.558	74	02	09.570	5.0

Targets within one meter of the surface probably represent discrete objects such as large rocks or man-made debris. Such objects tend to concentrate near the surface in an active sedimentary environment such as the mouth of New York Harbor. If cables were present in the near surface, there would most likely be some surface expression visible on sidescan sonar records.

A band of targets trending east-west were observed along the southern portion of the survey area. Targets 11B, 9A, 8B and 6C form the clearest possible cable route. These targets all have good sub-bottom signatures and are at approximately the same depth below the seafloor.

Another band of targets trend southeast-northwest across the northern part of the survey site. While there are a number of good targets, no compelling alignments are seen here.

These interpretations are based on remote-sensing data and as such may not accurately represent the presence of physical targets in the sub-bottom of the survey area. Additional information such as cable laying techniques or as-built reports for existing cables would help in developing target signatures. Ground truthing such as sediment probing is recommended to verify the interpretations presented here.

Cable Crossing Survey

The area of the cable crossing in the Narrows (Figures 91 and 92) was successfully surveyed using a magnetometer, sidescan sonar, and subbottom profiler. The results of the sub-bottom survey are discussed above. The results of the magnetometer survey are presented in Figure 91. Analysis of magnetic and sidescan data revealed no trace of a buried cable. Analysis of sub-bottom data was also inconclusive, although several targets held mild promise. However, this does not mean a cable does not exist in the area; it simply means that the three sensors used during the survey were unable to detect the presence of one.

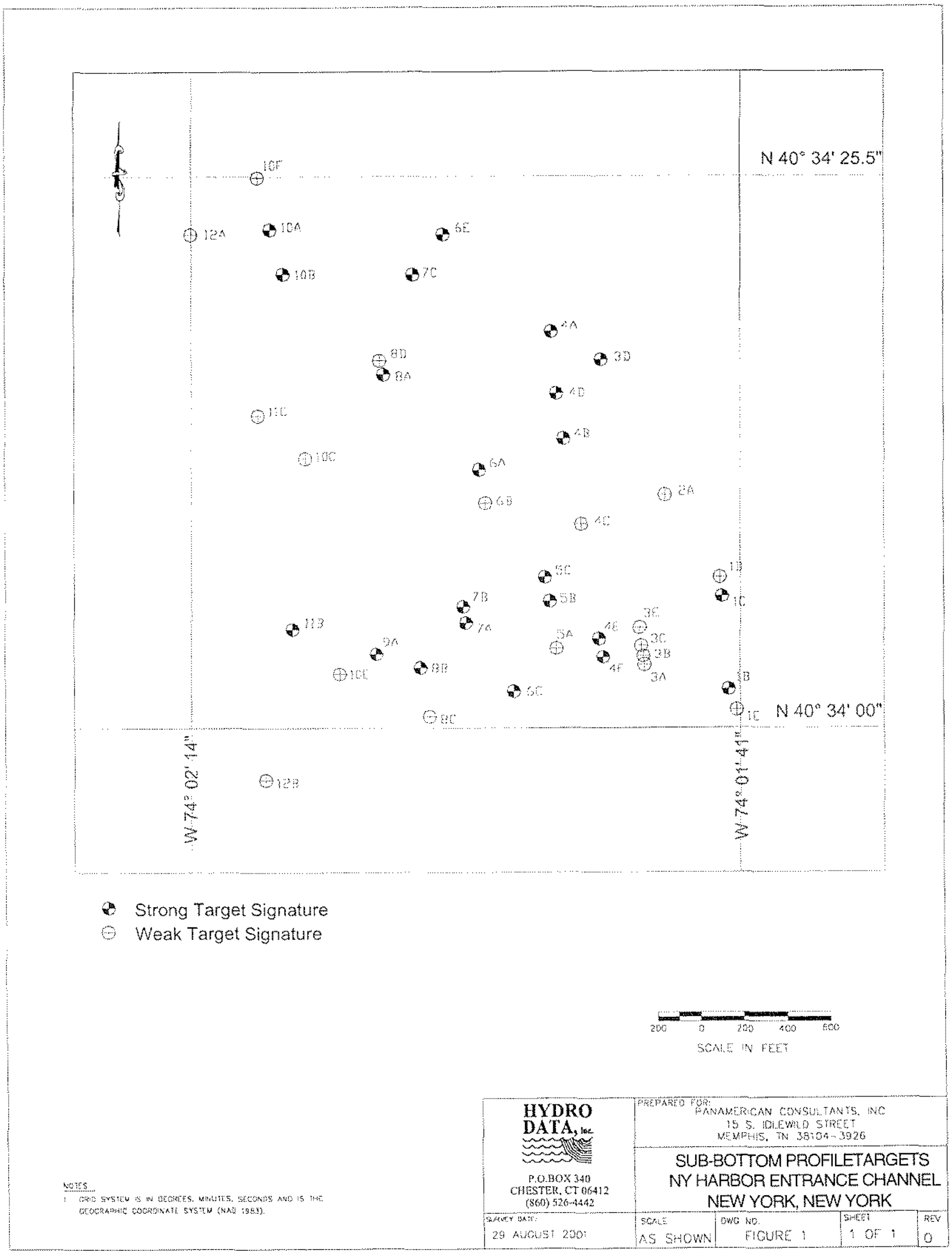

Figure 90. Map showing targets located during the sub-bottom profile survey.

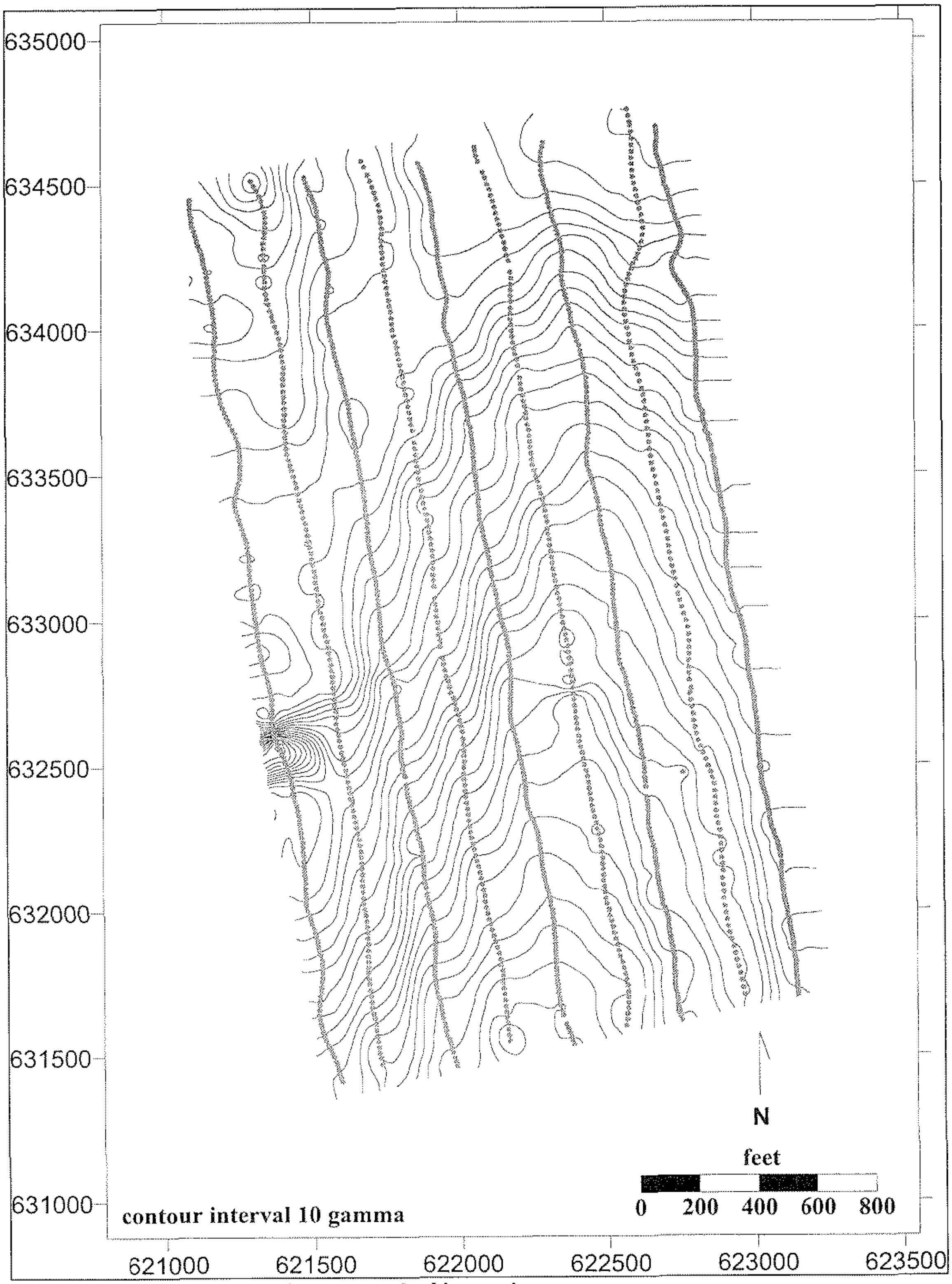

Figure 91. Contour map showing survey of cable crossing area.

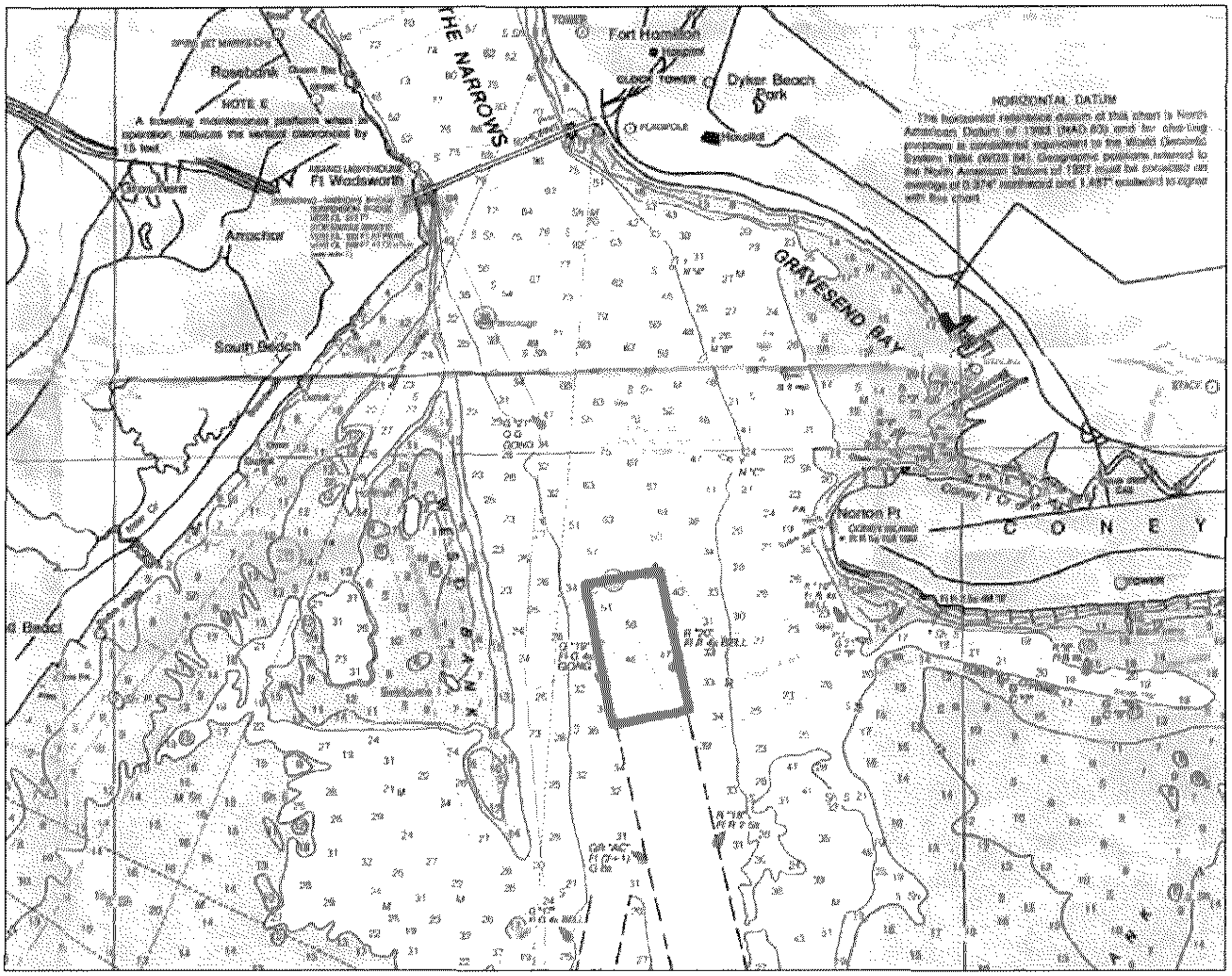

Figure 92. NOAA navigation chart showing cable crossing area (base map: *USGS North Hudson*, NY 7.5' navigation chart).

9. CONCLUSIONS AND RECOMMENDATIONS

Remote Sensing Survey

The remote-sensing survey phase of this project successfully collected data in all safely navigable areas within the project area. DGPS, magnetometer, and sidescan sonar data were collected and digitally recorded on computer disk. A total distance of 170 line miles in New York Harbor were investigated. Twenty-eight anomalies and 11 sidescan targets that met criteria for the potential existence of submerged cultural resources were located during the survey, and are recommended for further work in the form of probing and/or diver investigation (Table 9). Several targets were also located that coincided with the locations of vessels previously recorded. These were not recommended for further investigation if they have already been mitigated, investigated, or otherwise determined to be non significant.

Table 9. Targets Recommended for Further Investigation.

Anomaly/ Target	Type	Easting	Northing	Description
8	anomaly	593971	670141	unknown
9	anomaly	594123	670650	a wreck on the navigation chart
12	anomaly	595299	673793	unknown
15	anomaly	595451	674065	unknown
27	anomaly	590746	663270	a wreck on the navigation chart
33	anomaly	590574	662744	unknown
39	anomaly	576833	658171	a wreck on the navigation chart
43	anomaly	581591	660921	likely a sidescan target
46	anomaly	582338	660900	unknown
49	anomaly	589176	662578	unknown
50	anomaly	588844	662168	unknown
51	anomaly	588710	662020	unknown
52	anomaly	589250	662729	unknown
53	anomaly	588931	662335	unknown
54	anomaly	588762	662151	unknown
55	anomaly	587691	660908	unknown
61	anomaly	589315	662875	trash
62	anomaly	589479	663219	unknown
63	anomaly	589695	663650	debris on bottom
64	anomaly	593455	659908	a possible wreck on shore
73	anomaly	595314	659757	unknown
81	anomaly	656762	601225	a wreck on the navigation chart
85	anomaly	618275	651117	unknown
86	anomaly	618166	651567	unknown
99	anomaly	611407	660845	unknown
100	anomaly	612240	660479	unknown
101	anomaly	580587	660159	unknown, possibly wrecks
110	anomaly	616361	650135	near obstruction on navigation chart
3	side scan	657412	600934	3 parallel linear objects
4	side scan	656762	601225	16 m linear feature
11	side scan	600924	660453	rectangular wreckage with frames
16	side scan	587579	659553	at least three derelicts
19	side scan	582151	660191	a boat shaped object
24	side scan	581668	660989	a magnetic anomaly
26	side scan	593559	659955	a boat shaped object
27	side scan	590881	663231	a debris field
28	side scan	590309	662041	a round turret looking object
29	side scan	590743	663018	an uneven bottom, with possible exposed frames
15	side scan	599475	661384	derelicts on shore

The remote-sensing survey located 93 anomalies and 24 sidescan targets within the entire project area. Of the 93 anomalies, 65 were determined to be non-significant through data analysis, or were located outside the project area. Forty-one of the non-significant anomalies were attributed to known causes, such as modern vessels and navigation buoys. The sources of twenty-eight anomalies meeting the criteria for further investigation either remain unknown, or coincide with the locations of known but not yet evaluated potential cultural resources. These 28 anomalies are recommended for further investigation. Of the 24 sidescan targets, 13 are considered non-significant, are located outside the project area, or coincide with the locations of previously investigated sites. Eleven targets are unidentified or coincide with the locations of wreck sites that have been identified as such but have yet to be investigated. These eleven targets are also recommended for further investigation.

Non-Significant Known and Unknown Targets
A total of 65 anomalies are considered to be non-significant or are located outside the project area, including 41 known anomalies (e.g., buoys, modern vessels, etc.), eight anomalies located outside the project area, and 16 unknown anomalies. Using the signal characteristics discussed in the methodology section, the 16 unknown anomalies have been eliminated owing to low gamma strength, short duration, and detection on only one transect. These non-significant anomalies do not require avoidance from project activities, and no further work is recommended.

A total of 13 sidescan targets are considered to be non-significant or are located outside the project area. These non-significant targets do not require avoidance from project activities, and no further work is recommended.

Potentially Significant Targets
The remote-sensing data indicated 28 anomalies and 11 sidescan targets fit the criteria for potentially representing significant submerged resources. Six of the potentially significant anomalies have associated sidescan signatures representative of above-sea bed structure and could represent historic shipwrecks.

It should be stated that many of the targets listed within the potentially significant designate do not actually meet or fit the criteria established for magnetic signatures of submerged resources. These targets have been selected owing to the fact that the anomaly is located in an area that historically has seen a lot of vessel traffic and contains a large number of known significant cultural resources, may be associated with a known wreck area, or may be associated with an adjacent anomaly that has the likelihood of representing a shipwreck site.

We know that numerous historic vessels wrecked within our survey area, and therefore, the probability is high that many of our anomalies identified as potentially significant represent shipwreck locations. However, the exact location of these wrecks is somewhat vague and we are unable to accurately correlate the historic record with our targets.

Cable Crossing Area
A magnetometer, sidescan sonar, and subbottom profiler survey of the cable crossing area in the Narrows failed to locate any cable, either buried or on the surface. This does not mean that no cable exists in the area. It simply means that the instruments employed during this survey were unable to detect the presence of one.

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APPENDIX A:
SOUTH ELIZABETH CHANNEL REPORT OF FINDINGS

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INTRODUCTION

On September 3, 2001, Panamerican Consultants, Inc. (PCI) of Memphis, Tennessee conducted an underwater archaeological investigation for Barry Vittor and Associates, Inc under contract to the U.S. Army Corps of Engineers, New York District. This investigation is part of the New York and New Jersey Harbor Navigation Study Upper and Lower Bay Port of New York and New Jersey, and was performed in accordance with Section 106 of the National Historic Preservation Act of 1966, as amended through 1992, and the Advisory Council on Historic Preservation Guidelines for the Protection of Cultural and Historic Properties (36 CFR Part 800). The purpose of this investigation was to conduct a cultural resource evaluation of the South Elizabeth Channel in the form of a low-tide visual inspection and evaluation, and remote-sensing survey.

The project area is located just south of the South Elizabeth Channel (Figure 1). Although the potential for the location of significant cultural resources within the project area is considered high, no potentially significant cultural resources were identified during the inspection. One structure, a pier, is located in the area, but was constructed after 1955 and is not considered significant. The west shore contained a large amount of debris, none of which is considered significant. No submerged or derelict vessels were identified in the project area. No further work is recommended. The remote-sensing survey failed to located submerged cultural resources in the area, although the entire area was not surveyed due to extremely low water. The results of the remote-sensing survey are presented in the parent report.

POTENTIAL FOR SUBMERGED PREHISTORIC SITES

Consideration of the potential for cultural resources within the project area focuses on two distinct types: prehistoric sites and historic shipwrecks. Although the location of shipwreck sites can be realized through the employment of an array of remote-sensing equipment like that currently being utilized within the project area, the location of submerged prehistoric sites with current technology is highly unlikely. Rather, the emphasis during a study of this nature is more hypothesis than reality, the investigation basing potential submerged site locations on known above current sea level site locational parameters (i.e., land forms such as river terraces), as well as data on Pleistocene environments and resources for the area (i.e., estuaries, food types). However, it is possible to identify relic submerged landforms to some extent with the sidescan sonar and sub-bottom profilers, and then apply known parameters from above-sea-level sites to these landforms.

With this in mind, the potential for prehistoric resources within our project area is directly related to the geological morphology of the area resulting from post-Pleistocene sea-level changes. The last of the Pleistocene glacial stages was the Wisconsin glaciation; the project area lies just south of the maximum southerly limit of this glaciation (Ferguson 1986). Between 18,000 and 14,000 years before present (B.P.), sea level was more than 100 meters (325 feet) lower than it is now. Depending on the source quoted, by 12,000 B.P. sea level had risen to between 60 m and 30 m below its current level. Hunter et al. (1985:3-28) illustrate that all the project area was above sea level during the Holocene period, or termination of the Pleistocene. With human occupation believed to have begun in this area circa 12,000 B.P. (a conservative estimation), current speculation suggests that the entire project area would have been available for prehistoric occupation (Ferguson 1986:6).

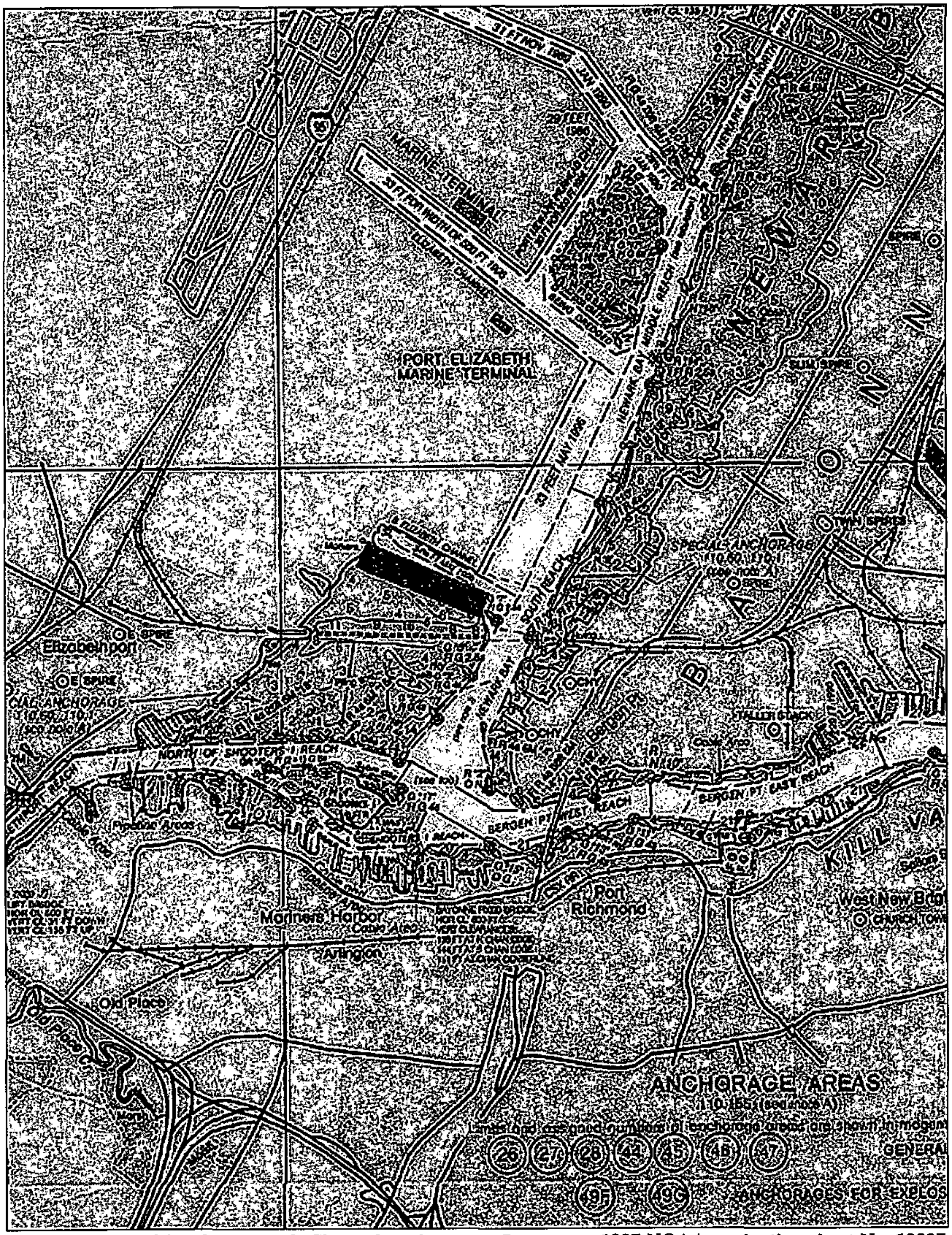

Figure 1. Map of South Elizabeth Channel project area (base map: 1997 NOAA navigation chart No. 12327, New York Harbor).

During an early investigation Roberts et al. (1979:Volume II) indicated that evidence for Pleistocene megafauna and relic shell-fish beds has been reported from offshore areas, both representing Pleistocene resources and environments favorable or conducive to prehistoric population utilization, but there was no actual evidence for prehistoric occupation or utilization during the Holocene for offshore areas. Megafauna certainly could have been a resource exploited by prehistoric peoples. In the area there are three regions where megafauna remains appear to be clustered offshore. Mammoth teeth have been found at a depth of approximately 80 meters. Mastodon teeth have been found in two separate belts from 20-25 meters and 40-50 meters below present sea level. These clusters of terrestrial remains may corroborate with past sea levels, indicating possible areas for human occupation (Miller et al. 1990:7).

The potential for submerged prehistoric sites on the continental shelf has been treated by several authors since Roberts et al.'s research (Stright 1990, 1995; Pickman 1993; Thieme 2000). Stright (1990) listed numerous sites found in a shallow water context and then went on to create some predictive modeling as to where sites could be located. Later (1995), Stright focused her studies on the effect of sea-level change on potential archaeological site location and expected levels of preservation. Pickman (1993) also focused on the potential location of prehistoric sites relative to sea-level change in the Long Island, New York area. In his study of the New York harbor region, Thieme (2000) indicates that there are known Late Paleoindian or Early Archaic sites on Staten Island. He believes that the sites represent only a small portion of actual settlement in the region and settlement extended across the inundated surfaces of the harbor region (Thieme 2000:3).

Many submerged prehistoric sites have been located in various regions of the continental shelf. Stright's (1990) compilation of 34 submerged prehistoric sites indicated the potential for the resource to be found on the continental shelf. Although the definition of *site is* "...used to designate any locality of archaeological material, not necessarily an in situ archaeological deposit," and the sample is admittedly biased–from shallow water areas–the data support the thesis that there are early prehistoric sites located in a submerged context (Stright 1990:439). Supporting this hypothesis, artifactual materials in the New England/Long Island Sound area were located due to dredging activity and were assigned to the Archaic period (Stright 1990: 441-442). Thus there is a body of evidence to support the contention that there may be submerged prehistoric resources in the present project area.

It is believed that past dredging activity off of Sandy Hook, south of the project area, may have exposed and redeposited portions of a prehistoric site. An assemblage of over 200 prehistoric artifacts was collected by a shell seeker on the beaches of Monmouth, New Jersey, well south of the park. The area where the artifacts were located had recently been renourished by sands dredged from offshore the lower end of the park and south of the current project area. The dredging took place in an area approximately one mile east off the southern portion of Sandy Hook in depths of 35 to 40 feet below mean low water. It is believed that the artifacts came from a layer within the first five feet of the sea bed from the Weeks 1 Borrow area (COE Memo, 9/21/95). The lithics, including numerous projectile points, have been tentatively identified as ranging from the Early Archaic to the Late Woodland periods, with a large portion from the Archaic. It is tentatively considered that the concentration of the artifacts, most from the Archaic period, can be considered to consist of a site that had been dredged from the borrow area and deposited with sands onto the beach at Monmouth (Merwin, personal communication 2001).

Comparable submerged sites have been found and investigated in Florida. Most artifacts have not been found by archaeologists, but by diver/collectors. Some of the extinct faunal remains found in a submerged context show evidence of butcher cuts and other evidence of human shaping (Faught 2001). However, in general the Florida environment is much more benign than the conditions found off Sandy Hook. Lower sedimentation, clearer and warmer waters, milder or no tides, and less dynamic conditions have allowed the Florida sites to be more easily found and investigated (Merwin, personal communications 2001). Although the environment is presently quite different between Sandy Hook and Florida, the evidence of Holocene occupation existing in now-submerged portions of the continental shelf may be applicable to the Holocene environment of the present project area.

Two major factors affecting the potential for locating any prehistoric resources in the project area are the fact that the area has been relatively undisturbed until recently, and the fact that sea levels were lower during the Archaic period. The project area is shallow enough that it likely would have been exposed during this period.

With the knowledge that there are other submerged prehistoric sites located on previously terrestrial Holocene environments, there is the potential for sites to be located in the present project area. This is evidenced by the assemblage of prehistoric cultural artifacts recovered from a renourished beach context, the original in situ location of the artifacts being considered an offshore borrow area south of the current project area. This would indicate that there are indeed submerged prehistoric sites in proximity to the project area. The question then is how to identify prehistoric sites that cannot be recorded during a typical marine remote-sensing investigation.

The equipment utilized for this project, i.e., magnetometer and sidescan sonar, cannot positively identify prehistoric sites, which are non-magnetic and don't protrude from the sea bed. Alternate methods and techniques may have better results. The application of a subbottom profiler survey, with parameters to identify relict landforms, and in conjunction with coring could possibly identify likely locations for submerged prehistoric sites. Rather than using these instruments in a broad survey to look for specific sites, which would be difficult, their application should be to indicate past submerged Holocene landforms with potential to contain cultural material. Subsequent testing for prehistoric sites (i.e., coring) could concentrate on the areas of higher potential, increasing the chance to contact these materials.

Potential for Submerged Historic Sites

A number of sources have been written concerning the history of the approach to New York Harbor and the subsequent loss of numerous vessels due to foul weather, lack of navigational aids, marine accidents, or simply grounding-out near the surf zone (followed by the subsequent degradation of the hull if the vessel could not be removed). Rattray mentions that the south shore of Long Island is well-known for shifting sandbars which parallel the whole length of the island (1973:50). Any and all of these factors helped to make both the "approach to New York Harbor, and the harbor itself a haven for shipwreck disasters. Derelict vessels also figure prominently in any inventory of the project area, and have been studied extensively" (James 1999).

Considering the volume of shipping that moved in and out New York Harbor for the last three centuries, the probability of shipwreck remains within the project area can be considered high. The report written by the Harvard University Institute for Conservation Archaeology (ICA) study of the Atlantic Coast titled *Summary and Analysis of Cultural Resource Information on the Continental Shelf from the Bay of Fundy to Cape Hatteras* (1979) supplies some useful information regarding the final disposition, durability, historic shipping, data, and categories of shipwrecks:

> A. Shipwreck locations
> (1) References to shipwreck location are often vague, owing principally to the difficulty of locating things at sea. Even as late as World War II it was not customary or feasible for merchantships to maintain their position at sea with any great accuracy. Thus, a position reported at the time of the vessel's distress often refers to the last known position rather than the actual position at the time of the wreck.
>
> (2) The change from sail to steam power during the mid-nineteenth century seems not to have affected shipwreck location.

B. Construction material and durability of shipwrecks

(1) Wooden shipwrecks tend to break up and disintegrate due to the effects of storms and/or attacks of marine organisms, with their remains scattered over an area much larger than the original dimension of the ship.

(2) Steel-vessel shipwrecks tend to retain a greater degree of structural integrity than wooden vessels.

(3) The early steel (actually iron) vessels of the 1860s were generally made of thin sheets of metal and tended to sink rapidly and scatter their remains over larger areas than the later, more-rigidly constructed steel vessels.

C.) Historic shipping

(1) The Harvard University study presents a brief history of shipping in the Greater New York Harbor area and makes predictions as to probable primary locations for shipwrecks for the various periods. New York Harbor has been an active port since the first Dutch settlements, and in fact since the early 1800s it has been a leading--often the leading--American port for commercial shipping. Because modern aids to navigation appeared only toward the latter part of the nineteenth century, it is probable that yearly vessel losses peaked during the period 1850-1880 (That the data contained in this shipwreck inventory does not show a peak towards the latter part of the nineteenth century is problematic, but perhaps is due only to the onset of record keeping in the twentieth century).

D.) Shipwreck data sources through time

(1) Pre-1800: there are not many records of any sort pertaining to shipwrecks during this period; what records do exist tend to be located now in European archives, since the ships involved, until 1776, were of European registry. Potential shipwreck locations are derived from analysis of shipping routes, trade, and settlement patterns.

(2) 1800-1880: coastal newspapers are the major source for information about ship arrivals and departures and about ship losses during this period.

(3) 1880-present: By 1880 the U.S. Life-Saving Service was publishing lists of casualties in its annual report. By 1910 a list of vessels lost was also included in Merchant Vessels of the United States, an annual record of registered vessels published by various government branches. By 1915 the U.S. Life-Saving Service was taken over by the U.S. Coast Guard, which also published annual reports of casualties and assistance.

4.) Categories of areas of expected shipwrecks

a. Primary: locations where popular shipping route pass through hazardous waters and/or close to shorelines.

b. Secondary: coastal and shoal areas less frequently utilized but known to contain submerged hazards and lee shores.

c. Tertiary: deep-water areas of major shipping channels, where shipwreck density relates directly to traffic density (as presented in Engebretsen 1982:2-3).

These factors (compiled by ICA) aided in establishing a shipwreck inventory for Lower New York Bay in a report titled *New York Harbor and Adjacent Channels Study Shipwreck Inventory* (Engebretsen 1982). In cooperation with the Corps and Port Authority of New York, this study established the potential for shipwrecks within navigation channels (and adjacent areas) in and near New York Harbor. Engebretsen created the inventory "of all known shipwrecks in the Greater New York Harbor area" (1982:3) using several shipwreck compendiums, lesser inventories, and government reports. The four major sources consulted include (but were not limited to) Londsdale and Kaplan (1964); Marx (1971); Berman (1972); and Rattray (1973).

Vessels lost in or near the project area are listed in Table 1.

Table 1. Vessel Losses Documented in or Near the Project Area.

Name	Rig	Tons	Built	Date	Comment
A.C. Nickerson	Steam screw	64	1864	3-25-1891	Lost, New York, NY.
A.J. Sinonfcon	Schooner			6-25-1873	Collided, off Long Island.
A.M. Andrews	Barge	2017	1919	1-28-1933	Foundered, Brooklyn.
Abangarez	Steamship			3-11-1955	Collided In fog, Gravesend Bay.
Abraham Leggett	Pilot boat			"1879"	Becalmed in lee of steamship, which rolled over & crushed her.
Abrao Collerd	Barge	217	1869	9-11-1905	Collided with steamer *Maine*. NY, NY.
Absecon	Barge	911	1918	5- 9-1911	Collided with Sta. *Sterlington* & Sts. *Empire Curzon*, NY Harbor.
Acapuloo	Steamer			2-11-1875	Anchored, Gravesend Bay; ice damage.
Adelaide	Steam side wheel	731	1853	6-19-1880	Collided, sank. New York, NY.
Admiral Dewey	Steamship			11-22-1908	Smashed into a steamer off Coney Island.
Adolph Obrig	Bark	1,118	1881	11-10-1907	Sailed from NY & not heard from.
Adriatic	Or it. Steamer			10-21-1874	Collided in New York Bay; damaged.
Adventure	Scot. merchantman			1760	Lost in Lower New York Bay.
Aetna	Citizen's line steamer			5-15-1821	Exploded in New York Harbor; complete wreck.
African Star	Farrell Line's Freighter			12-18-1956	Collided in New York Harbor; sank
AJace	Ital. bark			3-3/1-1881	Wrecked Rockaway Shoals (Coney Island); total loss.
Albany	Schooner	650	1889	11-16-1922	Stranded, Man-0-War Rock, New York Harbor.
Albion	Brit. merchantman			2-1818	Wrecked on Coney Island, crew & cargo saved.
Alexa	Brit. Schooner			1-23-190f	Total loss, Rockaway Point, LI.
Alfred & Edwin	Oil screw	109	1872	12-19-1926	Foundered, Brooklyn; iron vessel.
Alice	Steam screw	154	1897	1-28-1935	Foundered, Erie Basin, Brooklyn.
Alice Roy	Bark			8-1887	Abandoned, off New York.
Alice Sheridan	Coal barge	373	1919	10-1-1915	Sunk in NY Harbor after collision off Staten Island (St. George).
Ambrose Snow	Pilot boat			5-13-1912	Rammed & sunk in Lower Bay.
American Leader	Freighter			1-15-1953	Collided, New York Harbor, in fog.
American Press	Freighter			0-29-1959	Collided in New York Harbor.
Americus	Scow	170	1898	4-18-1925	Collided w/Sts. *Bronx, Brooklyn*.
Andrew Fletcher	Steam aide wheel	160	1865	12-20-1872	Burned, Quarantine landing, Staten Island.
Annie Bulge?	Barge	233	1906	2-26-1918	Foundered, New York Harbor.
Arbitrator	Schooner	106	1897	12-13-1916	Sailed from NY, not heard from.
Ariel	Sloop	54	1857	9-21-1908	Burned, New York City, NY.
Aminda	Steamer			3-18-1931	Collided in Narrows; damaged.
Avon	Ship	1,573	1884	4-5-1918	Sailed from NY, not heard from.
Ayuruoca	Steamer Freighter (ft)	6872		"1940", 6-11-1945	
B.W. O'Hara	Barge	227	1903	5-11-1914	Foundered, NY Harbor.
B.Y. 11	Barge	157		1-15-1926	Foundered, NY, NY.
Belle P. Mustek	Barge	350	1904	2-26-1918	Foundered, Brooklyn.
Benj. E. Weeks	Schooner	77	1867	11-1-1920	Stranded, New York, NY
Benaore	Bark	1,178	1870	7-10-1921	Foundered, NY, NY; iron vessel.
Bertha L. Barker	Schooner		1895	11-7-1916	Foundered, NY, NY.
Betsey	Brit., troop-transport			1780	Wrecked on rooks, Lower NY Bay.
Betty B	Fishing boat			7-28-1951	Exploded & sank in Lower NY Bay.
Bit Bob	OAS yawl	51	1905	2-23-1920	Burned, NY, NY.
Black Warrior	Side wheel steamer			2-20-1859	Sank in 30ft off Rockaway Beach, LI

Name	Rig	Tons	Built	Date	Comment
Bohemian	Steam screw	72	1906	6-13-1935	Collided, NY Harbor.
Boston City	Brit. screw steamship			1-31-1901	Collided in Lower NY Bay.
Boyle	Schooner			1-30-1900	Wrecked west of Rockaway Ft, LI.
Broadway	Steam side wheel	755	1869	9-19-1917	Burned, NY, NY.
Bronx No.4	Steam side wheel	100	1893	9-29-1913	Foundered, Pier 5, Staten Island.
Buffalo (R,B)	Steam side wheel	1129	1854	6-29-1854	Foundered, New York, NY.
Buffalo	Steam screw	131	1885	11-21-1913	Burned, Staten Island.
Cresent	Steam screw	68	1872	1-13-1929	Foundered, Brooklyn.
Cl	Barge	518	1906	8-31-1928	Foundered, NY, NY.
C.W. Horae	Steam Screw	509	1889	7-17-1916	Sailed, NY, never heard from.
Caldwell H. Colt	Pilot boat			3-11/12-1888	Damaged in blizzard.
Caprice	Pilot boat			2-27-1876	Run down in Narrows; sank; raised.
Capt. Mathlasen	Steam screw	117	1899	4-20-1925	Burned, Gravesend Bay, NJ.
Caroline	Brig			unknown	Sunk near Bills Island.
Caroline	Steam screw	63	1875	8-6-1922	Burned, Brooklyn.
Caroline	Sloop			6-24-1874	Run into off Battery; filled; sank.
Carrie C. Miles	Schooner	106	1871	10-15-1907	Stranded, Dry Rooer Shoal NY.
Carrie S. Webb	Schooner			3-1-1881	Sand, Homer Shoals, alongside Auguste; wrecked.
Carrie Winslow	Brig			2-11-1878	Wrecked New York Bay.
Caatlefcon	Barge	1112	1899	10-1-1907	Collided w/*Rochester*, New York, NY.
Castor	Steam screw	73	1891	3-7-1923	Foundered, NY, NY.
Chaleur	HM Sloop			7-10-1761	Burned by mob in New York.
Chancellor	Steam screw	383	1910	7-31-1928	Burned, Bosebank,Staten Island.
Charlie & Willie	Schooner	123	1849	10-30-1923	Burned, NY, NY.
Charter Oak	Steam side wheel	439	1838	3-1-1850	Burned, NYC.
Chatham	Ferry			8-29-1960	Collided in fog in NY Harbor.
Chicago City	?			10-20-1919	Sunk in collision off Staten Island.
Chris Olsen	Steam screw	54	1907	4-19-1948	Burned, Mariner's Harbor, Staten Island.
Christ!ane	Danish bark			12-27-1866	Panned & sunk 6 miles e. of Sandy Hook.
Cincinnati	Merchantman			11-10-1810	Wrecked on Governor's Island.
City of Albany	Steam side wheel	1158	1863	10-6-1894	Burned, New York, NY.
City of Detroit	PCanal boat?	118	1875	4-18-1906	Burned, St. George, Staten Island.
City of Worry	Amer ship			1761	Sunk in Narrows; crew saved.
Columbia	Pilot boat			12-3-1883	Run over; all lost.
Columbia	Steam screw	174	1890	12-24-1909	Sailed from NY; not heard from since.
Columbus	Ferry			1-1856	NY-SI ferry; hull crushed by ice off Battery; passengers and crew saved.
Coaefc	Steam screw	97	1904	6-17-1925	Burned, Brooklyn.
Comet.	Steam screw	77	1901	5-26-1939	Foundered at pier, Arlington, Staten Island.
Conineroe	Pilot boat			1852	Lost with all on board.
Copla	Schooner			9-18-1882	Total loss off Rockaway Pt, Cargo coal.
Cornelia Soule	3-Masted Schooner			4-26-1902	Sank off Rockaway Pt, LI.; cargo granite, called "Granite Wreck"
David E. Baxter	Barge	173	1889	5-8-1908	Foundered, St. George, Staten Island.
Denvlle	Lighter			8-5-1940	Capsized off Stapleton, Staten Island.
Dolphin	Gas screw			1960	unknown cause, 830 yd., 192° from Coney Island Light. Depth 27'.
Dom Pedro	Barge	193	1876	2-21-1906	Collided with dock, NY, NY.
Dredge No. 12	Barge	330		1-19-1939	Burned off Bayonne, NJ.

Name	Rig	Tons	Built	Date	Comment
Duchess J	Steamer			8-26-1902	Burned, New York.
E.G. Hay	Schooner	63	1873	6-28-1906	Collided off Debrosses St., NY, NY.
E.M. Card	Steam screw	204	1920	4-3-1945	Burned, Red Hook, Brooklyn; steel vessel.
EX-PC 469	Oil screw			1961	Unknown cause, Swinburne Island area, NY Harbor. 40° 43.3' N, 74° 03.4' W U.S. navy vessel.
East Wreck	3-Coal barges			1917	In triangle w/in 5 miles of shore, near Rockaway Point.
Economy	Steam sidewheel	239	1853	6-30-1851	Burned, NY, NY.
Edmund Driggs	Pilot Boat			3-11/12-1888	Ashore at Bay Ridge, Brooklyn; hole in bottom; lost.
Kilward T. Dalzell	Steam screw	96	1900	10-26-1926	Collided, Brooklyn.
Edwin Collyer	Schooner			1903	Sunk, Gravesend Bay; cargo sand.
Ekefors	Swed motor vessel			12-16-1949	Collided at Narrow; badly damaged.
El Estero	ship			11-24-1903	Fire at Caven Ft., towed to Robbins Reef & sunk (Upper Bay).
El Sol	Steam screw	6,108	1910	3-11-1927	Collision in fog in New York Harbor; sank.
Elizabeth	steam side wheel	1,079	1867	10-22-1901	Burned, New York NY; ferryboat.
Ellis P. Rogers	Barge	68	1878	12-23-1907	Collided w/*Mauretania*, NY, NY.
Enna R.	Barge	251	1903	9-8-1906	Foundered, NY, NY.
Enmett McLoughlin	Barge	331	192'!	9-21-1938	Stranded, Gravesend, NY.
Escape	Schooner			7-6-1916	Sank after collision off Ambrose Lightship.
Europe	Ger. bark			10-7-1876	Fire in hold at New York.
Evelyn	Schooner			11-30-1900	Wrecked west of Rockaway Pt, LI.
Evelyn	Ferry			1-13-1917	Wrecked in explosion
Evelyn	Steam screw	57	18811	10-25-1930	Burned, Brooklyn.
Evening Star	?			1866	Foundered at sea, out of New York.
Express	Steam side wheel	1,023	1864	5-11-1933	Foundered, Brooklyn; iron vessel
Fly	Pilot boat			1813	Lost with all hands.
Fort Victoria	Passenger boat			12-18-1929	Collided; sank at entrance to NY harbor 0° 28.6" N 73° 53.2' W Depth 12
Frank Pendleton	Schooner	1,393	1874	3-8-1917	Foundered, Ambrose Channel, NY.
Gen. Meigs	Steam screw	267		10-27-1926	Foundered, NY, NY; steel vessel
George L. Garlick	Steam tug			5-25-1897	Wrecked. Coney Island.
George W. Beale	Steamer			10-1887	Collided, New York Harbor.
Glendower	Schooner-barge	855	1894	1-3-1930	Collided, Brooklyn, w/*City of Elwood*.
Glide	Schooner			1905	Lost at Rockaway, LI.
"Golden Nugget"	?			unknown	Wreck west of Rockaway Inlet.
Governor	Tug			3-12-1888	Sunk between Rockaway Pt. and Swash Channel.
H.S. Inc. No. 11	Barge	258		5-18-1948	Collided, off Pier 6, Staten Island.
Haleyon	Steam screw	89	1875	10-18-1923	Foundered, Coney Island.
Harry Bum	Steam screw	51	18611	5-27-1872	Exploded, New York, NY.
Hattie Thomas	Steam screw	56	1890	1-29-1928	Foundered, Elm Park, Staten Island.
Hazel Mitchell	Barge	377	1907	4-16-1929	Stranded, St. George, Staten Island.
Henry Eckford	Steamer	153	1824	11-27-1841	Exploded, NY, NY, used as coal barge.
Henry D. McCord	Steam screw	69	1872	4-18-1926	Burned, Brooklyn.
Herbert Parker	Oil screw	137	1919	5-16-1932	Burned off Ambrose Channel Lightship.
Hibernian	Liner			5-2-1867	Burned at Fulton Perry.
Hopafccong	Barge	563	1885	12-6-1910	Foundered, NY Bay; iron vessel
Hudson	Liner			5-29-1912	Rammed in New York Harbor; "began to sink".
Ideal	Steam screw	149	1906	1-7-1945	Stranded, Staten Island, NY.
Idle Time	Cabin cruiser			9-10-1951	Capsized off Rockaway Point.

Name	Rig	Tons	Built	Date	Comment
Idler	Steam screw		1886	7-24-1912	Collided w/*Old Colony*, NY.
Ilion	Barge	113	1890	12-14-1917	Stranded, Coney Island.
Isabella	Schooner			11-1-1837	Foundered in gale near New York.
Isabella Gill	Schooner	585	1891	8-17-1906	Sailed from NY & not heard from.
Italy	Scow	339	1914	11-19-1920	Burned, Brooklyn.
Ithaca	Steam screw	1,462	1906	8-11-1946	Burned, Brighton Marine Repair yd. West New Brighton, NY.
J.A. Reynolds	Tug			12-13-1940	Collided, New York Harbor; sank.
J.J. Rudolf	Lighter			11-11-1941	Sank at Atlantic Basin Pier, Brooklyn.
J.H. HcLaren	Bark			11-25-1871	Sunk In Lower Bay off Staten Island, probably total loss; cargo coal.
J.P. MeAUiater	Steam screw	133	1909	5-18-1934	Burned, Brooklyn.
Jacob A. Stamler		1,198	1856	2-17-1916	Burned, NY.
Jacob W. Morrisa	Schooner			unknown	Total loss off Battery.
James F. Murphy	Tug			1961	Unknown cause, Sailors Snug Harbor, NY Harbor. Depth 27
James H. Robinson	Canal boat	97	1881	5-26-1909	Foundered, Brooklyn.
Jaoea Funck	Pilot boat			1862	Sank In Narrows; raised.
James Logan	Steam screw	201	1914	11-17-1917	Collided w/*Lexington*, NY, NY.
Janes Runsey	Steam side wheel	341	1845	11-11-1853	Burned, NY, NY. Ferryboat.
James Rumsey	Steam side wheel	671	1867	2-20-1891	Sank, NY, NY. Ferryboat.
Jane	Pilot boat			4-2-1873	Ashore on West Bank, Lower Bay; filled.
Japanese	Pilot boat			3-11/12-1888	Collided; damaged.
Jenny	Merchantman			1778	Wrecked during gale on Staten Island.
Jenny	Merchantman			1798	Wrecked in Lower New York Bay.
John A. Hadgeman	Steamer			2-19-1890	Burned, New York.
John B. Mather	Schooner			3-21-1860	Damaged in collision off West Bank.
John D. Jones	Pilot boat			3-18-1871	Run down by City of Washington; all saved.
John E. Berwind	Steam screw	75	1888	2-16-1931	Foundered, Stapleton, Staten Island.
John G.. Olsen	Steam screw	134	1900		Burned, Pier 31, Brooklyn.
John Mckeon	Pilot boat			7-18-1939	Off NJ; lost at sea in hurricane.
John Nelson	Barge	341	1849	8-19-1905	Stranded, NY, NY.
John Schmults	Schooner	59	1884	2-26-1925	Foundered, Brooklyn.
Johnson No. 17	Barge	131	1806		Burned, Black Tom Island, New York Harbor, due to explosion.
Joseph J Flannery	Steam screw	107	1881	1-25-1927	Burned, Port Richmond State Island.
Josephine Elliot	Schooner	391	1890	1-9-1908	Sailed from NY, NY., not heard from.
Joaiah Johnaon	Pilot boat			3-6-1869	"Run down & sunk by schooner sunk in bay".
Josle Mildred	Bark			8-1873	Run into at anchor in Lower Quarantine, cut through from water line up.
Joyce Card	Steam tug	123	1892	3-7-1931	Exploded in Erie Basin, Brooklyn; sank.
Juanita	Tug			12-27-1917	Sank in collision. New York Bay.
Julia	Schooner	57	1878	9-13-1907	Collided, Coney Island.
Kaoikawa Maru	Jap. Freighter			6-9-1966	Collided in fog with Nor. freighter *Nordvind* near Ambrose Lightship.
Kaskaskia	Steam screw	2,931	1918	1-31-1920	Burned, New York, NY.
Kate Dyer	?			1866	Sank about 10 miles off Fire Island after colliding w/*Scotland*; cargo cotton.
Kate Marquise				11-12-1890	Total loss off Highlands, NJ.
Kelsey	Barge	203		11-28-1904	Foundered, New York, NY.
Kenneth W. KcNeil	Barge	261	1903	5-2-1907	Foundered, New York, NY.

Name	Rig	Tons	Built	Date	Comment
Kenyon	Schooner			11-30-1900	Wrecked off (w) of Bockaway Pt., LI.
Knoxville	Steam side wheel	1,210	18511	12-22-1856	Burned, New York, NY.
L.A. Buzby	?	117	1892	1-31-1919	Collided w/*McAllister*, NY, NY.
Lamartlne	Schooner			1888	Lost in East Bay, NY.
Lanarkshire	Freighter			2-15-1943	Collided in main ship channel. Upper Bay, w/U.S. destroyer *Hobpy*.
Liguria	Ital. Liner			12-1906	Collided, New York Bay, with *Peconic*.
Lizzie D	Steam screw	122	1907	10-19-1922	Sailed from Brooklyn; not heard from.
Lloyd H. Dalzell	Steam screw	202	1927	1-19-1951	Burned at commercial wharf, foot of Atlantic Basin, Brooklyn.
Lord Dufferin	Freighter			2-28-1919	Sunk in New York Bay by *Sultana*.
Louis	Steam screw	89	1863	10-16-1876	Stranded, Coney Island.
Louise	Side wheel steamer	1,351	1864	5-11-1933	Foundered, Brooklyn. Steel vessel.
Lucy & Elizabeth	Amer. ship			1812	Lost in Lower New York Bay; All saved.
Ludlow	Barge	1113	1899	11-3-1911	Burned, Pier 22, Brooklyn.
Mamie K	Motor boat			11-25-1919	Total loss 1 mile w. of Rockaway Beach.
Mandalay	Steam screw	1,120	1889	5-28-1939	Rammed & sunk by Acadia, New York Bay. Iron vessel.
Manhattan	U.S. Coast Guard Cutter			1-13-1932	Collided w/*Guayaouil*. New York.
Margaret Julia Howard	Bary	500	11(8	11-27-1920	Collided w/Brit *Clifftower*. NY.
Margaret Olaen	Steam screw	78	1890	5-4-1929	Collided w/tug *Joseph A. Cinder*, Brooklyn.
Maria Dagwell		110	1890	7-19-1919	Collided w/*Townsman*. NY.
Marigold	Steam screw	115	1863	11-30-1875	Burned, New York, NY.
Marion Olsen	Steam screw	87	1881	8-22-1931	Burned, Brooklyn.
Martha Ogden	Steamer			11-12-1832	Stranded, New York.
Martha Stevens	Steam screw	283	1862	7-20-1909	Collided w/*Confidence*, NY Harbor; iron vessel.
Mary	Dutch ship			1802	Lost in Lower New York Bay.
Mary	Steam tug	58	1859	3-15-1875	Collided with Harlem passenger boat *Shady Side*. New York Harbor; sank.
Mary A. Hall	Schooner	381	1882	5-29-1919	Burned, NY Harbor.
J Mary Heitman	Schooner			3-11/12-1888	Last seen going through Narrow.
Masootta	Bark			2-18-1891	Wrecked in collision, NY Harbor.
Matthew Kinney	Schooner			2-5-1872	In Narrows, bow port stove in by ice; vessel filled.
McCall	U.S. destroyer			12-3-1917	Collided w/*Comanche* below Narrows in high wind.
Metinio	Schooner	261	1901	2-26-1916	Sailed from NY Harbor, not heard from.
Michael Howard	Barge	502	1918	3-18-1912	Foundered, New York Harbor.
Mississippi	Merchantman			1807	Wrecked in Lower New York Bay; crew & some cargo saved.
Mohawk	Yacht			7-20-1876	Capsized in bay near New York; lost.
Mohawk	USN revenue cutter			10-1-1917	Lost in collision off New York.
Mohawk	Schooner	913	1882	1918	Sailed from NY & not heard from.
Montague	Side wheel steamer	110	1853	12-8-1853	Burned, NY. Used as ferryboat.
Morning Star	Brit. Ordnance sloop			8-1-1778	Blew up near New York coffeehouse; believed struck by lightning.
Mosea B. Bramhall	Schooner			10-21-1891	Unknown: entrance to NY Harbor.
Mutual	Steam screw	84	1890	1-3-1930	Collided w/ferry *W.R. Hearst*. Erie Basin, Brooklyn.
Mutual	Tug			4-30-1929	Collided w/ferry *Youngstown*; sunk.
Mystery	Gas boat	137	1905	2-23-1920	Burned, NY. Steel vessel.

Name	Rig	Tons	Built	Date	Comment
N.B. Starbuck	Steam screw	101 (72)	1863 (65)	10-17-1928	Burned, New York (2 listings in B, with variances).
N.S. Starbuck	Steam tug			6-9-1872	Collided off Battery w/*City of London* (Brit.); badly damaged.
Narragansett	Steam screw	115	1873	8-I3-113B	Burned, Pier 32, Brooklyn.
Nathaniel Bacon	U.S. Cargo ship			11-21-1942	Damaged in collision w/*Esso Belgium* in NY Harbor.
Nat Sutton	Steam screw	66	1887	5-27-1946	Burned at Canal Terminal, ft. of Columbia St., Brooklyn.
Navesink	U.S. Dredge			5-7-1928	Sank after collision. New York Harbor.
Hellle T	Barge	255	1904	11.14-1919	Collided w/unknown vessel, Brooklyn.
Nelson	Brit. Merchantman			1815	Sank in Lower New York Bay.
New York	Barge	523	1923	1-1964	Foundered, Foot of Columbia St., Brooklyn.
New York Marine Co 16	Steam screw	179	1904	2-17-1926	Foundered, Brooklyn.
Nifadelos	Bark			12-16-1865	Collided & sank. New York Harbor
North Dakota	Tanker			1-26-1959	Collided off Bayonne, NJ with U.S. Army Dredge *Essayons*.
Northfleld	Staten Island Perry			6-14-1901	Radioed sunk in New York Harbor.
Northumberland	Oil screw	169	1897	10-24-1955	Foundered, 40° 22' M 73° 31' W.
No. 7	Schooner	957	1907	10-6-1918	Collided w/USS *Monitor*. NY.
No. 9	Oil screw	299	1920	12-21-1951	Foundered, Brooklyn.
Oceanua	Steam screw	1,996	1665	5-21-1868	Burned, NY. (East River?)
Ohio	Side wheel steamer	1112	1829	7-6-1842	Exploded, NY.
Ohioan	Steam ship			11-22-1933	Collided w/SS *Liberty*. Ambrose Channel; settled on shoals.
Old Glory	Hontauk Steamboat Co Steamer			1921	Destroyed by fire, New York.
Oliver A, Arnold	Steam screw	50	1863	2-11-1890	Burned, New York, NY.
Oregon	Side wheel steamer		1845		Collided w/*City of Boston*, sank in NY Harbor.
Orlo VI	Gas screw	79	1917	16-Sep	Collided w/*Barwick*. Brooklyn.
Oreanfcan	Steam screw	2,293	1880	11-3-1915	Sailed from NY & not heard from.
Ovidia	Steal ship			11-19-1930	Sank off Ambrose Lightship.
P.W. fiprague	Steamer			10-1880	Burned, New York.
Palnella	Steam screw	595	1867	6-30-1870	Lost, NY, NY.
Passaic	Barge	552	1922	5-8-1930	Burned, Bayonne, NJ.
HKS Penfcland Firth	Brit. oil screw	500		9-22-1942	Torpedoed & sunk, Rockaway Inlet 40 25' 19" N 73° 52' 05" w. Patrolcraft Depth 50' (70'-Rattray).
Pequoit Hill	Tanker			1.14.1946	Exploded, Bayonne, NJ; on fire.
Petersburg	Tanker			5-24-1944	Exploded, Constable Hook, NJ.(Bayonne).
Phantom	Pilot boat			3-11/12-1888	Lost in storm.
Philip J. Kenny	Steam screw	142	1884	1-19-1923	Burned, off Ambrose Channel.
Phoenix	Schooner	901	1898	2-3-1926	Stranded, New York, NY
Pilgrim	Steam screw	261	1891	3-27-1937	Burned, Bayonne, NJ.
Pilot	Pilot boat			12-16-1917	Caught in submarine net off New York; rammed, sunk, by steamer *Berkshire*.
Pilot Boat	Pilot boat	361		4-27-1939	Collided w/Oslofjord off Sandy Hook. NJ. IO" 27' 45" N 73^9' 30" W. Depth BO
Pocono	?			9-5-1930	Total loss, Atlantic Highlands.
Pontin 227	Barge	234	1916	6-8-1966	Burned, Port Richmond, Staten Island.
Portland Packet	Schooner	91	1885	7-16-1916	Sailed from NY & not heard from.
Port Philip	Brit. steamer	4060		10-16-1918	Rammed, sunk by USS *Proteus*, Ambrose Ch.

Name	Rig	Tons	Built	Date	Comment
Queens	Steam side wheel	802	1877	11-9-1918	Burned, New York, NY.
Quickstep	Bark			unknown	Run down & sunk In Lower NY Harbor, wreck removed & buoy placed on spot to mark shoal, near West Bank.
R.S. Lindsay	Schooner			11-10-1887	Sank sw of Rockaway Life Saving Station.
Rundlet	Schooner	271	1892	6-29-1916	Foundered, New York, NY.
Red Ash	Steam screw	117	1888	7-7-1927	Burned, Staten Island, NY.
Reichers Bros.	Steam Screw	85	1873	9-3-1930	Burned, New York, NY.
Relief Lightship NO. 5				6-211- 1960	Hit on Ambrose Station in fog; sank; wreck site marked, but moved.
Relief Lightship UAL				1961	Unknown; in vicinity of Ambrose Channel Lightship Station.
Rhea	Nor. bark			5-31-1871	Collided w/*Hansa*; sank.
Richard Card	Steam screw	182	1904	10-1-1944	Foundered, north side of pier, foot of 31st St., Brooklyn.
Richard Jaokaon	Barge	230	1880	3-6-1913	Foundered, New York, NY.
Richard Morrell	Schooner			10-12-1888	Unknown; Coney Island, NY
Richiond	Ferry			9-14-1944	Capsized, Bay Ridge, Long Island.
Robt.. C. Bonhaa	Oil screw				Burned, ft. of 6th St, Jersey City, NJ.
Robt.. Rodo«rs	Steam screw	142	1881	10-11-1913	Burned, New York, NY.
Rose	Naval vessel			12-1778	Wrecked on Staten Island.
Rose McLoughlin	Barge	199	1912	9-21-1938	Stranded, Gravesend Bay, NY
Rotterdam			1882	1902	Run down and damaged.
Rudolph	Steam screw	200	1898	9-25-1918	Collided w/USS *St. Louis*, NY, NY.
Ruth	Barge	224	1916	3-21-1942	Stranded, Brooklyn.
Ruth E. Pember	Gas screw				Struck submerged wreck off Scotland Light: total loss.
Ruth Shaw	Barge	185	1916	11-11-1939	Foundered, 2 miles SE of Jones Inlet Buoy, LI. tO0 29' M 73° 15' W.
S.H. 5	Tug			2.5-1940	Sunk at Brooklyn by ice floe.
S.M. Hayena	Schooner			8-30-1887	Collided, New York Bay.
S.S. Wyckoff	Steam screw	267	1860	3-13-1913	Collided w/*Heroine*, NY Harbor.
Sb, Janes	Brit. troop-transport			1783	Wrecked on Staten Island.
Sb. Vincent	Tug			11-23-1917	Damaged in collision, NY Harbor.
Sallle E. Ludiam	Schooner	237	1873	6-17-1917	Collided w/ Corozal, NY Harbor.
Sally	Merchantman			1789	Wrecked on Coney Island.
Samson	Ferry			7-1-1839	Wrecked between NY & Staten Island.
Samuel Marquand		101	1882	5-17-1918	Foundered, Erie Basin, NY.
San Jacinbo	Pilot Boat			18/12	Lost with all hands.
San Jose II	Pan. Tanker			7-23-1956	Damaged in collision, 3 miles south of Ambrose Lightship.
Sander-art	Steamer	2,054	1918	7-2-1950	Sank after collision w/*Melrose*, entrance to Narrows. Steel vessel; Depth 47'.
Sandy Hook	Pilot boat steamer	361	1902	4-27-1939	Collided w/*Oslofjord*, 1 mile outside Ambrose Lightship. Steel; 40° 27' 45" M 73° 49' 30" W.
Santa Barbera	Steam ship			9-17-1935	Collided w/Ambrose Lightship.
Sarah	Barge	296	1889	10-12-1929	Collided w/ George W. Loft. Bay Ridge, Brooklyn.
Satellite	Steam screw	381	1894	11-20-1915	Burned, New York Harbor.
Scow Franklin	Scow			8-15-1897	Total wreck; Rockaway Inlet.
Sea Bird	Steamer			5-9-1932	Burned, New York.
Sea Wave	Scow			3-18-1950	Capsized off Ambrose Lightship.
Secaucua	Steam screw	919	1873	11-3-1935	Burned in ferry slip, foot of Bay Ridge Ave.

Name	Rig	Tons	Built	Date	Comment
Seneca	Side wheel steamer	313	1819	6-30-1872	Burned, New York, NY; ferryboat.
Seneca	Steam screw	2,963	1894	1-9-1928	Burned, New York, NY.
Seth Low	Fireboat			1917	Wooden City of Brooklyn boat; sank at dock.
Shamokin	Barge	829	1904	5-11-1925	Foundered, Scotland Lightship.
Shepherd Knapp	Side wheel steamer	186	1845	1856	Burned, New York, NY.
Silveryew	Brit. motor vessel			3-18-1931	Damaged in collision, Narrows.
Soaeraefc	Schooner	629	1905	2-10-1918	Foundered off Ambrose Light, NY.
Speculator	Schooner			7-21-1831	Sank off Coney Island.
Spitfire	Side wheel steamer	221	1846	10-12-1819	Burned, New York, NY.
Springhill	Tanker			2-5-1915	On fire after collision in Lower New York Bay.
SquantuB	Steam screw		1089	1-16-1121	Foundered, Brooklyn. Steel vessel.
Star	Barge	89		9-12-1905	Foundered, New York, NY.
Staten Island	Steamer			7-30-1871	Exploded, NY, NY. Ferryboat.
Supply 3	Oil screw	66	1921	1-30-1920	Foundered, Brooklyn.
T.W.O. Co. 28	Barge	312	1917	3-1-1930	Burned, Staten Island.
Teka	Barge	389	1917	1-13-1942	Collided, NY, NY.
Tempest	Side wheel steamer	80	1849	10-1-1866	Burned, New York, NY.
The Bruce	Ship			2-11-1891	Unknown, Bayonne, NJ.
Theodore	Barge	126	1882	7-30-1916	Burned, Jersey City, NJ.
Thomas Bulger	Barge	265	1900	2-11-1925	Collided w/B&O RR Bridge, Bayonne, NJ
Thomas E. Hulae	Side wheel steamer	314	1851	3-30-1875	Damaged by ice, New York, NY.
Thonas Hale	Barge	207	1896	2-5-1917	Foundered, Brooklyn.
Tloellne	Steam screw	99	1896	11-22-1920	Collision, w/*Correction*, NY, NY
Titania	Brit. steamer			11-19-1881	Collided in Narrows w/*Hypatla*.
Transport	Steam screw	162	1900	3-22-1933	Foundered, Brooklyn.
Trojan	Side wheel steamer	280	1812	8-9-1851	Burned, New York, NY.
True American	Merchantman			2-20-1809	Wrecked near the Narrows, Upper New York Bay.
Tynefield	Tanker			2-8-1958	Collided off Staten Island with ferry; damaged.
U.S. 110	Barge	294	1919	3-7-1921	Foundered, Brooklyn. Concrete vessel.
U.S. Lightship, Ambrose Channel	Coast Guard Lightship			winter 1961-62	Disappeared.
U.S. Navy Escort Vessel				7-22-1911	Exploded, Tompkin, SI.
Umberto Prino	Bark			3-13-1891	Unknown. Romer Shoal; cargo hides and wool.
Union	Side wheel steamer	296	1811	12-15-1878	Burned, New York.
Union	Side wheel steamer	516	1862	7-17-1929	Burned, Port Richmond, 31 Perry.
Union Star	Side wheel steamer	163	1861	10-16-1862	Burned, New York, NY.
Universe	Barge	120	1915	1-2-1926	Foundered, New York, NY.
(unknown)	Sloop			8-20-1798	Struck Lightning off west end of Long Island.
(unknown)	Many			1839	Many wrecks, Coney Island, in gale
(unknown)	?			1890's	Suck en wreck miles NE. from Ambrose Channel Lightship; found 1893.
(unknown)	?			1920 vintage	Charted as obstruction, 5 miles off Sandy Hook in Ambrose Channel. Depth 40'.
(unknown)	?			unknown	5 miles off Sandy Hook, In 60' of water.
(unknown)	?			11-22-1933	Rammed off Coney Island; sank on Craven Shoals.
(unknown)	Launch			8-31-1935	Sank in collision with oil tanker at East Chester Bay, Staten Island.
(unknown)	?			unknown	40° 21' 18" N 73° 56' 06" W, Depth 35'.
(unknown)	?			unknown	40° 21' 24"-M 73° 49' 18" W. Pre WWII.

Name	Rig	Tons	Built	Date	Comment
(unknown)	?			unknown	40° 25' 12" N 73° 45' 18" W. Depth 70'.
(unknown)	?			unknown	40° 27' 22" N 73° 59' 13" W.
(unknown)	?			unknown	40° 27' 24" N 73° 53' 06" W Derrick barge.
(unknown)	?			unknown	40° 30' 08" N 73° 51' 40" W Depth 7'.
(unknown)	?			unknown	40° 32' 00" N 73° 51' 90" W Depth 24'; pro WWI.
(Unknown)	Barge			1946	5 miles off Sandy Hook.
Vallderooaa J	Steamer			5-11-1944	Collided w/*Woodrow Wilson*, approaching New York.
Violet BloasoB	Barge	371	1907	2-20-1913	Collided w/McAlliater Bros. NY.
Vivi	Nor. Tanker			2-5-1915	Collision, New York Harbor.
Vulcan	Steamer			1875	Struck rock between Bobbins Reef and Liberty Island; sank; cargo machinery.
W.A.L. 505 Lightship				6-21-1960	Struck by freighter *Green Bay* on Ambrose Station; sank. Wreck site marked, but moved.
W.J. Townsend	?	133	1876	1-16-1941	Foundered, Bayonne, NJ.; concrete vessel.
V. J. Tracy	Tug			9-8-1931	Foundered in Narrows.
W.L. Webater	Steam a crew	73	1882	6-3-1919	Collided w/unknown object; Brooklyn.
M.S. & A.L. Rogera	?	106	1889	12-1916	Foundered, New York.
Waubesa J	Freighter			3-17-1919	Sank after collision. New York Harbor; cargo grain.
Wellesley Victory	Tanker			1-31-1917	Collision, off Ambrose Lightship.
White Rook	Schooner			7-25-1890	Unknown cause; New York Bay.
Wm. A. Carroll	Steamer	71	1906	3-17-1918	Foundered, Battia St., Brooklyn.
Wm. Dinsdale	Steamer			1-24-1911	Collided w/*Conoho*. NY Harbor.
Wm. F. Havemeyer	Steamer	110	1875	7-28-1907	Burned, New York, NY.
Wm.. Gulndon	?	103	1888	6-1915	Foundered, South Brooklyn.
Win, H. Babcock	3 Basted schooner			5-21-1927	Sank at looping, Bensonhurst, Brooklyn.
Wm. H. Vanderbilt	Barge	211	1871	8-19-1905	Stranded, New York, NY.
W. J. Hahoney	Barge	320	1927	3-23-19611	Foundered off boardwalk. Coney Island.
Wm. J, Rooer	Pilot boat			1863	Struck submerged wreck & sank.
WH. H. Clark	Schooner			unknown	Lost in Gravesend Bay.
Wm. O'Brien	Steamer	5,211	1915	1-18-1920	Sailed from NY & not heard from.
Wm. V.R. Smith	Steamer	207	1905	3-11-1920	Stranded, New York, NY.
Wo, Voorhia	Schooner	89	1866	11-2-1907	Collided w/dock. New York, NY.
Yankee	Barge.	531	1902	2-4-1920	Stranded, Brooklyn.
Yeada	Yacht			5-25-1890	Wrecked, New York Bay.
Zero	Barge	331	1926	9-21-1938	Foundered, Oraveacnd Bay.

Engebretsen's principal purpose was to inventory shipwrecks "known or presumed to have occurred in the New York Harbor project area" (Engebretsen 1982:7). Additional purposes of the inventory were to:

- Assess the potential magnitude of the overall "shipwreck problem" with regard to deepening the navigation channels.
- Predict which areas have a high density of shipwrecks and which areas have a low density of wrecks.
- Predict the likelihood that a wreck encountered comes from a particular century and possibly predicting the parent material it is likely to be made from.

• Begin to track down and pinpoint the name and history of any shipwreck encountered (Engebretsen 1982:7).

As Table 1 above indicates, New York Harbor was an area of numerous historic vessel losses.

Daniel Berg's book *Wreck Valley Vol. II* "is designed as a diver's guide to shipwrecks located off the New Jersey and Long Island coasts" (1990:vi). Berg provides historical background, water depths, currents, visibility, and types of aquatic life on over 90 shipwrecks within the New York Bight or "Wreck Valley."

Another source of wreck accounts off Long Island is titled *Lost Voyages: Two Centuries of Shipwrecks in the Approaches to New York* by Bradley Sheard (1998). Sheard's book covers the evolution of oceangoing vessels, the tragedy of shipwrecks, and documents a number of wrecks located near the approaches to New York Harbor. Sheard admits that his map is:

> ...only a partial listing; there were more documented wrecks, as well as undocumented ones. Note that the wreck locations are approximate. Early records are often incomplete and imprecise, and the sheer number of wrecks shown cannot be plotted with any accuracy due to space limitations alone (Sheard 1998:70).

Sheard's work provides a map of wreck sites along the south shore of Long Island with the name and dates of vessels lost (Sheard 1998:70).

While Sheard's book provides a useful glimpse into numerous wreck sites strewn throughout the approach to New York Harbor, no history or loss accounts (besides the date and general location) of any of the vessels listed above are provided in the book. Sheard does acknowledge that:

> Estimates of the number of shipwrecks in the region run from the hundreds into the thousands. The Long Island and New Jersey coastlines form the two sides of a "funnel" directing traffic into New York's great harbor, and have witnessed more shipwrecks than anywhere else along the East Coast of the United States, with the possible exception of Cape Hatteras, along the Carolina Outer Banks (Sheard 1998:8).

Another factor which bears mention is the proximity of other wrecks and derelicts to the current project area. Large numbers of abandoned vessels are located in the vicinity of Shooter's Island, and along the shores of Arthur Kill and Kill van Kull. There are also vessels located along the site of the U.S. Dike on the northern shore of Arthur Kill, just south of the current project area (James 1991). Also, Kardas and Larrabee (1980) noted a hulk in the vicinity of the Singer plant, which is just south of the project area as well. Although the area was surveyed, they did not locate any wrecks or hulks in the current project area.

From the maritime history and shipwreck information above it is clear that the potential for shipwrecks within the approaches to New York Harbor remains extremely high. Vessel types spanning every era in American history have traversed, wrecked in, and been abandoned in the waters off New York, making it a haven for a variety of shipwreck sites, many still undocumented and unidentified.

Previous Investigations

Numerous investigations have taken place in the vicinity of the project area. However, the majority are not associated with the South Elizabeth Channel, save two. For a comprehensive review of all archaeological reports, please see the parent volume to this report. The two reports in close proximity to the project area both located at least one hulk or wreck. Five shipwrecks in proximity to the U.S. Dike in Arthur Kill were examined by Consulting Nautical Archaeologists (James 1987). This project coincided with the enlargement of South Newark Bay channel.

Initially slated to assess the eligibility of two shipwrecks for nomination to the NRHP, three additional wrecks were located and assessed as well. These vessels included four wooden-hulled steam tugs and a wooden-hulled sidewheel steamboat. Due to the deteriorated condition of the hulls and the lack of diagnostic and cultural material, it was determined that none of the five vessels were eligible for NRHP status.

Kardas and Larrabee (1980) examined parts of Arthur Kill, Shooter's Island, and the west side of Newark Bay up to Port Elizabeth as part of the New York Harbor Collection and Removal of Drift project. They concluded that many of the structures and sites along the channels are eligible for NRHP status, and recommended further investigation of sites such as the Central Railroad Bridge and the Singer plant, in the form of planning, monitoring, and recording. They also recommended detailed examination of several hulks in the vicinity of the Singer plant. None of the items discussed in this report are in the current project area.

Remote Sensing Survey

The remote-sensing survey of South Elizabeth Channel was completed on August 30, 2001. The complete results are included in the parent report, but in short no cultural resources were located. The entire area could not be surveyed, however, due to extremely low water.

LOW WATER VISUAL SURVEY

The low water visual survey of the shoreline adjacent to the South Elizabeth Channel was completed on August 30, 2001. During this survey approximately one roll of still photographs was taken, along with field notes. The survey examined an area extending south 250 feet from the south edge of the current channel (see Figure 1). One structure was identified in the form of a pier (Figure 2).

Figure 2. Photograph of wooden pier structure located in the project area.

This structure was constructed sometime after 1955, as it appears on the modern navigation chart (Figure 3), but does not appear on the U.S.G.S quad published in that year (Figure 4). It is not considered a significant structure. Also, the west shore was littered with debris (Figure 5). Although some of it was large and articulated, no sunken or derelict vessels or vessel remains were identified. It was determined that none of the items discussed are culturally significant and no further work is recommended.

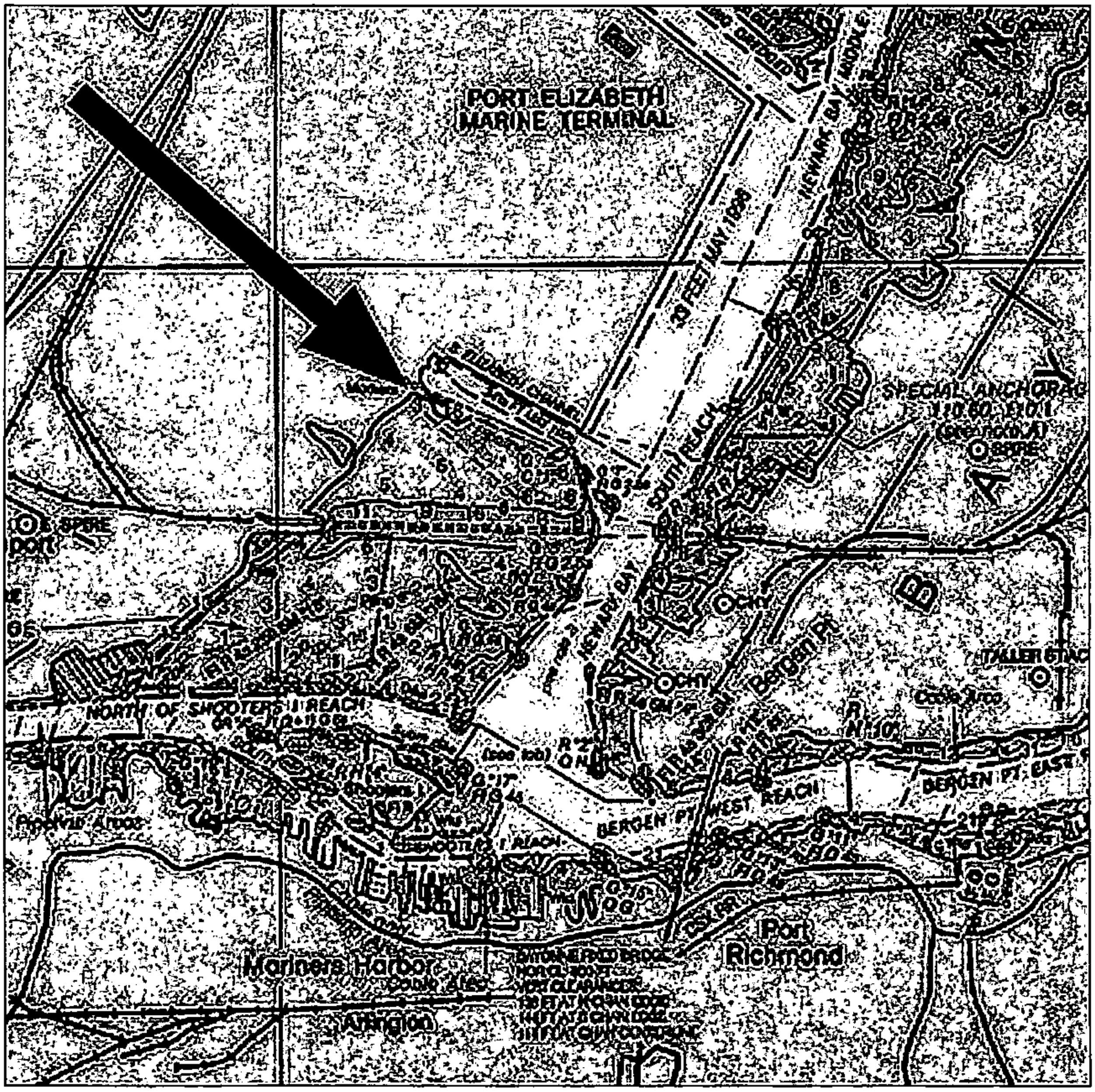

Figure 3. Section of 1997 navigation chart showing location of wooden pier structure (base map: NOAA navigation chart No. 12327, New York Harbor).

Figure 4. 1955 U.S.G.S. map showing South Elizabeth Channel vicinity. Note absence of pier structure, marked by gray circle north of the Central Railroad Bridge (base map: 1955 U.S.G.S. Elizabeth, New Jersey quadrangle).

Figure 5. Photograph of west shore of project area showing large amount of debris.

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APPENDIX B: REMOTE SENSING PLAN

REMOTE SENSING SURVEY PLAN

Remote Sensing Survey
In Connection with the
New York and New Jersey Harbor Navigation Study
Upper and Lower Bay
Port of New Jersey,
Kings, Queens, New York and Richmond Counties, New York,
Essex, Hudson, Monmouth and Union Counties, New Jersey

Contract No. DACW51-97-D-0009, Delivery Order No. 0062

INTRODUCTION

Under subcontract to Barry Vittor and Associates, Inc., Panamerican Consultants, Inc. (PCI) presents the following technical plan to conduct a magnetometer, sidescan sonar, and bathymetric survey of a proposed channel improvement project in New York Harbor along Ambrose, Anchorage, Port Jersey, Kill Van Kull, Arthur Kill (to Howland Hook), Newark Bay, Elizabeth, South Elizabeth, and Bay Ridge Channels. The following proposed technical survey plan is presented to the New York District, U.S. Army Corps of Engineers (Corps) in response to their Scope of Work (SOW) under Contract No. DACW51-97-D-0009, Delivery Order No. 0062 entitled *Remote Sensing Survey in Connection with the New York and New Jersey Harbor Navigation Study Upper and Lower Bay, Port of New York and New Jersey, Kings, Queens, New York, and Richmond Counties, New York, Essex, Hudson, Monmouth, and Union Counties, New Jersey*. As part of this study the New York District is responsible for identifying and determining if any properties within the project area are eligible for listing on the National Register of Historic Places (NRHP). This work is in partial fulfillment of the District's obligations under Section 106 of the National Historic Preservation Act of 1966, as amended through 1992; Executive Order 11593; the Advisory Council on Historic Preservation Procedures for the Protection of Historic and Cultural Properties (36 CFR Part 800); and the Abandoned Shipwreck Act of 1987.

The remote-sensing survey will cover an area of approximately 31 miles along the navigation channels listed below. It is these fill areas within the Design Reaches that require a cultural resources remote-sensing survey to ascertain the presence (if any) of potentially significant historical properties (i.e., shipwrecks).

The project area is divided into nine sections. They include:

- Ambrose Channel, both banks to 2,500 feet east of its current terminus.
- Anchorage Channel, entire length, west side only.
- Kill Van Kull Channel, entire length, both banks.
- Arthur Kill Channel, both sides to the Howland Hook Berth.
- Newark Bay Channel, east side to the northern edge of the Port Newark Channel, west side between Kill Van Kull and South Elizabeth Channels. Also the area between Port Elizabeth and Port Newark Channels to 250 feet east of current channel edge.

- South Elizabeth Channel, south edge only.

- Newark Bay/Kill Van Kull intersection.

- Robbins Reef, dredged pit and 100 feet south and east of pit.

- Cable Crossing, to locate buried cable. Magnetometer, sidescan sonar, and sub-bottom profiler shall be used. At least eight lines shall be run.

Professional services required under the SOW provided by the Corps include the following:

1) Development of a comprehensive remote-sensing plan.
2) Review of previous research.
3) Conduct a cultural resource evaluation of the South Elizabeth Channel.
4) Conduct a magnetometer and side-scan sonar survey along the areas specified above.
5) Preparation of interim report.
6) Analysis of survey data.
7) Preparation and submission of a technical report of findings.

Having conducted several similar surveys in the New York area for the Corps, PCI is well qualified to perform the study as outlined. In addition to those surveys conducted for the New York District, PCI's maritime archaeologists have extensive experience in the conduct of numerous other remote-sensing surveys, and diver location and assessment of potentially significant targets (e.g. shipwrecks). These investigations have been conducted throughout the Atlantic, Gulf, and Pacific seaboards of the U.S., the Great Lakes, the Caribbean, and numerous major riverine systems. This experience gives PCI maritime archaeologists in-depth knowledge concerning the assessment of site significance and integrity, as well as the equipment types best suited for the environment of a specific project.

PROJECT PERSONNEL

Mr. Stephen R. James, Jr. will serve as Project Manager for the duration of this project and will oversee all aspects of the project. Mr. James holds a degree in anthropology from Memphis State University and a master's degree in nautical archaeology from the Institute of Nautical Archaeology, Texas A&M University. SOPA (Society of Professional Archaeologists) certified since 1985, and with 15 years' experience in maritime archaeology, he has extensive project experience and has directed and conducted all phases of work on submerged sites including archival research, remote-sensing surveys, anomaly assessment, site testing, and full-scale shipwreck mitigation.

Mr. Andrew D.W. Lydecker, who will act as Principal Investigator for the investigation, holds an M.A. in archaeology from the University of Wisconsin-Madison, an M.S. in cartography and geographic information systems from the University of Wisconsin-Madison, and a B.A. in anthropology and geography from Minnesota State University–Mankato (formerly Mankato State University). Prior to employment with PCI, he obtained experience in maritime archaeology primarily in the Great Lakes region and Mid-Atlantic Coast as well as the South Pacific. He has also obtained terrestrial archaeology experience in the Midwestern U.S, South Pacific, and Caribbean. Since joining PCI, Mr. Lydecker has directed several remote-sensing projects for various clients ranging from the Army Corps of Engineers New York and Norfolk Districts, as well as various state, local, and private agencies. He has work experience on the Atlantic Coast, Gulf Coast, Pacific Ocean, Great Lakes, Caribbean, and numerous riverine systems. At present Mr. Lydecker is directing a National Register of Historic Places eligibility evaluation of the Breakwater of the City of Plattsburgh, New York.

Mr. James Duff, who joined PCI in August of 1991, is A.B.T. in the master's program at Texas A&M University, will act as Marine Survey Archaeologist. Prior to employment with PCI, he accumulated extensive professional experience working for the North Carolina State Underwater Archaeology Unit and participated in remote-sensing surveys and anomaly investigations on projects with various universities and consulting firms. Since joining PCI, Mr. Duff has successfully directed and completed a variety of underwater cultural resource projects. Among these, he co-authored a shipwreck compilation and historic background report recently completed as part of a remote-sensing survey for a submerged pipeline corridor from New Jersey to Staten Island, New York. That survey collected over 2,000 line miles of remote-sensing survey records, including magnetometer, sidescan sonar, and subbottom profiler, which were analyzed and interpreted by Mr. Duff for potentially significant cultural resources. He has directed several remote-sensing surveys for both the Savannah and Vicksburg District, as well as the North Carolina Department of Transportation.

The Archaeological Technician who will participate in this survey will be chosen from PCI's pool of qualified individuals.

PROJECT PHASES

LITERATURE REVIEW

PCI will perform the necessary literature and records check of pertinent sources (i.e., reports, literature) in order to prepare a detailed maritime history of the survey area, identify the locations of historic sites located within or in the immediate vicinity of the survey area, and identify changes that have taken place that could affect the types of resources present and their condition. Five references of relevant previous work conducted in the area are provided in the SOW, and two are viewed as major references relative to the presence of historic shipwrecks. As stipulated in the SOW, the literature review will not be limited to these identified references.

CULTURAL RESOURCES EVALUATION OF THE SOUTH ELIZABETH CHANNEL

PCI will perform a cultural resources evaluation of the South Elizabeth Channel to determine the potential for both prehistoric and historic resources. This evaluation will include a background literature review and limited fieldwork in the form of visual inspection. The evaluation will include recommendations for further work.

REMOTE SENSING SURVEY

The remote-sensing survey will cover an area of approximately 31 miles along the navigation channels listed above. These areas to be investigated will extend no further than 100 feet from the current edge of the navigation channel, unless otherwise noted. Onboard remote-sensing instrumentation will consist of an EG&G Geometrics 866 proton precession magnetometer, a Marine Sonic Technology Side Scan PC sidescan sonar, and an acoustic recording fathometer. The magnetometer's dual trace analog will be operated on 10/100 or 20/200-gamma scale with readings taken every second. Chart speed will be five inches per minute and background noise levels will be kept below ± 2 gammas. The magnetometer sensor will be towed at a predetermined distance aft of the navigation system's tracking antennae. A Datasonics CAP-6600 Chirp II sub-bottom profiler will be used in the area of buried cable.

With a dual frequency towfish of 600 kHz, the sidescan sonar has internal capability for removal of the water column from the instrument's digital chart printout, as well as correction for slant range distortion. Sidescan sonar data are useful in searching for the physical features that might indicate submerged cultural resources. Specifically, the record is examined for features that show characteristics such as height above bottom, linearity, and structural form.

An acoustic recording fathometer will also be employed to obtain bathymetric data from the survey area. The data will be recorded on thermal or ink trace paper and hand annotated with positioning fixes at regular intervals for each survey line. This data will be relative due to the daily change in water depths caused by the tides.

Positioning data during the survey will be collected on a Motorola LGT-1000 based Differential Global Positioning System (DGPS). DGPS data collected for this project will allow for repeatable accuracy of no more than ±5 feet. Navigation data will be annotated on remote-sensing instrument stripcharts and interfaced and stored along with magnetic data into a Winbook XP computer running proprietary navigation software provided by Chris Ransome and Associates (CRA) of Houston, Texas. Constantly receiving and storing positioning data from the DGPS, the information will be continuously processed and stored in a computer database. DGPS signals are additionally displayed on a helm-mounted monitor screen, allowing the vessel operator to navigate along pre-plotted transects (survey lines) which will be spaced at 100-foot intervals. The survey shall be conducted using the State Plane Coordinate system (NAD 83).

The sub-bottom profiler to be used will be a Datasonics CAP-6600 Chirp II Acoustic Profiler. This is a multi-frequency (20 khz to 400 khz) device which uses a chirp pulse to collect high-resolution images of the seafloor and sub-bottom layers. The unit has a Windows interface for real-time data processing and display.

Line spacing for the survey will be 50 feet (15 meters). Vessel speed during the survey will average between three and four miles per hour, with speeds sometimes lower when encountering ebbing tidal currents. Transects will be run parallel to the long axis of the project area. Additional tracklines shall be obtained for magnetic and/or sidescan sonar targets that are suspected to be shipwrecks. Tracklines will not be spaced greater than 65 feet apart for this survey.

DATA ANALYSIS AND REPORT PREPARATION

An Interim, Draft, and Final Report of the remote-sensing survey, as well as a letter report of the Elizabeth Channel evaluation, are required under the Scope of Work for this research.

Interim Report: Two (2) copies of the Interim Report will be submitted within one week from completion of the fieldwork. It will briefly discuss field methodology, results, conclusions, and recommendations. The Interim Report will be included as an appendix to the Draft and Final Reports.

South Elizabeth Channel letter report: Two (2) copies of the South Elizabeth Channel letter report will be submitted within one week from completion of the fieldwork. It will briefly discuss field methodology, results, conclusions, and recommendations.

Draft and Final Reports: Four (4) copies of a draft report of investigations will be submitted within six weeks after submission of the Interim Report. This report will include complete sections on the background of the study, environmental and historical contexts, detailed descriptions of the methods, techniques, and results of the archival research and remote-sensing survey, site specific and location maps including magnetic contour maps of significant anomalies, and sidescan sonar acoustic images, as well as a complete discussion of recommendations per the Scope of Work for any located cultural resources sites or targets potentially eligible for nomination to the National Register of Historic Places (NRHP).

The report will provide data on the presence and amplitude of ferrous anomalies and shall present an analysis of sidescan and magnetic data in order to predict possible shipwreck remains within the project area. Magnetic data shall be summarized and presented in tabular form, as well as in a magnetic contour map. Anomalies and sidescan targets will be prioritized as to their potential for representing submerged cultural resources and recommendations will be presented relative to further testing. Signal characteristics employed for the selection of magnetic anomalies will include anomaly strength; area coverage determined by duration of an anomaly along a trackline and extension of that anomaly on adjacent lines; and relative association of a given anomaly to other anomalies and to sidescan sonar targets. Signal characteristics employed for the selection of sidescan sonar targets will include indications, such as linearity and structural form, that a bottom feature represented an unnatural object, and association with magnetic anomalies and other side scan targets .

A component of the report shall be a discussion of how the field investigations were conducted and the results of these investigations. The effectiveness of equipment and methods used will be discussed in detail and recommendations for improved performance in underwater investigations of this type should be formulated if necessary.

All sites (potentially significant targets) will be depicted to scale, and plotted on quadrangle and existing project maps. Photocopies of these maps with plotted sites will be submitted to the Corps. Magnetic contour maps will be produced for each potentially significant anomalous target.

Six (6) copies including one (1) unbound, camera-ready original of the final report will be submitted within four weeks of receipt of government review comments for the draft report. Both the draft and final reports will conform to *American Antiquity* style, with the exceptions outlined in the Scope. The final report will be signed by the Principal Investigator. In addition, one copy of the magnetometer and sidescan sonar survey records will be submitted with the final report.

RESEARCH GUIDELINES

All field, laboratory, and office work to be carried out under this contract will be conducted in accordance with the Standards and Guidelines established in 36 CFR Part 66, Recovery of Scientific, Prehistoric, Historic, and Archaeological Data: Methods, Standards and Reporting Requirements (Federal Register, Vol. 42, No. 19 - Friday, January 18, 1977).

SAFETY AND LOGISTICS

Safety will be the paramount concern during the remote-sensing phase of the project. A copy of EM385-1-1,"Safety and Health Requirements," dated September 1996, will be reviewed prior to the fieldwork phase of the project. Special attention will be paid to chapter 19, "Floating Plant and Marine Activities," and a copy made available for inspection to all persons on the crew. All PCI personnel scheduled to participate in this research have been qualified in First Aid and CPR by the Red Cross or comparable agency. The field director will, upon arrival at the mooring area of the survey vessel, locate the nearest hospital and the quickest evacuation route to it. During the survey there will be available communication with shore in the event of an accident. All PCI personnel are adequately covered by insurance for all activities required under this contract.

PCI will charter a vessel to work the near-shore areas during this project. For this project a 65-foot crew boat will be leased from Captain Paul Hepler. The vessel will be fully U.S. Coast Guard approved for type and class, will conform to the above noted regulations, and will be piloted by a fully licensed captain. PCI will require that the vessel have on board the proper first aid and safety equipment, as well as potable water and proper sanitary facilities.

Finally, as with all marine activities, a constant monitoring of the weather and environment will be taken to avoid any situation that would be a hazard to navigation or the safe and effective collection of remote-sensing data. Such contradictions to safe navigation and work could include but not be limited to shallows, breaking waves, severe weather, commercial or private craft, as well as unidentified flotsam and jetsam, obstructing the survey vessel path, bathers and other individuals in the water, and any other situation that can be considered a hazard to navigation.

COMMUNICATION

PCI will maintain open communication with the Corps for the duration of this project. Regular communication with the Corps' archaeologist will be the responsibility of the Project Manager. All discussions will be communicated to Barry Vittor and Associates, Inc, and all report deliverables will be submitted through their New York office. Contractual concerns will be coordinated by the Project Manager assigned to this Delivery Order.

APPENDIX C: FIELD RECORDS

NY Harbour survey

SS notes

8/20/2007

NY HARBOR SLUDGE REMOVAL PROJECT MON. AUG. 6, 01'

CENTER LINE (RUNNING ON 50M OR FT?)
AM I EAST (+ 50) (HEADING EAST)

— AROUND 7000 FT WIND PICKS UP + SEA GETS CHOPPY
about 123000 large linear feature on left screen (far left) 06 AUG 021. MST (
↳ MAYBE 06 AUG 022. MST)

— AROUND 06 AUG 26. MST ON LEFT SCREEN POSSIBLE TRIANGULAR SHAPED FEATURE

— JUST AFTER 16,000 FT ON RT SCREEN
06 AUG 22. MST (ANNOTATED w/ ?)

AROUND HERE, 06 AUG 33. MST large mag hit, annotated the spot.

06 AUG 34. MST small linear structure
Annotated →

Another spot around 06 AUG 35. MST
Annotated

{very choppy}

CHECK LEFT SCREEN IN 06 AUG 40. MST
(I ANNOTATED RIGHT SIDE, BUT ON LEFT NEAR CENTER WAS A LINEAR STRUCTURE)

HFT

AT 28,000 (just past there) noticed set to 75 (NOT 50) RD. NOT SURE HOW LONG IT WAS RUNNING ON THIS

AT 06AUG053.MST, RIGHT SCREEN) Center, - circular object (annotated)

AMW1 LINE - 50 TUES. AUG. 7, 01'

HEADING WEST (RUNNING ON 50 RD) SUNNY, HOT, SWELLS

(TIME ANNOTATED IS NAV TIME, NOT MAGGIE TIME)

— 07AUG018. MST

THIS AREA WAS A LARGE MAG HIT ON PREVIOUS LINE & PAUL (CAPT) SAYS KNOWN WRECK SITE (ON CHART) LARGE MAG HIT IN THIS AREA. (STBD)

— 17AUG019. MST WEIRD EEL LOOKING OBJECT. Doesn't look like shipwreck. Annotated w/(?

17 AUG 021. MST Area marked (?) NO MAG HIT ASSOCIATED (PORT SIDE)

~~17~~AUG 029, MST 60 GAMA HIT IN THIS AREA (TOWARDS BEGINING

07AUG 045. MST — Current wash behind buoy. Marked (annotated.)

thru Sea Bright

straight on 36 3 miles past bridge

Ferry to Manhattan signs

rt at 1st Ave. to end

rt into Atl. High. Marina

go to end

Pier 6 is last one

at end.

~~www.~~

englishtownauction.com

Englishtown

Sa Sun

7-4

9-4

90 Wilson Ave

NJTP x9

18 S

+527S,

RUNNING ON 20 RD

NY HARBOR ~~B~~ SLUDGE REMOVAL PROJECT

(AMBROSE CHANNEL END)

(?)
(+50) AMEND (2500 FT. LINE) WED. AUG 8, 01
(heading ~~East~~ ~~west~~ west)

GAIN ADJUSTED TO 10.5 - 30.5 (TO THE EOL)

→ OR 019
07 AUG 016. MST - OBJECT ON LEFT (PORT) SIDE

(+100) AMEND (Heading EAST)

CHECK 07 AUG 24. MST. PORT + STBD SIDES. ONE ANNOTATED; ONE IS NOT ANNOTATED.

(+150) heading ~~E~~ west AMEND

07 AUG 032. MST. CHECK ANNOT. ?

+ ~~200 AMEND. (due EAST)~~

07 AUG 036. MST PORT SIDE.
linear OBJECT PORT SIDE Annotated
ALSO CHECK LAST SECTION IN (+150) ~~[illegible]~~ PORT SIDE (NOT ANN)

(+200) AMEND (due EAST)

AUG 07 043/044 ? Annotated STBD

AUG 07 049. MST - STBD SIDE CROSS HATCH
~~[illegible]~~ OBJECT LINEAR w/ CURVE]

08/08/01
NY HARBOR -
DREDGE PROJECT

(+250) AMEND due west

+300 AMEND due EAST

AUG 07.065 STBD SIDE - FAIRLY LARGE STRUCTURE

CHECK AUG07 068/067.MST. (STBD SIDE

+350 due west

+400 due east
(capt! thought he saw something at very end of this line - check)

+ 450 due west
07AUG091 .MST Annotated STBD.
large square structure

+ 500 DUE EAST

+ 550 DUE WEST - large container ship had passed thru channel

+600 Due east
07AUG126 MST - Stbd. small, linear

~~#6~~

NY HARBOR
SLUDGE
REMOVAL.

AMEND

+650 heading west

+700 due ~~east~~ west (prior LINES NEED TO BE RE-CHECKED
NOT SURE IF ~~ON~~ IN THE
RIGHT PLACE)

large mag hit in
same spot down line 750

+750 due east
(large 100 gamma hit in here - no picture though)

~~+800~~

+800 due west
~~mag hit~~ MAG HIT IN beginning OF
07 AUG 174.mst (large Rock
FORMATION ~~port~~ STBD SIDE)

+ ~~900~~ 850 due east

+900 West
mag hit in 07 AUG 192.MST

+950 east

+1000 West - check 07 AUG 207.MST
PORT SIDE (near the end)

+1050 EAST -
small structure PORT AUG 07 218.MST

1100 West

+ 1150 east AMEND

AUG. ~~10~~ 09th, 01
HOT

+1200 EAST ~~progress~~ ?

+1250 WEST

+1300 EAST

+1350 ~~E~~WEST

+1400 EAST

1450 west

+ 1500 EAST

+ 1550 ~~west~~ west

(NOTE: ~~R~~ Somehow, ~~+1600 EAST~~ I

I ~~am~~ was one ahead

Please check ~~#~~'s (line #'s) ~~from~~ 1250 → this line (1550))

→ +1600 east
STBD SIDE (FAR RIGHT)
AUG 080~~77~~. MST
faint Rectangular object.

+ 1650 West

+ 1700 EAST PORT + STBD 08 AUG ~~90~~ 91. MST
Annotated. Prob. nothing - no assoc. mag hits.

+ 1750 WEST

+1800 EAST ~~PORT SIDE~~ 08 AUG 109 - MST
PORT SIDE
No mag assoc.

~~53 81~~ Aug 9, 01' CONT

+1850 West

+1900 EAST

+1950 ~~EAST~~ west.

LAST ONE IN THIS TRACK, NEED TO RE-DO 0 - +650 (FOLLOWING:)

5.0 +50 EAST AMEND (THIS ONE) AUG 9, 01'

+100 WEST (1st line aborted due to GPS)

+100 west.

4.4 +150 EAST (put on 50RD last FOR Approx. 200 FT. TO CHECK BOTTOM, then back to 20 RD)

+200 WEST

+250 EAST

+300 West. AUG08 0193 ~~0193~~ (at end) MST Port side linear structure, no associated mag hit.

+350 EAST

+400 WEST

+450 EAST

Aug. 9, 01

+500 West

+550 EAST

+600 West.

+650 EAST

AUG 10, 01

EAST +50 AM2E

- CHANNEL BUOY (ANNOTATED)
(09AUG001. MST) OTHER 2 ANNOTATED BUOYS ALSO

- (2)
09AUG005. MST LINEAR OBJECTS
513 PORT SIDE (NO MAG HITS)

WEST - 50 AM2W

AM3

5.8 AM3W (-50)

09 AUG 30. MST
Center - NOT ANNOTATED

MON. AUG 13, 01'
SUNNY, 80's (YEA!)

UNDER VERRAZANO BRIDGE

AK1 ~~W~~ E (+50) SOUTH (RUNNING ON 50 RD)

SOL A few MAG HITS, ONE PRETTY LARGE — (ANNOTATED) MANY SMALL HITS THROUGHOUT

*NOTE

* NOTE: I MARKED THIS AS (-50) SOUTH AT END-OF-LINE ANNOTATION.

[illegible]

~~[illegible]~~ (-50) AK1W

NOTE * NOTE: * LARGE TANKER IN WAY, WILL TRY AGAIN ANOTHER DAY. (tanker & tanker go away, come again another day)

11:00 ~~1050~~ AM

AK2W SOUTH ~~North~~ (-50)

J.S.

* NOTE: AT SOL NOT SURE I WROTE -50 ~~or~~ / AND I AM NOT SURE I WROTE SOUTH.

PICTURE VERY UNCLEAR ON THIS LINE DUE TO TUG WASH. ALOT OF GRADIENT & MAG HITS (NOISY!)

3. 2.

AUG. 13, 01

~~AK2~~ ~~CONT.~~

~~AK3 (-50)~~

AK3 (-50) EAST

4. 4

4. 2

~~AK4~~

— AK4 (-50) EAST

— AKVK 1 (-50) EAST

CHECK 12AUG024 STBD SIDE
OR
12AUG025

* NOTE: ~~AT BEGINNING OF LINE A SERIES OF~~
NO — ~~PIER PILONS VISIBLE TO SOUTH (ALONG SHORELINE, STBD SIDE)~~ OUT OF LINE AREA

— ~~HULL MA~~

* NOTE ✓ (OK) — ~~LARGE MAG ANOMALIE RIGHT IN FRONT OF STATEN ISLAND FERRY TERMINAL~~ (AT END OF THIS LINE AND BEGINNING OF KVK 1 (-100) WEST.)

ABOUT 12' OUT ON SIDE SCAN

KVK 2 (-50) EAST

CHECK AUG 12.032 MST. STBD SIDE
AUG 12.033 MST STBD SIDE

KVK 2 (-100) west

Check these! alot of STUFF
AUG 12.033 MST PORT SIDE
AUG 12.034 MST
this, other unident. object. concrete pilon

KVK 3 (-50)
CHECK 12 AUG 036. /37 MST STBD.
(AS SHORELINE BENDS OFF)

KVK 3 (-100)
CHECK ENTRE FILE. (12 AUG 038/39)
* NOTE: → MARKED 1st SHORELINE INCORRECTLY. 2ND TIME IS CORRECT.

KVK 4 (-50) EAST

UNABLE TO DO LINE -100 - NEXT TO LARGE ABANDONED FACTORIES THAT BUTT ~~WATER~~ WATER.
12 AUG.43.MST / 12 AUG 044.MST

KVK 5 (-50 EAST) (HAD RUNNING FOR O LINE, NOT MARKED THOUGH)
FILE# → AUG 12 049. MST

Couldn't finish -100 west - too close to shore and too shallow

3.7

4.1.

KVK 6 (-50) EAST
CHECK FILE 12AUG 053/054/055/056

KVK 7 (-50) EAST
12 AUG 060 EAST.

KVK8 (-50) EAST

12 AUG 063. PORT SIDE. LARGE
cylindrical objects 

KVK 9 (-50) east

12 AUG 068 - pier port side
check next to it. Appears to be
a linear structure.
12 AUG 069. check also.
mostly STBD side.

~~KVK 10 (-50)~~

KVK 20 (-50) west (partly clear)
12AUG 073/074/075

ABOUT 15' out ~~EDM~~. ON SIDE SCAN

AM 3 EAST (+50) (50 RD)

TUES, AUG 14, 01
SUNNY + GOOD

Clean line, good picture, didnt see anything.

AM 4 E (+50) South

NEAR BEGINNING OF LINE BOAT CAPTAIN SAID THERE WERE '10 FT THINGS' HE SAW ON Radar. (MAY BE UNDER BOAT WAKE)

AM 4 E (+100) NORTH. –
LOCATED IN.
14 AUG 001@. MST ~~or previous~~ ~~(14 AUG 001 MST)~~

Mag hit ass. w/ picture (annotated) also located by Paul

AM 4 W (-50) ~~N~~ NORTH

~~FAR side~~
Check FAR STBD AUG 14 D10
Otherwise clean.

AM3 (-50) SOUTH

14 AUG 021. MST WRECK ON CHART + MAG. HITS

BOTTOM RETURN VERY BAD @ end of THIS LINE.

AK1 W (Heading SOUTH)

SUNNY calm seas
AUG 15, 01'

15' of S.S. cable out

4.6
blasting IN AM ~~UNDER~~ UNDER BAYONNE BRIDGE

KVK 27 (-50) EAST

boat anchorage area (visible ~~areas~~ on bottom IN AREAS)

* NOTE: INITIAL SPEED WAS 4.6 - DID NOT CHANGE UNTIL ABOUT 1,000 FT.

KVK 26 (-50) EAST

KVK 25 (0) WEST

14 AUG 015 - PORT. JUST PAST Hess pier - large obstructions, but doesn't look ~~l~~ like pier (PROB. Related)

(1st set)

* NOTE: WE WERE UNSURE WHETHER WE COULD DO THE THE 50 LINE, SO Recorded the 0 line. (KVK 25)

Never mind ↑

KVK ~~-50~~ 25 west - 50

trying to look at pile that was beyond pier. (

CHECK 14AUG021 PORT SIDE JUST Beyond piers

KVK 24 west (~~0~~ -50 line)

KVK 24 EAST (0 Line)

CHECK

14AUG025 port side.

~~Just~~ past barge linear object.

SCRATCHED -100 LINE

KVK 23 WEST (~~0~~ (-50)) LINE

MOSTLY Hess piers, etc. ~~Port~~ STBD side

~~KVK~~

KVK 23 EAST (0) LINE

KVK 22 WEST (~~-50~~ 0) LINE

* MARKED SOL ~~0~~ (-50)

KVK 22 EAST (50) line

*CHECK THESE DIRECTIONS IN ANNOTATIONS

KVK 21 (0 ~~east~~ west ~~west~~)

NOTE * (marked SOL as -50 east)

KVK 21 -50 ~~east~~ east ~~west~~

~~KVK 19~~

KVK 21 (-100) ~~we~~ ~~EAST~~ WEST

SWITCHED to 75RD RIGHT CHANNEL
(CHECKING Near Derelicts

~~KVK 19~~

AR1 0 LINE (~~EAST~~ west)
5.0 SOL WAS OFF - (I think a bit later than actual SOL)

AR1 -50 line (east) RIGHT
SHOOTING ON 50RD 1

5.2. AR2 0 line west

AR2 -50 line East
RUNNING RIGHT (STBD CHANNEL) * speed was ~~between~~ about 4.8 (NOT 5.2)
(RUN 1/2 ON 20RD)

tucked

AR3 O LINE West

derelicts just ~~south~~ west of shooters Island ~~the~~ most were visible at ~~[illegible]~~ low tide (tide coming in.) depth was about 20 feet. (just tucked into south western edge of Shooters)

AR 3 - 50 east

RUNNING ON RT channel @ 20 RD + 50 RD.
TONS OF DERelicts visible + not visible @ low tide.

AR 4 0 west

AR 4 - 50 east

AR 5 ~~+0~~ +50 west
UNABLE TO DO ZERO LINE

AR 6 0 LINE
line scratched.
unable to get to due to large container ships in port.

mmm curry chicken

4.5

AR 7 0 Line ~~[illegible]~~ east
only unable to do otherwise

48 AR 8 ~~WEST~~ EAST
check port side
~~14~~AUG 140 (port)
14 AUG 141 (port) just before marina pu

AR 9 EAST. 0 LINE.
AR 9 west -50 line
14 AUG ~~151~~ MST. ~~Assoc~~. w/ mag hit (~~port~~ STBD side)
151↑

AR 10 0 LINE WEST.

large dyke obstructions around
1,000 ft into the line.

~~ARM~~ AR 11 (SKIPPING - TOO SHALLOW)

NB 1 0 line (1st line aborted.) north

NB 1 -50 line south

NB 2 0 line north

NB 2 -50 SOUTH

4-4-3.5 12' Cable out

AUG16, 01
SUNNY, 85°

ROBBINS REEF (RR) 1, 0 LINE, EAST
MAG SCREAMING, nothing ON 55, pipeline thru here

ROBBINS REEF (RR) 1, -50 LINE, WEST

ROBBINS Reef 1, -100 LINE, EAST

RR1, +150, WEST

RR1, +200, east

RR1 +250 west
RR1 +300 east
RR1 +350 west
RR1, +400 east
RR1, +450 west
RR1, +500' EAST
RR1, +550 west
RR1, +600 east (done on right channel 75 RD)

→ RR1 - circular picture around area
will mark turns
(RECORDED at 75 RD TO THE LEFT CHANNEL)

KVK 19 -50 EAST
barge, port side 15AUG034.

KVK 19 -100 West (may go off line due to shallows)

RUN ON 50 R.D
RIGHT CHANNEL
CHECK ~~AUG 044~~, 04
↳ 15 AUG. 040 - .043

(NOT SURE I MARKED END OF LINE IN THE RIGHT PLACE)
SOME DEBRIS, CHECK .042, THOUGHT I SAW A STRUCTURE)

KVK 18 O LINE WEST
derelicts (2 VISIBLE @ LOW TIDE) [PHOTOS TAKEN & ANNOTATED
(EARLY ON ON THIS LINE)

KVK 18 -50 EAST
Very shallow (5-15 FT), NOT A GREAT PICTURE AT ALL

NB 4 (+50) SOUTH
PORT SIDE 16 AUG. 004

WILL NOT FINISH DUE TO SHALLOW H20 (Low 5 FT.)

NB 3 O LINE SOUTH
16 AUG 024 Wreck ON CHART, MARKED W/BUOY

ROUND OBJECT, PORT SIDE.
16 AUG. 026

NB 3 +50 NORTH

RUNNING ON 75 RD (RT CHANNEL)

We moved to avoid wreck Area did show up ON SIDE scan - Area is annotated "moved to avoid wreck"

SURVEY OF Eliz. Channel

Tide was 2 hrs after low (It is 4pm, low 2 PM)

NOTHING VISIBLE @ THIS POINT. ONE STRUCTURE RUNNING FROM SHORE NEXT TO JETTY, APPEARS TO BE PIER WOOD & NOT SHIP STRUCTURE (w/ BINOCULARS). WE WERE about 100 yds from shore, 28 FT water (EDGE OF CHANNEL) ALOT OF garbage ON SHORE (BUOYS + OTHER)

N. CARROLL NY HARBOR SURVEY - SIDESCAN LOG

8/29/01
WED.

CABLE AREA

0 NORTH
28 AUG 006. MST
OUTLINE OF OBJECT RUNNING ACROSS CENTER
OF PICTURE ON A DIAGANOL

-200 SOUTH
FISH

-400 NORTH

-600 SOUTH
1) OUTLINE OF LINEAR OBJECT (could be natural)
28 AUG 014. - PORT SIDE.
2) About 60 gamma hit w/ ~~___~~ 1000 approx feet to go on this line
28 AUG 016. MST.

-800 NORTH
-1000 South
} clean, NO MAG HITS

-1200 NORTH

-1400 SOUTH
-1600 NORTH.

* ANDY - SUN GLARE BAD, YOU MAY WANT TO LOOK AT THESE Files ON your OWN.
NC

LABOR DAY
Sept 3, 01

SUNNY, CALM, HIGH 70'S

MAG JUMPING AROUND

NB4 +150 NORTH
~~looked~~ really clean. (~~except for Dead~~ bodies)
MINOR MAG HITS

NB4 +200 South
looked really clean

NB4 +250 NORTH
looks really clean mag data still jumping.

CHECK 02 Sept 22 MST. There was a mag hit in here but I missed looking @ the area

20 gamma hit check 02 Sept 24 MST

MAG DATA STILL WACKY (INTERFERENCE)

NB3 EXT +150 SOUTH

NB3 EXT +250 SOUTH

KVKXI

NY Harbour

Remote Sensing

Survey

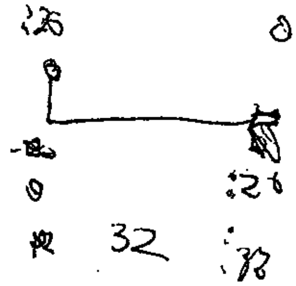
Mag Data

8/2001

Amie

pos time +0 sec | laybach 85

Line#	Heading	time	notes
0	W	~~SOL 11 39 13~~ EOL	~~ABORT~~
0	W	SOL 11 46 23 EOL 13 41 41	dipole @ 20,000 ft
-30	E	SOL 14 11 15 EOL 15 30 53	41,649
S.T.O.			
+100	W	SOL 09 42 55 EOL 11 20 31	Pos time -20 sec passed [illegible] @ 21,[illegible] + 20,[illegible] [illegible] ship [illegible]



Billy [illegible]

s.b.bottom Nancy Burns 860-526-4442

@ EOL

~~[illegible]~~ ss!

~~[illegible] files~~

Don't forget area at end of Ambrose Channel!!!!!

AMIW

Line	time	heading	pos time - 22 sec notes
0	SOL 111613 EOL 123851	E	Anom @ 20,000 90 gamma * 2000 gamma anomaly @ 34,000 ft coincides w/wreck in charts
-50	SOL 125421 EOL 144505	W	pos time - 23 sec * wreck at 34,000 ft
-100	SOL 085459 EOL 102133	E	8/8/0 pos time +25 party barge at 26,000 ft * wreck on chart @ 34,000 ft 50 ft deep " 38,400 - prob noticed bump in depth

42190.4

* Chart says wreck at 40' deep - might be "Fort Victorian" no idea of a

- 240 noticed ~~stop~~ w west behind buoy on 55 due to tidal current ≈ 1500 off on line

Mon 8/13 1hr fieldwork ~~8-16:00~~ 9 hrs boat
2 hrs maps

Tues 8/13 2 fw
8 boat

Wed 8/16 10.25

hours Sat 8/4 8hr travel Friday 8/3 8hr travel
Sunday 8-5 6 hours
Monday 8/6 3 hours 5 FW + 1 hour data
8 hours Boat

Tues 8/7 7:30 start
8 hr boat 3hr fieldwork
Wed 8/8 8 hr boat 3hr Fieldwork
Thurs 8/9 8 hr boat 3hr FW
Friday 8/10 8hr boat 3hr FW
Sat 8/11 3hr maps 4hr mobe/fw Nancy Brighton
Sun 8/12 1hr travel 212-264-2198

call
→ UPS 1-800 PICKUP
→ ~~Office~~
Nancy Brighton Phone #
→ Nancy Burns re: sub hotel

732-600-2044

Nancy C

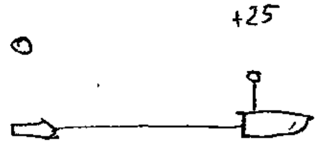
342
17

2400 ft long ~~[illegible]~~

Amend

line		heading		notes
+50	SOL 105151 EOL 105709	W	5 min 18 sec	pos time +25 sec.
			3[illegible] 6.5 ft/sec 310 sec	
+100	SOL 105951 EOL 110511 5'20"	E		layback = 85' speed
+150	SOL 110857 5'4" EOL 111201	W		13 sec layback
+200	SOL 111403 5'14" EOL 111917	E		
+250	SOL 112115 EOL 112607 4'53"	W		~~+30 sec~~
+300	SOL 112753 5'10" EOL 113303	E		13 25 -12 sec
+350	SOL 113455 5'4" EOL 113959	W		~~subtract 12 sec.~~ mag 12 sec behind pos.
+400	SOL 114141 5'6" EOL 114647	E		6 sec 21 sec behind pos.
+450	SOL 114845 5'2" EOL 115347	W		

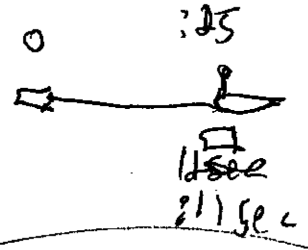
2.5



13 sec

AMend cont.

SS time = magtime

		Ready	notes
+500	SOL 120415 EOL 120853	E 4'38"	
+550	SOL 123521 EOL 124059	W 5'38"	
+600	SOL 124245 EOL 124727	E 4'42"	
+650	SOL 124919 EOL 125441	W 5'22"	pos wrong line segment?
+700	SOL 133935 EOL 134511	W 5'24"	5 min average time 300 sec 2400 ft length 8 ft/sec 85/8 = 10.6 ~~ft/sec~~ sec
+750	SOL 134635 EOL 135111	E 4'36"	pos time +25 sec
+800	SOL 135431 EOL 140115	W 6'44"	
+850	SOL 140225 EOL 140723	E 4'58"	mag time 11 sec < pos ti
+900	SOL 140913 EOL 141515	W 5'58"	to -22 sec

Magirne Basin Marina
718 372-580
Gravesend

		heading	notes
+950	SOL 14 26 11 EOL 14 30 41	E 4'30"	Hotels - Harbour 946-92 - Golden Gate 743-40 - exit 9 Belt Windjammer 891
+1000	SOL 14 32 45 EOL 14 39 19	W 6'26"	
+1050	SOL 14 41 21 EOL 14 45 51	E 4' 30"	~~#45 day~~
+1100	SOL 14 48 47 EOL 14 54 39	W 5" 52"	#50/day
+1150	SOL 14 55 41 EOL 15 00 29	E 4" 48"	Chasins 69

8/9/

+1200	SOL 09 34 23 EOL 09 39 53	E 5" 30"	pos time -4 sec 300 sec 5 min ave time
+1250	SOL 09 41 31 EOL 09 46 07	W 4'38"	8 ft/sec ~~10.63 sec~~ 11 sec :04 ~~:40~~
+1300	SOL 09 47 53 EOL 09 53 19	E 5'26"	+15 sec Mag time 15 sec > pos time 18 sec diff. -9 sec
+1350	SOL 09 54 29 EOL 09 59 03	W 4'34"	mag time 6 sec > pos time 0 :04

go 100ft past end of line on E

		heading	notes
1404	SOL 100051 EOL 100615	E 5'24"	
1450	SOL 100753 EOL 101241	W 4'48"	5 min average speed.
1500	SOL 101409 EOL 101923	E 5'14"	
1550	SOL 103931 EOL 104357	W 4'26"	
1600	SOL 104557 EOL 105131	E 5'34"	
1650	SOL 105407 EOL 105851	W 4'44"	
1700	SOL 110111 EOL 110645	E 5'34"	
1750	SOL 110759 EOL 111231	W 4'28"	
1800	SOL 111439 EOL 112015	E 5'36"	

speed 4.5 kts
layback 85 ft

heading

1850 SOL 112131 W 4' 24"
EOL 112607

1900 SOL 112829 E 5"
EOL 113403

1950 SOL 113553 W
EOL 114021

Attend rerun 50-650

50 SOL 114733 E 6' 6'
EOL 115325

5' 30" average

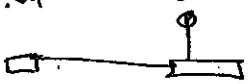
100 SOL 121919 W 5'
EOL 122411

330 sec 7.25 ft/sec

~~A~~ 12 sec

150 SOL 122559 E 5'
EOL 123115

:04 0



:16 sec

200 SOL 123237 W
EOL 123803

mag time +16 sec over pos time

- 9 sec

mag time +7 sec over pos time

250 SOL 123939 E
EOL 124509

300 SOL 124655 W
EOL 125209

350 SOL 12 54 09 E
EOL 12 59 25

400 SOL 13 00 47 W
EOL 13 06 01

450 SOL 13 07 27 E
EOL 13 12 59

500 SOL 13 24 13 W
EOL 13 29 21

---

550 SOL 13 37 55 E 5 min
EOL 13 43 19

600 SOL 13 44 49 W 5 min
EOL 13 49 53

650 SOL 13 51 53 E 5 min
EOL 13 56 51

Hotel
107 thru Frid
210 thru Sat

tonight
- add more cords
- new hotel for ~~Sunday~~ nite
- new marina
- Stop at West Marine
- Ask about Paul + Peth Rhodes Chec

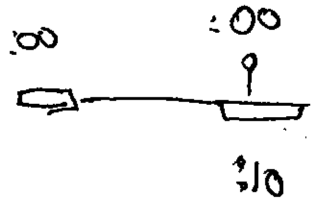
5077 ft

pos time On

Amaze

	time	heading	notes			
0	SOL 085613 EOL 090441	W 8'28"	508 sec	10 ft/sec	8.5 sec	
+50	SOL 09 06 53 EOL 09 18 29	E ~~11~~ 11' 36"	fighter passing 696 sec	7 ft sec	12 sec	
+100	SOL 09 19 57 EOL 09 28 09	W 8' 12"	492 sec	10 ft/sec	8.5 sec 9	10

10 sec diff



~~mag time is +10 sec over pos~~

mag tm is pos time +10 sec
-9 sec
+1 sec

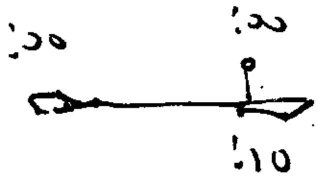
5982 ft.

AM2 W

pos time On

	time	heading	notes
0	SOL 093255 EOL 094813	E 15' 18"	918 sec 6.5 ft/sec 13 sec
-50	SOL 095021 EOL 100039 No	W 10' 18" 618 sec	100 ft past eol on either end & corner overlap 9.7 ft sec
-100	SOL 100337 EOL 101929	E 15' 52" 952 sec	100 ft passed eol on either end 6.3

11 sec diff.



mag time is pos. time + 10 sec
− 9 sec

+1 sec

AM3 W 1919.8 ft

		time	heading	notes
0	SOL	10 29 01	W	small fishing boat at 7700 ft went around
	EOL	~~10~~ 11 02 47		
-50	SOL	11 05 19	E	
	EOL	11 56 29		
-100	SOL		W	N 620939
	EOL			639692
			12 sec	E 62364
				619533

Jim Hamilton 860-434-0087
21st → 23rd

MST 400/day
SS

Wed Aug 22nd

starting this week only

Hotel Info

157^{50} promotional rate
165^{95} corporate

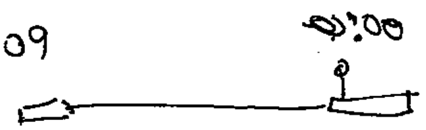
Comfort Inn 128284

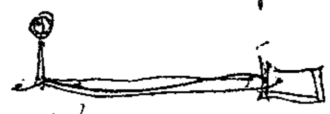
Start 8/13/01   AKle   3810 ft   pos time − 9 sec

		time		heading		notes
+0	SOL	09:09.21	9'48"	N	6.5 ft/sec	anomaly @ 900 ft
	EOL	09 19 09	588 sec		13 sec	wss?
+50	SOL	09:20:15	7'24"	S	8.6 ft/sec	anomaly at 1500 ft
	EOL	09 27 39	444 sec		10 sec	pipeline?
+100	SOL	09 29 37	9"	N	7 ft/sec	pipeline anomaly
	EOL	09 38 37	540 sec		12 sec	

~~Z08~~

11 sec layback





~~+20 sec~~

mag time is pos. time +20 sec
− 9

+11 sec

5 mph 4.5 mph

5280
4.5

2 6400
211200

237600 ft/hr

13 sec

237600 66 6.6 ft/sec

122 85 ft

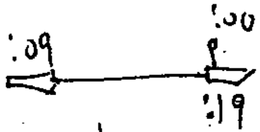
8/13/67 AK)W 12330 ft

		time	hedg	notes
0	SOL EOL		N	
-50	SOL EOL		S	
-100	SOL EOL		N	

2509

AK2W

		time		heading		notes
0	SOL	10 16 37	5' 44"	N		photos 9-12
	EOL	10 22 21	344 sec 7.3 ft/sec		11.6 sec	
-50	SOL	10 25 41	4' 42"	S		
	EOL	10 30 23	282 sec 8.9 ft/sec		9.5 sec	
-100	SOL	10 33 07	5' 14"	N		10 sec layback
	EOL	10 38 15	314 sec 8 ft. sec		10.5	



mag time is pos. time +19 sec -9 sec

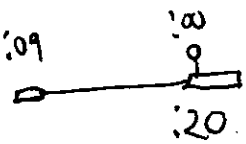
+10 sec

1595 ft.

AK3

pos time -9 sec

		time		heading	notes
0	SOL	11 06 23	3'20"	W	
	EOL	11 09 43	200 sec 8 ft/sec	~~8 sec layback~~ 11 sec layback	
-50	SOL	11 11 37	3' 26"	E	
	EOL	11 15 03	206 sec		
-100	SOL	11 17 17	3' 30 sec	W	
	EOL	11 20 47	210 sec		



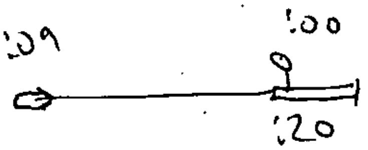
mag time is pos. time +20 sec
-9 sec
+11 sec

AK4 853 ft

		time	heading	notes
0	SOL	11 35 37	W	
	EOL	11 37 19	1'42"	
			102 sec	
-50	SOL	11 41 57	E	
	EOL	11 43 53	1'56"	
			116 sec	
-100	SOL	11 47 01	W	
	EOL	11 48 41	1'40"	
			100 sec	

8 ft/sec

~~[illegible]~~ 11 sec layback



magtime is pos. time + 20 sec

$$\begin{array}{r} -9 \\ \hline 11 \text{ sec} \end{array}$$

KVKI 3625ft

		time		heading	notes
0	SOL	11 51 57		W	around @ 2800
	EOL	11 58 17	6'20"		
			320sec	11.3ft/sec	7.5sec
-50	SOL	~~1153~~ 12 03 05		E	
	EOL	12 11 07	7'58"		
			478sec	7.6ft/sec	11sec
-100	SOL	12 18 11	6'22"	W	
	EOL	12 24 33			
			322sec	11.25ft/sec	7.5sec

9 ~~9.5~~ sec layback

mast tm is pos tim +18 sec
-9
+9 sec

KVK 2 1388 ft

		~~time~~		heading		notes
0	SOL	12 27 51	2'30"	W		photos 15-18
	EOL	12 30 21				roll #1
				9.12 ft/sec 9.5 sec		
-50	SOL	12 35 07	3'18"	E		piers, survey area
	EOL	12 38 25				looking west,
				7 ft/sec 12 sec		
-100	SOL	12 40 23	2'32"	W		
	EOL	12 42 55				

11 sec layback

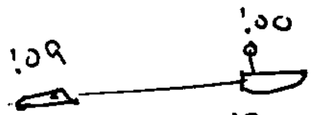
-9

~~12 sec~~

KVK 3 1359

		time	heading	notes		
0	SOL	12 48 07	W	2' 28"		
	EOL	12 50 35		148 sec	~~9 sec~~ 9 ft/sec	9.5 sec
-50	SOL	12 52 27	E	photos 19 to 20		
	EOL	12 55 41		roll #1		
				3' 14" 194 sec	7 ft/sec	12 sec
-100	SOL	12 57 13	W	mag file included		
	EOL	12 59 45		2' 32" with KVK4		
				152 sec	9 ft/sec	

10 to 11 sec layback



:20
- :09
+:11 sec

mag time is ~~sec~~ pos. time +11 sec

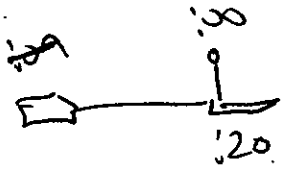
1896

KVK4

		time		hdg	notes	
0	~~SOL~~	13 10 11				
	EOL	13 13 39	3'28" 208sec	W 9ft/sec	9.5 sec	
→5°	SOL	13 16 21	4'40"	E	photos 21–33	ruins
	EOL	13 21 01	~~300sec~~ 280sec			
≤100	SOL	DOGGED!	9ft/sec	W 12sec	dogged this line shore too close!	
	EOL					

11 sec layback

lots of buildings on shore in this area. Showed up on SS



mag time = pos time + 20 sec
-9

+11 sec

XVK5

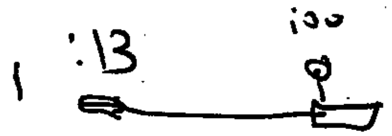
		time			heading	notes
0	SOL	13	26	11	W	
	EOL	13	28	35		
-50	SOL	13	30	45	E	
	EOL	13	33	31		
-100	SOL				W	clogged due to shore
	EOL					

KVK6

pos time -13 sec

2805

		time	heading	notes
0	SOL	13 38 22	W	
	EOL	13 43 43		
-50	SOL	13 45 51	E	
	EOL	13 52 49		
-100	SOL	13 54 59	W	chested over to avoid shore
	EOL	14 01 01		



:24
-9
:15 sec

KVK7 postime ⇁ 14 sec

		time	heading	notes 1551
0	SOL	14 07 49	W	
	EOL	14 11 05		
→50	SOL	14 12 29	E	photo 7, 8 barges on shore roll #2
	EOL	14 15 43		
−100	SOL	14 17 21	W	9+10 roll #2 junk on shore barge at 300 ft
	EOL	14 21 27		

+16 sec

KVK 8 2492

		time	heading	notes
0	SOL	14 28 13	W	barge passing in channel ca 1730 ft
	EOL	14 33 41		Iron drydock on south side of area.
-50	SOL	14 40 37	E	11+12 roll #2 drydock at barges.
	EOL	14 45 49		
-100	SOL	14 47 31	W	roll #2 13+14 wooden drydock barge #15 at 2400
	EOL	14 53 27		bump on bottom -100 2300. Paul says shipwreck

Caddell Dry Dock & Repair yard in area

#15 roll #2 Sukmbag
SUKMBAG
Suck 'em bag

+16 sec

KVK9 2053

		time	heading	notes
0	SOL	14 57 09	W	roll 2 #16 sewage treatment plant. Anomaly assoc
	EOL	15 01 01		
-50	SOL	15 02 39	E	barge on shore
	EOL	15 06 49		
-100	SOL	15 08 37	W	#17 roll 2 two wrecks on shore - out of proj area
	EOL	15 14 11		

4/6

8/13 KVK20 1800 ft 1816

		time	heading	notes
0	SOL	154033	E	19 roll #2 big ship
	EOL	154455		in channel - eventually on line -100
-50	SOL	153423	W	barges on shore
	EOL	153845		20 roll #2 Stambugs! 21, 22 roll barge shore
-100	SOL	152905	E	barge @ 400 ft
	EOL	153235		

+16

8/14 AMBE

pos time On

		time	heading	notes
0	SOL	08 33 40	N	paul samsonty on bottom circe w eninaly just n of 21 buoy
	EOL	09 29 20		
+50	SOL	09 30 56	S	21-26 roll#2 equipment photos
	EOL	10 04 32		
+100	SOL	10 16 44	N	27, 28 roll#2 equipment photos
	EOL	11 12 06		

+2 sec

AM4E

pos time 0h

SS time
is pos tir

8628

	time	heading	notes
0	SOL 112506 EOL 114442	N	Ship in anchorage bridge at ± 6000 ft
50	SOL 114610 EOL 120156	S	Paul noticed large bumps (ca. 10) on bottom, Ship in anchorage
100	SOL 120406 EOL 122310	N	passed w/in 50 ft of large freighter, ca. 5900 ft SS + mag targets together ca. 300 ft

OK
LFMDX

UFX
SEFX
UFM
SEFM

+2 sec

8/1/14 AM4W

pos time - 1sec

8586

		time	heading	notes
0	SOL	122908	S	
	EOL	124556		
-50	SOL	124804	N	
	EOL	130522		
-100	SOL	130712	S	
	EOL	132632		

20,000 x 2
9000 x 3
9000 x 3
20,000 x 3

+3sec

Wed

No

8/1/14 AMBW

		time	heading	notes
-50	SOL	13 37 42	S	note: notations of "wreck on chart" no wreck on chart, Paul just noticed a bump 30k
	EOL	14 27 34		Check last week for ~~1st~~ line!
-100	SOL	14 31 14	N	rerun of second line, finish 3rd line.
	EOL	15 04 48		several container ships passing

+3 sec

8/14 AKIW

postime -1 sec

		time	heading	notes
0	SOL	15 19 36	N	anomaly in vicinity of obstn on chart
	EOL	15 33 56		
-50	SOL	15 38 12	S	28, 29 Roll #2 Ships @ anchor
	EOL	16 12 76		
-100	SOL	16 14 12	N	
	EOL	16 32 10		

Paul noticed several things on bottom in vicinity of bridge. ca. 6-8 ft tall

40 36.686
74 02.558

+3 sec

8/15/2001 KVK27 pos time -6 sec

		time	heading	notes
0	SOL	08 36 23	W	fieldberg in anchorage ca 3400 ft. went e-c on lines -50, -100
	EOL	08 44 35		
-50	SOL	08 46 19	E	
	EOL	08 55 43		
-100	SOL	09 19 55	W	abort line Coastguard had almost 1 gone over mag sensor
	EOL	09 28 27		

+8 sec

8/15/07 KVK26

		time	heading	notes
0	SOL	9 33 05	W	
	EOL	9 40 01		
-50	SOL	09 41 55	E	went around bulkhead
	EOL	09 47 23		at start of line (-50, -)
-100	SOL	09 49 05	W	
	EOL	09 56 23		

+8 sec

8/15/01 KVK25

		time	heading	notes
0	SOL	10 00 21	W	31, 32, 33 roll #2 Hess pier.
	EOL	10 05 53		
-50	SOL	10 14 17	W	"trash" on bottom that is not a pier
	EOL	10 19 35		
-100	~~SOL~~		W	~~dogged too close~~ to piers
	EOL			

+8 sec

8/15/01 KVK24

		time	heading	notes
-50	SOL	102129	W	34 roll #2 old pilings in way
	EOL	102315		35 roll #2 large barge
0	SOL	102543	E	dogged
	EOL	102743		
~~-100~~	~~SOL~~		~~W~~	-100 due to shore + pilings and moored barge
	EOL			

check strip chart
reverse two lines
0 becomes -50
+ vice versa

+8 sec

9/13/07 KVK23

		time	heading	notes
-50	SOL	10 31 05	W	36, 37 r #2 piers
	EOL	10 33 09		
0	SOL	10 34 49	E	passing barge on at on SS image
	EOL	10 36 57		
~~+100~~	~~SOL~~			
	~~EOL~~			
-100				dogged too close to piers

+8 sec

KVK 22

pos time - 9 sec

		time	hdg	notes
0	SOL	10 42 47	W	1&2 R#3 barge, area to west
	EOL	10 49 13		
50	SOL	10 50 59	E	
	EOL	10 57 35		
100	SOL	10 59 07	W	piers on shore - lots of magnetics. tugs, too.
	EOL	11 05 31		

+11 sec

6/15/01 KVK21

29th 30th

113707
3000

	time	heading	notes
0	SOL 11 11 43 EOL 11 18 07	W	3,4,5,6, photos of wrecks on shore out of p[illegible] area
50	SOL 11 20 03 EOL 11 27 37	E	50 or 50 wrecks at 750 ft along centerline. Cheat around barge on -50 - -100 lines
100	SOL 11 31 15 EOL 11 37 59	W	cheated around barge ca. 2000 ft.

not till sec

8/15/01 ARI

	time	heading	notes
0	SOL 120537 EOL 120727	W	Shipyard piers to S of area
50	SOL 120939 EOL 121139	E	24-27 shooters isld wrecks
~~-100~~	~~SOL 12~~ ~~EOL 121139~~	~~W~~	dogged off this line. Piers in WAY. Piers in p.g. area

+//see

photos 7-22 Dredging operations KVK + Wickson
shooters Island.

-Skipped several areas in KVK due to dredging operations.
May not be able to do this

AR2

		time	head	notes
0	SOL	12 14 45	W	2X RoN3 AR2 shore
	EOL	12 16 03		
-50	SOL	12 18 11	E	
	EOL	12 19 41		
~~-100~~	~~SOL~~	~~12~~		dogged - too close to shore
	EOL			

+)/ish

AR3

		time	heading
0	SOL	122237	W
	EOL	123215	
-50	SOL	123415	E
	EOL	124529	
-100	SOL	Dogged, too Shallow, Stuff in way.	
	EOL		

notes
29, 30, 31 Roll #3
derelict barges dredged
32, 33 also, 34 remn barge
Shooters Island.
35 wreck on Shooters Is
36 Pipeline Sign.
ca. 1100 ft
Breakwater? off to S. of area
Roll 4 - 5 derelicts + old piers.

+11 sec

* ~~[illegible]~~ Derelicts on shore definitely in proj. area.

× Several wrecks on SS not visible above water
ca. 2200 ft

× Dogged off -100 line due to close proximity to derelicts & shoreline.

× Some stuff below waterline in area of derelict dry dock.
In project area!

× lots of stuff on bottom here, underwater, in proj. area
see SS.

8/15/2001

AR4

		time	heading	notes
0	SOL	12 53 49	W	RL #5 pipeline sign
	EOL	12 55 45		
50	SOL	12 57 45	E	submerged pilings c. 300 ft 6 roll #4
	EOL	12 59 51		
-100	SOL	Dogged. Too close to shore + piers	W	
	EOL			

* this area @ low tide

+ 11 sec

8/15/01 AR5 pos time - 8 sec

		time	hdg	notes
0	SOL	13:03 43	W	~~[illegible]~~ actually not on zero line +40ft or so due to shoreline
	EOL	130607		
-50	SOL		E	photos 7+8 @#4 shorelines.
	EOL			
-100	SOL		W	
	EOL			

+10 sec

8/15/01 ~~AR6~~ AR7

		time	hdg	notes
0	SOL	131959	E	off track at end of line due to shore. Channel goes right to sheet pile
	EOL	132201		
-50	SOL			
	EOL			
-100	SOL			11+12 roll #4 sheet p
	EOL			

+10sec

Dogged ~~[illegible]~~ preab (AR6). Zero line right at shore. Ships docked. Couldn't get closer than +50 ft.

photos 9+10. Ships at anchor.
roll #4

AR8

		time	reading	notes
0	SOL	13:29 03	E	this line is right against sheet piling and moored barg
	EOL	133551		14 & 15 RH4 sheet piling, bri
-50	SOL			possible something on SS
	EOL	Dogged		marina or port ca. 600 ft
-100	SOL	-50 & -100		
	EOL	too close to shore		

+110sec

AR9

		time	heading	notes
0	SOL	13 47 01	E	off line at begining due to shallows.
	EOL	13 51 43		
.50	SOL	135349	W	off line at end due to shore
	EOL	135923		
.100	SOL	Dogged line due to Shallows and obstructions and shoreline	E	
	EOL			

t/use

AR10

		time	heading	notes
0	SOL	14 08 31	E	lots o' mag activity off line by 150 ft due to shallows
	EOL	14 17 47		
-50	SOL	Dogged	W	55 vs pt channel only 50m scale
	EOL	both		
-100	SOL	lines	E	
	EOL	-50 -100		

due to presence of dike along channel edge (see chart)

+10 sec

AR11

Dogged off due to shallow water
< 8 ft in places

check #s just to be sure.

NB1 pos time -8 sec

		time	heading	notes
0	SOL	15 09 19	N	
	EOL	15 13 51		
-50	SOL	15 16 03	S	
	EOL	15 22 13		
-100	SOL	15 29 21	N	
	EOL	15 33 55		

Flosse

8/15/01 NB2

		time	heading	notes
0	SOL	153830	N	
	EOL	154114		
-50	SOL	154304	S	
		154702		
	EOL			
-100	SOL	154846	N	
	EOL	155136		

+105q

Robbins Reef . RR1 pos time - 13

		time	heading	notes
0	SOL	09 30 31	E	
	EOL	09 31 59		
50	SOL	09 33 41	W	
	EOL	09 35 07		
100	SOL	09 36 19	E	
	EOL	09 37 51		

~~#~~

~~+44sec~~ +15 sec

N: 665435.12
E: 612699.85

N: 665658.57
E: 612045.79

~~+~~ 150	SOL	09 39 33	W	
	EOL	09 40 55		
+200	SOL	09 42 37	E	
	EOL	09 43 59		
+250	SOL	09 45 39	W	
	EOL	09 46 53		

.300	SOL	09 48 25	E	
	EOL	09 49 39		
.350	SOL	09 51 25	W	
	EOL	09 52 35		
+400	SOL	09 54 23	E	
	EOL	09 55 39		
+450	SOL	09 57 27	W	photos 17 & 18 @ #4 lighthouse @ Robbins Reef.
	EOL	09 58 39		
+500	SOL	10 00 25	E	
	EOL	10 01 47		
+550	SOL	10 03 45	W	
	EOL	10 05 01		
+600	SOL	10 07 01	E	ended 200' early
	EOL	10 08 13		
+650	SOL		W	
	EOL			
+700	SOL		E	
	EOL			

KVK 19 pos time -14 sec.

		time	~~tube~~	notes
0	SOL	10 47 03	W	
	EOL	10 50 43		
-50	SOL	10 52 53	E	SS hit at 775 ft
	EOL	10 55 45		
-100	SOL	10 57 37	W	SS hit at 775 again photo 19 R#4 shows in vicinity of SS target
	EOL	11 01 55		

look for propeller on SS / tug lost one in area

+16 sec

KVK 18

		time	heading	notes
0	SOL	11 10 47	W	prop blade? on bottom just before SOL
	EOL	11 17 17		debris on shore? photo 20 R #4 - derelict 27 R #4 - derelict on shore
-50	SOL	11 28 07	E	derelict @ 600 ft
	EOL	14 34 33		
-100	SOL	dragged off, too shallow.	W	
	EOL			

+16 sec

N 659904 poop
E 593981 coords

~~25 ...~~

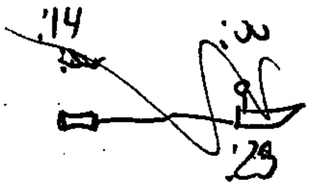
b/n line and shore

NB4

pos time -14 sec

		time	heading	notes
0	SOL	12 42 25	N	
	EOL	12 53 13		
+50	SOL	13 07 35	S	55 hit ca 1500 ft
	EOL	13 19 27		
+100	SOL	13 21 17	N	
	EOL	13 32 47		
+150	SOL		S	
	EOL			
+200	SOL		N	
	EOL			
+250	SOL		S	
	EOL			

Shallow!



+16 sec

NB3

		time	heading	notes
0	SOL	13 45 33	S	55 at 300 ft wreck on chart ca. 7206 23 + 24 roll bb4 docks + proj. area
	EOL	14 09 29		
+50	SOL	14 11 11	N	texaco wharf at beginning off course to 80 around wreck on chart
	EOL	14 29 07		
+100	~~SOL~~	14 36 39	S	detour around wreck on chart c. 7200 off course ca 9300 ft
	~~EOL~~	15 00 05		

+16 sec

8/29/01 Cable Area

		time	heading	pos time On notes
0	SOL	203906	N	
	EOL	204906		
200	SOL	205054	S	gradient on mag off
	EOL	205524		
400	SOL	205738	N	
	EOL	210434		
600	SOL	210554	S	40 gamma on mag CG 2004
	EOL	211056		
800	SOL	211254	N	
	EOL	212002		
1000	SOL	212134	S	
	EOL	212632		+2sec
1200	SOL	212830	N	
	EOL	213528		
1400	SOL	213644	S	
	EOL	214152		
1600	SOL	214310	N	
	EOL	214940		mag hit @ ca.1500ft

NB4 p-time -29 sec

		time	heading	notes
+150	SOL	19 44 17	N	
	EOL	19 55 55		
+200	SOL	20 13 15	S	
	EOL	20 28 03		
+250	SOL	20 33 09	N	
	EOL	20 44 55		

+31 sec

N 659240
E 589796

WB3 ~~ext~~

	time		hdg	notes
+150	SOL	210039	S	do not vsp no logging bad data
	EOL	210319		
+200	SOL	210555	N	
	EOL	210849		
+250	SOL	211023	S	
	EOL	211337		
+150	SOL	211603	N	redo
	EOL	211915		

+31 sec

~~[illegible]~~ +31 sec

XVKX1

		time	Nearby
0	SOL	214345	N
	EOL	214855	
+50	SOL	215259	S
	EOL	215659	
+100	SOL	220011	N
	EOL	220433	
+150	SOL	220613	S
	EOL	221005	
+200	SOL	22~~1529~~ 2549	S
	EOL	222853	
+250	SOL	223233	N S 0
	EOL	223705	
+300	SOL	224329	S
	EOL	224706	
+350	SOL	224759	N
	EOL	225247	
+400	SOL	230155	S
	EOL	230655	

notes

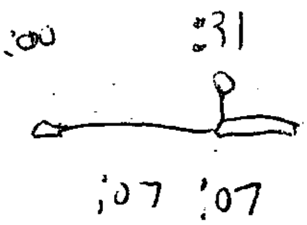
~~+22 sec~~

~~+25 sec~~

~~30 sec~~

29 sec

abort due to float mag



pos time is 24 sec ahead of mag time

KvK x1 cont.

	time	heading	notes
+450	SOL 230719	N	
	EOL 231113		
	SOL 231435	S	
+500	EOL 231827		

South Elizabeth Channel

time heading notes

Φ SOL set from S.C. E too shallow
EOL 000509

dogged off rest. 4 feet deep - 5.5, in danger
of hitting bottom

+31 sec.