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CULTURAL RESOURCE INVESTIGATION OF TEN SITES IN THE HACKENSACK MEADOWLANDS

HACKENSACK MEADOWLANDS RESTORATION PROJECT

HUDSON AND BERGEN COUNTIES NEW JERSEY

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Prepared for:
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New York District
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MANAGEMENT SUMMARY

Cultural resources investigations were undertaken at 10 environmental restoration locations within the Hackensack Meadowlands District in the Counties of Hudson and Bergen in New Jersey. The study was undertaken by Hunter Research, Inc., working as subconsultants to Northern Ecological Associates, Inc., for the New York District of the U.S. Army Corps of Engineers under contract DACW51-01-D-0018, Delivery Order 0046. The project was carried out pursuant to Section 106 of the National Historic Preservation Act of 1966.

A major component of the study was the review and synthesis of archaeological, geoarchaeological, and palynological research that has been undertaken on the complex and still somewhat poorly understood environmental development of the Hackensack Meadowlands since the end of the Wisconsin Glaciation. A number of studies from the 19th and early 20th centuries provide useful information on general conditions, but modern investigations began in the late 1940s. Since that time several multidisciplinary projects have been completed. These have enabled a general picture of environmental change to be constructed, and the more substantive studies have emphasized the importance of change in relative sea level as the primary determinant of hydrological and floral conditions over time.

In terms of human settlement and exploitation of the area, the draining of glacial lake Hackensack more than 10,000 years ago and the consequent exposure of the lakebed marks the first point at which archaeological signatures are possible. However, the character of the Hackensack valley in the long period between the draining of the lake and the initiation of peat formation about 5000 years ago remains very unclear. Fluviatile and/or eolian deposits, overlying the lake deposits and pre-dating the peat, have been identified at several locations on the east side of the Hackensack River. Some of these may represent settings attractive to settlement before 5000 B.P.

The vegetational succession in the Meadowlands has now been documented at several locations. Improvements in sampling and analytical methods are progressively refining the sequence. An initial forested environment was replaced by one dominated by sedges, reeds and mosses as tidal influence and /or runoff from the surrounding uplands increased and fluctuated through time. In the southern portion of the Meadowlands District there are indications that forest environments were never established. The initially dryer forested setting, which temporally coincides with the Late Archaic and Early Woodland cultural periods, is one which may have been attractive for large or frequently re-used seasonal encampments, typically at confluences or terraces near to drainages. The consensus view is that the Hackensack and its tributaries were in their present channels by this time, and thus provide broad predictors of site location at depth.

The environmental changes of the last 5,000 years are most clearly typified by the appearance of Atlantic white cedar in the Meadowlands about 1,000 years B.P. This species reflects a warmer and less saline environment prevailing into the 17th and 18th centuries. Cedar forests are favored over-wintering sites for white-tailed deer, suggesting that systemic exploitation of these settings by Late Woodland groups is to be anticipated.

MANAGEMENT SUMMARY (CONTINUED)

Documentary and palynological evidence show that Dutch and English settlers made significant impacts on the Meadowlands from the second quarter of the 17th century. Increases in plant pollen from species such as ragweed reflect land clearance for agriculture. Understanding sea levels is crucial to evaluating the extent to which the marshlands may have been settled and cultivated in the early historic period. Sea levels lower than anticipated have been documented for 17th-century sites in Manhattan and Chesapeake Bay. This may imply that certain areas, perhaps along Penhorn and Cromakill Creeks on the eastern side of the Meadowlands, were more attractive to permanent settlement at this time than later.

During the Colonial and Federal periods the cedar timber was increasingly exploited at a time when rising salinity levels began to destroy the viability of the stands. It is clear, however, that the chief economic benefit from the Meadowlands was salt hay. It was appreciated as early as the 18th century that reducing salinity and lowering the water table could make these areas suitable as freshwater meadowlands growing perennial English grasses.

In the 1810s through *circa* 1830, and again in the late 1860s, there were significant efforts to drain and improve the Meadowlands. Chiefly confined to the southern portions of the District, these enterprises involved the ditching and diking of large areas for arable cultivation to feed the New York market. Both efforts failed, and by the late 19th century the Meadowlands were regarded as a source of nuisance and disease, and as a possible area for substantial urban and suburban expansion. Strong efforts to eliminate mosquito-breeding environments led to very extensive ditching and draining in the first half of the 20th century. The changes wrought by this program appear to have encouraged the invasion and eventual dominance by the reed *phragmites* so characteristic of the landscape today.

Extensive documentary research on each of the ten areas showed that details of ownership and land use cannot be traced much earlier than *circa* 1800 for most of these properties. Recovery of detailed 17th- and earlier 18th-century land information, if feasible at all, would require a research effort beyond the scope of this study. The research showed the reclamation sites to have functioned for the most part as salt meadows, with most being subjected to drainage and reclamation schemes of varying degrees of intensity. The crossing of several sites by railroads provides dates before which some of these schemes were created. Extensive ditching at Oritani and Berry’s Creek marshes on the west side of the river, for example, must date to before the mid-1830s because they are dissected by the Paterson Railroad alignment.

MANAGEMENT SUMMARY (CONTINUED)

Field investigations at the 10 sites were limited to pedestrian walkovers or, in the case of wetter sites, inspection from boats. On the basis of these inspections, subsurface testing was undertaken at only one site, Riverbend Wetlands Preserve, where dryer high marsh conditions, clear of dense *phragmites* growth, were located. These tests, using hand bucket augers and shovels, confirmed that these conventional archaeological approaches yield very limited cultural data in such settings.

Historical, topographic, and paleoenvironmental data were subsequently used to develop a cultural resource sensitivity ranking for the ten sites. The Meadowlark Marsh, on the east bank of the Hackensack at Bellman's Creek in the northern portion of the District, emerged as having the greatest potential. From this ranking, a palynological/geoarchaeological testing strategy and protocol was developed which takes into account the potential of the sites and the likely impact of the proposed restoration actions on any cultural resources.

A preliminary evaluation of significance of the sites and assessment of impact of proposed remediation actions is presented, although there are limitations to both of these given the current database.

A review of recent paleoenvironmental research approaches in the Lower Hudson region, particularly the data from Piermont Marsh on the Hudson, assisted in the development of recommendations for detailed assessment of the remediation parcels in the Hackensack Meadowlands. Three sites, Meadowlark Marsh, Anderson Creek Marsh and Riverbend Wetland Preserve are identified for testing. At each location, two probes and one high-integrity core sample were recommended. The core sample will be subjected to a range of close-interval analyses (4 cm/1.5 inches is recommended) that will address specific research questions directed at human usage of, and interaction with, this complex environment.

Recommendations are also made for revision of the 1994 sub-marsh topography model, contextual research on the historic drainage features of the Meadowlands, and specific historic research on the *circa* 1917-1930 fill material at Meadowlark Marsh.

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

LIST OF FIGURES

LIST OF FIGURES (CONTINUED)

LIST OF PLATES

LIST OF TABLES

ACKNOWLEDGMENTS

Thanks are extended to the individuals and organizations who have contributed to this project.

Carissa Scarpa, Archaeologist in the Environmental/Planning Division of the New York District, was point of contact with the U.S. Army Corps of Engineers. She provided helpful support and input to the project and took part in site inspections. The work was performed on contract to Northern Ecological Associates, Inc., with David Santillo serving as Quality Control Monitor. Beth Stuba assisted with contractual issues.

Brett Bragin of the New Jersey Meadowlands Commission was unfailingly helpful and supportive of the project in many ways. He guided the field team to the survey locations, arranged for site access, provided copies of numerous technical and research reports, and was in general an invaluable resource.

The project team included outside consultants Dr. Joel W. Grossman and Dr. Dorothy M. Peteet (Lamont-Doherty Earth Observatory of Columbia University). Dr. Grossman's extensive previous experience in cultural resource assessment methodology and research in the Meadowlands was invaluable for this project. Likewise, Dr. Peteet's long-standing research in the Late Pleistocene and Holocene palynology and paleoenvironment of the Meadowlands and the Lower Hudson region has ensured that the project has had the benefit of current thinking in these areas. Both are thanked for their enthusiasm and collegiality.

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The project also benefited from the insights of Dr. Joseph Schuldenrein (Geoarchaeology Research Associates), who has undertaken important geoarchaeological work at several locations in the Meadowlands, as well as closely related studies of submerged landform archaeology in the New York Harbor and Bight.

The staff of the many agencies, libraries and record repositories visited during the course of the work are also thanked for their assistance. These included the New Jersey Historic Preservation Office, the New Jersey State Library and Archives, the New Jersey Historical Society, the New Jersey Meadowlands Commission, the Bergen County Historical Society, the Bergen County Office of Mosquito Control, and the New York Public Library,

Ian Burrow and Richard Hunter were project managers, with Dr. Hunter taking the lead in the earlier contractual and fieldwork stages and Dr. Burrow coordinating research and reporting. William Liebeknecht and James Lee were responsible for the fieldwork program, assisted by Ben Harris. Research was undertaken by Nadine Sergejeff, Damon Tvaryanas, Richard Hunter and Ian Burrow. The report was written by Ian Burrow and

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Chapter 1

PROJECT DESCRIPTION AND SCOPE-OF-WORK

A. INTRODUCTION

This report describes, analyzes, and places in context, cultural resources investigations at 10 environmental restoration locations within the Hackensack Meadowlands in the Counties of Hudson and Bergen in New Jersey (Figures 1.1, 1.2 and 1.3a-b.). This study was undertaken by Hunter Research, Inc., working as subconsultants to Northern Ecological Associates, Inc., for the New York District of the U.S. Army Corps of Engineers under contract DACW51-01-D-0018, Delivery Order 0046. The work is in partial fulfillment of the U.S. Army Corps of Engineers' obligations under Section 106 of the National Historic Preservation Act of 1966 (as amended), as implemented under 36CFR Part 800.

The New York District of the U.S. Army Corps of Engineers, in conjunction with the New Jersey Meadowlands Commission, is undertaking an ecosystem restoration study of the Meadowlands. This project examines 10 restoration sites, totaling more than 1100 acres. As lead federal agency, the Corps is required to fulfill responsibilities toward historic properties as set out in the National Historic Preservation Act (as amended) and 36CFR Part 800.

The Hackensack Meadowlands is an extensive area of tidal brackish marsh on the eastern and western banks of the Hackensack River in northeastern New Jersey, a short distance from New York City and north of Newark Bay. Approximately 8,400 acres of the present-day landscape comprises wide, flat, largely uniform expanses of *Phragmites* reed dissected by natural and artificial watercourses. These expanses are traversed by numerous road and railroad corridors, the majority of which reflect the long-standing desire to efficiently connect the Hudson waterfront (and therefore New York City) with the remainder of New Jersey. A major exception to this is the New Jersey Turnpike, which runs northeast on two alignments, one east and one west of the Hackensack, before terminating at the George Washington Bridge north of the project area.

Many areas within the Meadowlands have been modified through use as formal and informal landfills. Some filled areas have been subsequently developed for industrial and residential use in the 20th century. Slightly higher areas, notably around Secaucus, have been settled for much longer.

The ecological history of the Meadowlands is complex and still not fully understood. Originating as a glacially scoured and depressed basin during the Pleistocene, the area was the site of a large lake at the end of the Wisconsin glaciation. This lake subsequently drained, leaving the area as dry ground, but as sea levels rose in the Holocene the Meadowlands were transformed into first a freshwater and then a brackish marsh. The complexity and chronology of these changes, including the contributions made by human populations, are gradually being appreciated as a range of paleoenvironmental research is undertaken.

After 19th-century attempts at reclamation for agriculture failed, the area was long held in low esteem as little more than a wasteland, useful only as a large trash receptacle and harmful as a source of disease (particularly from mosquitoes). From 1926 onwards, however, attempts were made to achieve a coordinated approach to planning for development and, latterly, conservation. The Meadowlands has come to be seen as an ecologically valuable, if now

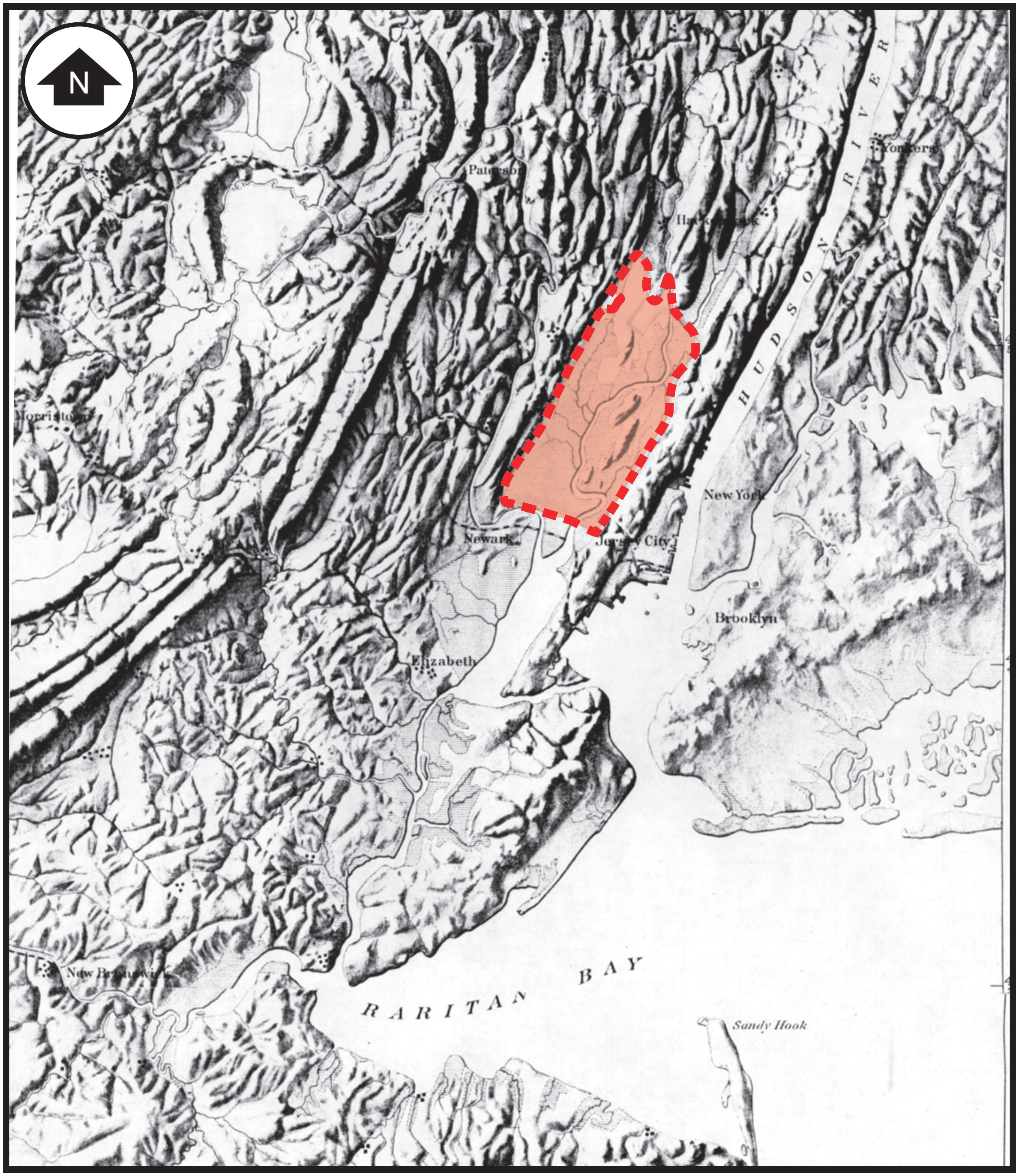

Figure 1.1. General Location of Project Area. Base map is the 1897 *Relief Map of New Jersey*. Geological Survey of New Jersey. Scale: 1 inch = 5 miles (approximately). The Meadowlands District Boundary is shown.

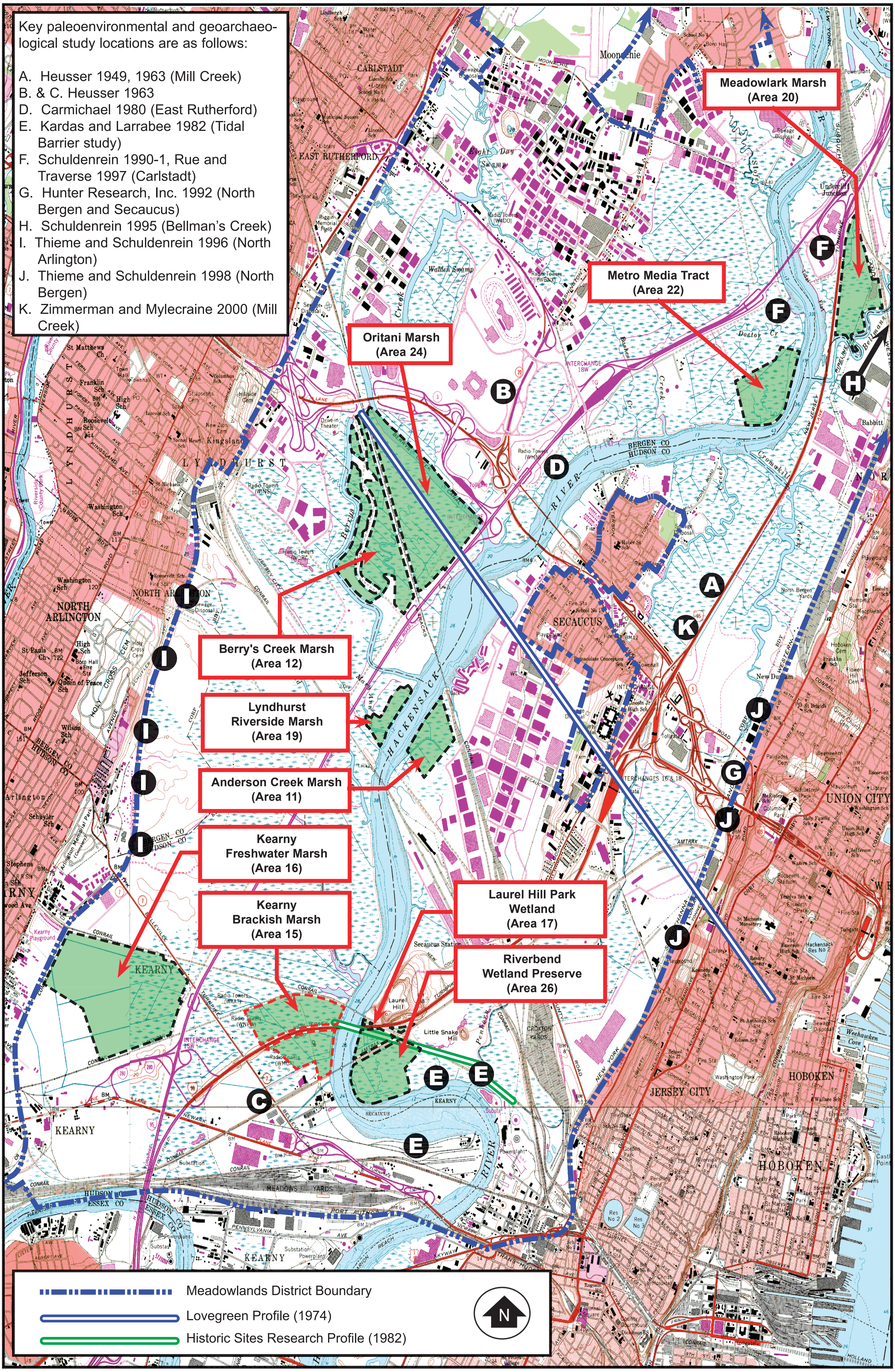

Figure 1.2. Detailed Location of Project Sites. Source: USGS 7.5' Topographic Series, Orange, N.J. quadrangle (1955 [photorevised 1981]), Weehawken N.J.-N.Y. quadrangle (1967 [photorevised 1981]), Elizabeth, N.J.-N.Y. quadrangle (1967 [photorevised 1981]), Jersey City, N.J.-N.Y. quadrangle (1967 [photorevised 1981]). Project sites outlined. Scale : 1 inch= 3780 feet. Note that Project Site boundaries are for reference purposes. For precise boundaries see individual site descriptions in Chapter 5. Meadowlands District boundary and key paleoenvironmental/geoarcheological sites shown.

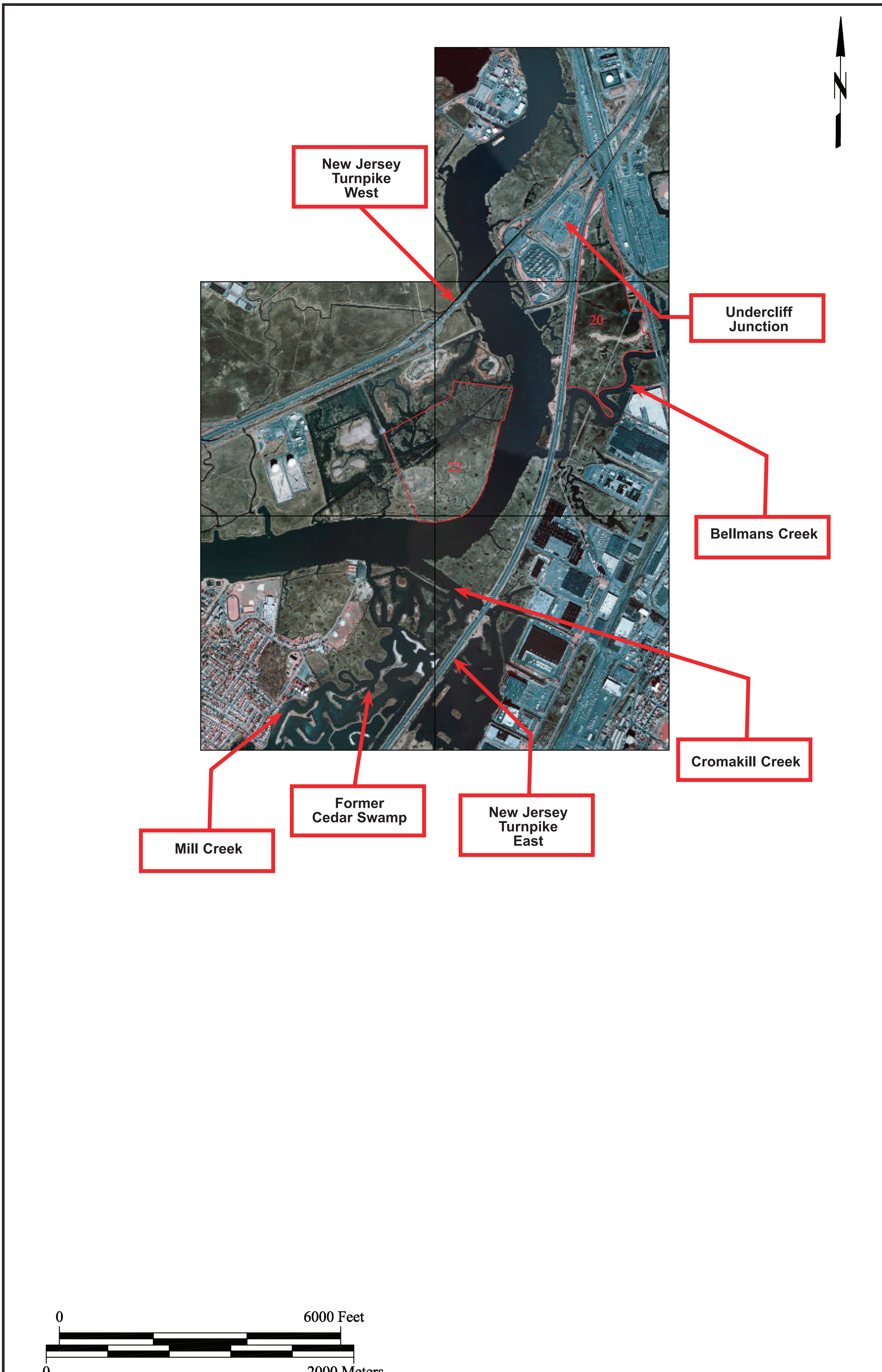

Figure 1.3a. Annotated Aerial Photograph of Project Sites, North Section. 2002. Sites from north to south: 20. Meadowlark Marsh (Tier 1). 22. Metro Media Tract. Source: New Jersey Department of Environmental Protection 2002.

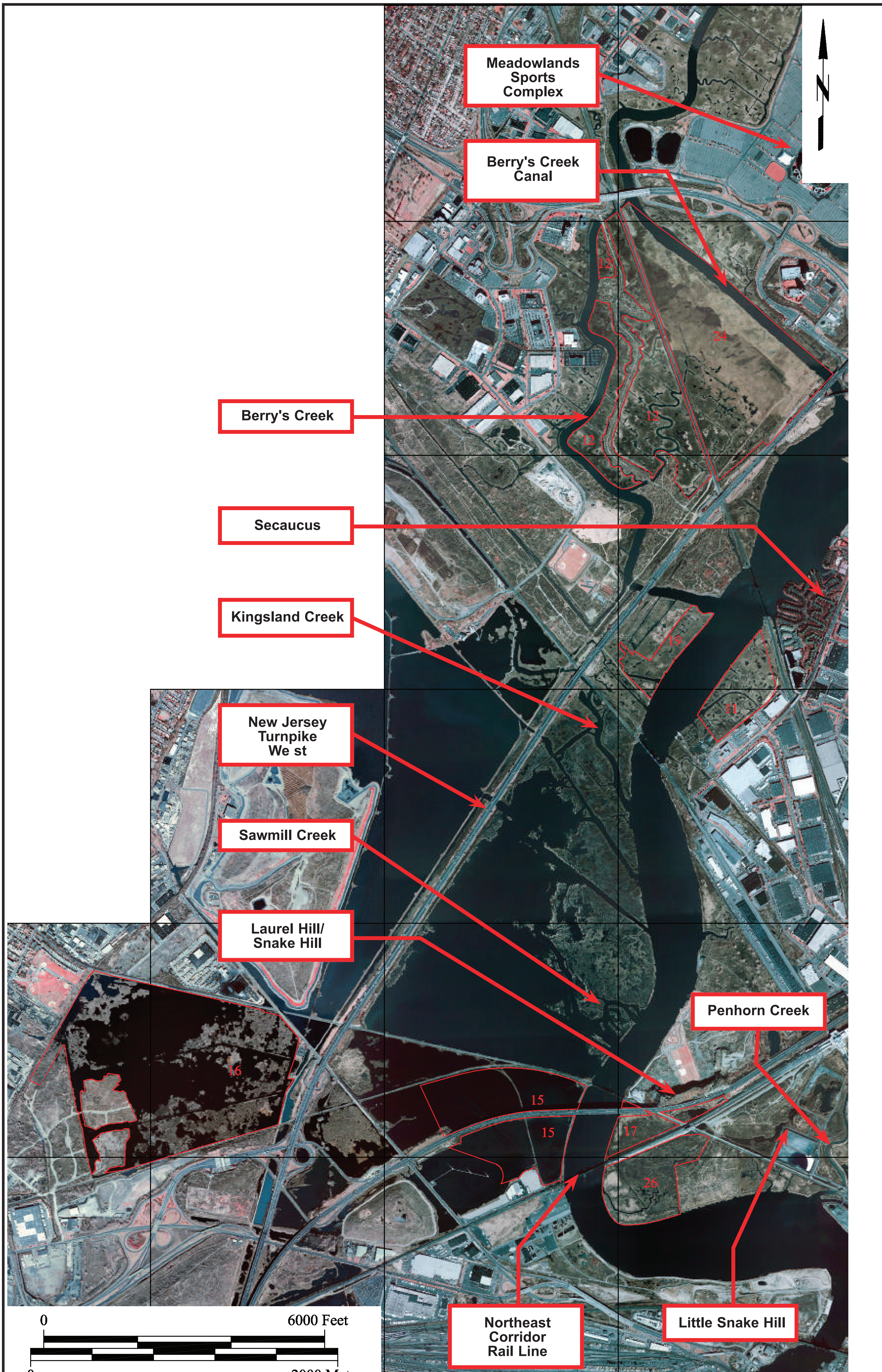

Figure 1.3b. Annotated Aerial Photograph of Project Sites, South Section. 2002. Sites from north to south: 24. Oritani Marsh. 12. Berry's Creek Marsh. 19. Lyndhurst Riverside Marsh (Tier 1). 11. Anderson Creek Marsh (Tier 1). 16. Kearny Freshwater Marsh (Tier 1). 15. Kearny Brackish Marsh. 17. Laurel Hill Park Wetland. 26. Riverbend Wetlands Preserve (Tier 1). Source: New Jersey Department of Environmental Protection 2002.

degraded, environment. The New Jersey Meadowlands Commission, established in 1969 as the Hackensack Meadowlands Development Commission, therefore has mandates to plan for environmental protection, economic development and solid waste management over an area of 19,485 acres (30.4 square miles): the greater part of the ecosystem.

B. PROJECT SCOPE-OF-WORK

This study has two main purposes. The first is to identify prehistoric and historic archaeological resources in the 10 restoration sites, covering about 1160 acres, through background research and field investigation. The second is to use the data from these tasks to develop a palynological sampling plan for all the sites. This will establish consistent best practice procedures for paleoenvironmental reconstruction and for the associated identification of deeply buried archaeological sites.

Following a comprehensive review of existing research and the preparation of a health and safety plan (included in this report as Appendix D), the original scope envisaged a pedestrian survey followed by shovel testing and (where feasible) the use of a backhoe in areas identified as holding archaeological potential, based on background research and surface inspection.

Following preliminary research and site reconnaissance, it was apparent that shovel or backhoe testing at the majority of the areas was not practicable because of waterlogged conditions and the presence of dense stands of *phragmites*. The latter rendered the areas difficult of access and their dense and deep root systems extend below the depth reachable by standard shovel testing. The scope was therefore modified by consensus to place more emphasis on site assessments and the development of the palynological plan.

C. RESEARCH METHODS AND DESIGN

A primary objective of the background research was to complete a thorough review of the literature pertaining to paleoenvironmental and geoarchaeological research on the Meadowlands, referencing other pertinent regional studies. Much of this material was provided by the New York District of the Army Corps of Engineers and by the New Jersey Meadowlands Commission. Additional materials were consulted at the New Jersey Historic Preservation Office, and information was also obtained through consultation with researchers Joel Grossman, Dorothy Peteet and Joseph Schuldenrein.

Historical background research comprised primary archival, published and unpublished secondary and cartographic materials consulted at the New York Public Library, the Bergen County Historical Society, Special Collections Department of the Alexander Library at Rutgers University, the New York Historical Society, the New Jersey Historical Society, the New Jersey State Library, the New Jersey State Archives, the Hudson County Clerk's office, the Bergen County Clerk's office, the Bergen County Division of Cultural and Heritage Affairs Office, the New Jersey Meadowlands Commission, the New Jersey Historic Preservation Office and the New Jersey Bureau of Tidelands Management.

Once general sources had been examined and digested, a more detailed phase of research was pursued which focused on the 10 restoration sites. The process primarily involved deed research at the Bergen County and Hudson County Clerk's offices where attempts were made to trace the properties to the late 18th and early 19th centuries. Mortgages and aerial photographs were consulted. The photographs, covering a period from 1931-1968 were obtained from the New Jersey Meadowlands Commission. Once the deed research on property histories neared completion, additional analysis was undertaken if necessary. For instance, several tracts of marsh were owned and reclaimed by the Swartwout brothers at present-day Kearny during the early half of the 19th century. Clearly, an overview of this endeavor was needed and was supplemented by examining the Robert Swartwout Papers at the New York Public Library.

D. PREVIOUS RESEARCH AND PRINCIPAL SOURCES OF INFORMATION

1. Paleoenvironmental and Prehistoric Research

There is a now a substantial body of technical literature, chiefly in the form of published research papers and of reports produced as part of various environmental studies mandated by federal and state laws and regulations, exploring the complex history of the Meadowlands environment from the end of the Wisconsin glaciation about 10,000 years ago to the present. This section of the report reviews those studies considered most pertinent to the present project. Additional and specialist references may be found in the more substantive papers (Heusser 1963; Carmichael 1980; Grossman and Associates, Inc. 1994; Grossman 2003). Particularly useful summaries of the issues are found in these studies, and in Schuldenrein 1995 and Thieme and Schuldenrein 1996. A synthesis of current understanding of the development of the Meadowlands, and presentation of outstanding issues as they apply to cultural resources, is presented in condensed form in Chapter 3. The review here is organized chronologically, to track the development of research on the subject to the present, and to provide a reference source for subsequent studies.

Systematic scientific interest in the modern and past ecology of the Meadowlands may be regarded as starting with the studies and reports by the New Jersey State Geologist C.C. Vermeule in the later 19th century (Vermeule 1897), although valuable botanical work had also been undertaken earlier in the century, and continued into the early 1900s (Heusser 1949b:389-390). The current phase of research in the post-glacial development of the area began with the work of Calvin Heusser in the late 1940s (Heusser 1949a,b; 1963) and now employs the systematic and controlled recovery of paleoenvironmental data from the peats and sediments of the Meadowlands and the analysis of data from pollen, spores, faunal remains (especially foraminifera) and radiocarbon assays,

Heusser's work was undertaken in association with initial design and engineering studies for the New Jersey Turnpike, and investigated the area of a former cedar bog forest between Mill Creek and Cromakill Creek on the east side of the Hackensack River northeast of Secaucus (Figure 1.2, location A). He noted the presence of large buried logs of white cedar (*Chamaecyparis thyoides*), remnants of the once extensive cedar bogs of late prehistoric and colonial times. The age at death of one of the trees was estimated at 311 years (Heusser 1949a). In a much fuller analysis published the same year (1949b), he presented the first results of peat sampling at 100 meter intervals along three transects at the Secaucus location. The sampling showed the peat here to be about 10 feet deep and lying on gray lacustrine clay. Near the creeks, peat formed from marshland vegetation overlay the peat formed from forests.

The study was important in showing a clear succession of tree species at this location. Analysis of the forest peat showed that black ash (*Fraxinus niger*) was common at the base of the profile, with larch (*Larix*) and spruce (*Picea*) more common in the middle, and white cedar present only in the upper portions. This succession was primarily attributed to rising water levels and increasing salinity. Plants adapted to brackish water first appeared at a depth of six feet within the larch and spruce forest. The appearance of white cedar at this northern limit of its range was ascribed to amelioration of the climate in relatively recent historic times.

Heusser subsequently (1963) published results from this and two other former cedar bogs (at East Rutherford and Kearny, B and C on Figure 1.2). These revealed the complexity of vegetational changes through time. Vegetation on the bed of the drained lake was possibly identified (at Secaucus), being represented there by organic silts between gray and red silts. Heusser speculated that the general absence of early and middle Holocene sediments was the result of a marine transgression between 5000 and 6000 B.P. that eroded and compromised these deposits. This was followed by a regression that eventually permitted the development of freshwater peats.

A radiocarbon date of 2025±300 B.P (before present) was obtained from the lowest level of the peat above the lacustrine clays, a relatively recent date in light of the assumed much earlier date of the clays. Pollen analysis showed that alder and birch (Alnus) were unusually dominant in the lowest levels of the peat (pollen zone C3a). In the overlying cooler zone C3b (dated to about 1880±100 B.P. on Cape Cod) spruce was more common, confirming observations in the 1949 study. A presumably milder interval (C3b1) was identified during which white cedar invaded the area. In the following C3b2 sub-zone there was a sharp rise of herbaceous species, attributed to European impact. Peat deposition was found to have been continuous at Secaucus but not at Kearny and Rutherford. Evidence of fires was found in all three profiles. A three-meter rise in sea level over the last 2000 years was posited on the basis of the profiles.

In his 1974 Columbia Master's Thesis, Lovegreen created a northwest-southeast geological profile across the central portion of the Meadowlands (see Figure 1.2), using data from borings undertaken for the New Jersey Turnpike. This was generalized and concentrated on the data from the deeper strata.

The research methods of Heusser were further expanded and refined by his student Dorothy Peteet Carmichael (1980), who published a 3.8 meter profile from the west bank of the Hackensack just north of Secaucus (D on Figure 1.2). Carmichael obtained four radiocarbon dates from the column, and analyzed not only pollen, but also spores, macrofossils and *foraminifera* (small water-dwelling protozoans whose shells are good environmental indicators).

The problem of the hiatus between the late glacial lacustrine clays and the earliest peat (dated here to 2610±130 B.P.) was now addressed in more detail. Either marine or fluvial erosion were favored as explanation. A third hypothesis, that the upper clays were not lacustrine but estuarine and of more recent date, was not felt by Carmichael to be supported by the evidence. Birch (*Alnus*) was again prominent in the earliest peat. Subsequent changes (reflected by seven different plant assemblages) were ascribed to oscillating tidal influence, which became steadily more significant after about 1800 B.P.

Archaeologically oriented cultural resource studies began to be undertaken in the Meadowlands during the 1970s. At this time Cultural Resource Management Services, Inc. (1979) made the first assessment of the prehistoric and historic archaeological potential of the Meadowlands to make use of the then still-limited information on Late-Glacial and Post-Glacial environmental change. Also in 1979 a survey identified prehistoric materials reputedly found along Penhorn Creek, a so-far unique attribution that unfortunately cannot be substantiated (De Leuw Cather/Parsons 1979:30, Resource #96).

A 1982 investigation (Historic Sites Research 1982) involving pollen probes and archaeological tests south of Snake/Laurel Hill and across the Hackensack in Kearny (E on Figure 1.2) appears to be the first attempt to combine archaeological field testing with paleoenvironmental investigations in the Meadowlands. No radiocarbon dates were recovered from these cores, but the upper 15 feet of silts, peat and clay were interpreted as accumulating in the last 2000 years, a conclusion broadly comparable to the results from Heusser and Carmichael. Deeper clay deposits, down to 26 feet, may be up 5000 years old and reflect earlier deposition in this lower portion of the drainage. The report included a roughly east-west geological profile of the Meadowlands between Penhorn Creek and the Hackensack River, reproduced here as Figure 1.4. This crosses two of the present study areas: 17 (Laurel Hill Park Wetland) and 26 (River Bend Wetlands Preserve).

As part of the Meadowlands Master Plan Revision Program, Research & Archaeological Management (1989) produced an updated overview of cultural resource sensitivity. This study failed to reference Carmichael's 1980 study, and suggested that Post-Glacial deposits in the Meadowlands might be up to 30 feet thick. The latter assertion was evidently based on generalized comments from Wolfe (1977), and perhaps from the so-far uniquely deep data from the Historic Sites Research 1982 study, but did not reflect general understanding of the geology of the area at the time. Typically, peat deposits average half the depth posited in this study.

Proposed improvements at the intersection of Paterson Plank Road and U.S. Routes 1 and 9 in North Bergen and Secaucus enabled Hunter Research, Inc. (1992) to collate data from borings chiefly undertaken in 1978 and 1990. Figure 7.1 of the report presented the data from these borings as an east-west cross section of this eastern periphery of the Meadowlands (G in Figure 1.2). Good information was obtained about the configuration of the diabase bedrock and the lake deposits. Peats were not identified close to the Bergen Ridge, and were capped by modern fill materials further west. Areas north of Paterson Plank Road were considered to retain considerable paleoecological and geoarchaeological potential, despite the overlying contaminated fill. 19th-century clay extraction south of Paterson Plank Road had removed any potentially significant deposits from this area.

In 1991-1992 Grossman and Associates, Inc. produced two map-based studies of prehistoric and historic archaeological sensitivity for the whole of the Meadowlands (Grossman 1991, Grossman and Associates, Inc. 1992a). Both these initial and later (1994) studies were conducted as Federal compliance efforts mandated by the Environmental Protection Agency as lead agency in a cooperative multi-agency initiative to develop a Special Area Management Plan (SAMP). The work was a phase I generalized sensitivity evaluation and attempt to synthesis of previous work. The subsequent 1994 studies were second stage-parcel-specific studies using GIS impact analysis to define low impact areas.

A series of overlay maps in both reports collated a range of data from historic maps and other sources and produced assessments and evaluations of Development Zones identified by the (then) Hackensack Meadowlands Development Commission. Map A in the 1992 study presented a prehistoric archaeological sensitivity assessment of the Meadowlands, identifying the environs of the main tributaries of the Hackensack as having the greatest prehistoric potential. This map is included here as Figure 1.5.

The results and conclusions of these and other cultural resource studies up to 1992 were summarized by Grossman (Grossman and Associates, Inc. 1992b). Two somewhat contradictory viewpoints are discernible in these studies. One is a general assumption that the Meadowlands would have been a rich and attractive environment in prehistoric times, at least from the Late Archaic period onwards. The second (based on the results of conventional near-surface archaeological testing) is that specific areas investigated within the marsh environment had little or no prehistoric archaeological potential. Grossman

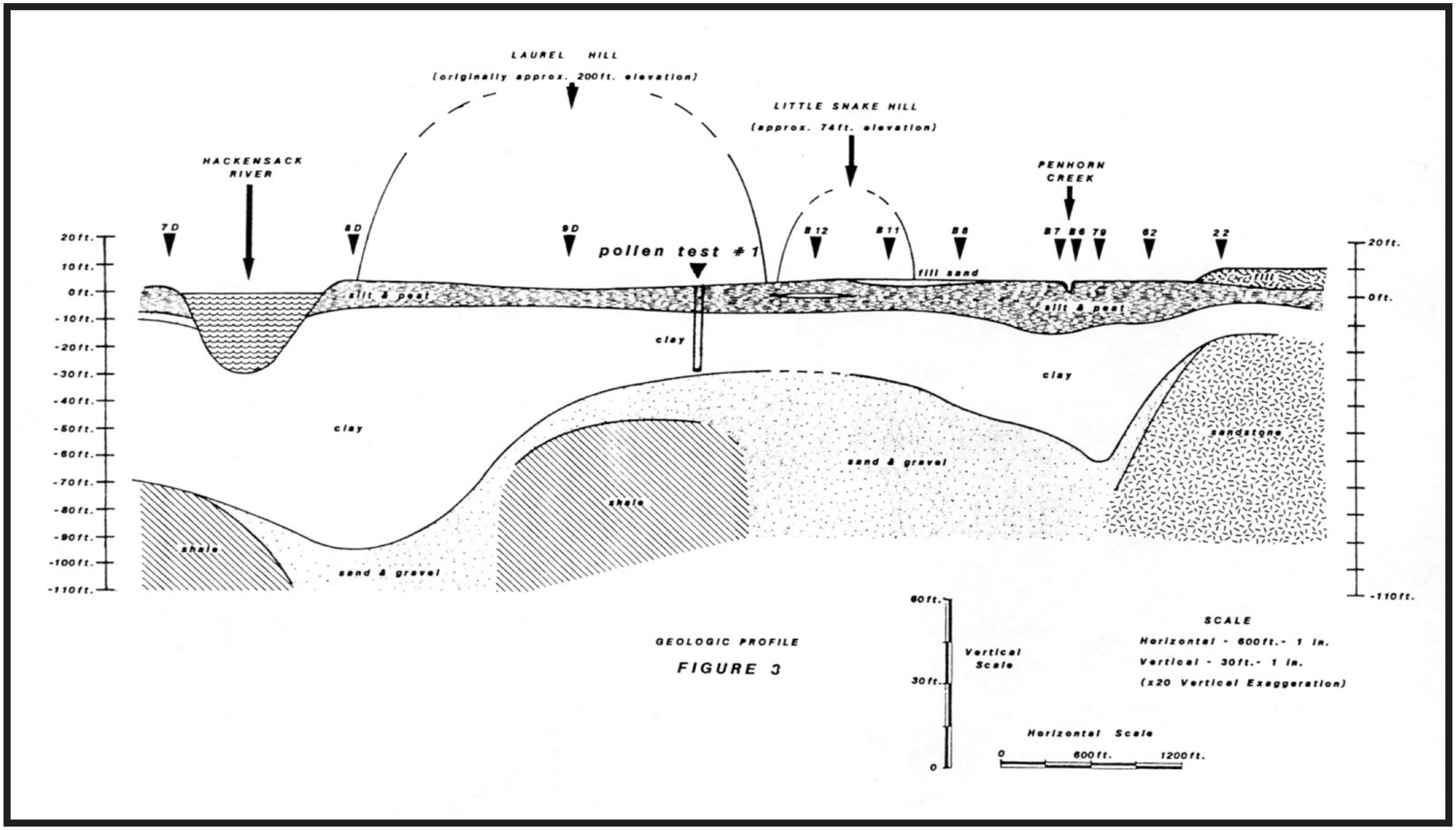

Figure 1.4. Profile across part of the Meadowlands between Penhorn Creek and the Hackensack River produced in 1982. Note the greater depth of silt and peat in the area of Penhorn Creek. Source: Historic Sites Research 1982: Figure 3.

pointed out (1992:10) that these archaeological studies had for the most part not appreciated the dynamic and changing environmental prehistory of the Meadowlands revealed by the work of Heusser and Carmichael, and had therefore not incorporated such information into their models of prehistoric settlement.

These studies were expanded in 1994 to provide recommendations for three categories of proposed land use: Preferred Development Alternative areas, Transportation Improvement Corridors, and Wetland Creation and Mitigation Areas under consideration by the Special Area Management Plan, or SAMP (Grossman and Associates, Inc. 1994). The latter include the greater part of the areas included in the present study. One of these (19 - Lyndhurst Riverside Marsh, identified as WA 2-6-a W) was recommended for pollen coring because no disturbance was identifiable from landfills or other impacts. The proposed method was for *"vibra-core samples to provide non-compacted vertical columns to the base of the marsh sediments (ca. 12 to 13 feet), with the analysis at a minimum of 1 foot intervals of the pollen record within each fraction, and each of which would be tied to a radiocarbon determination involving a total of 10 to 15 samples per pollen core location"* (Grossman and Associates, Inc.1994:4).

A central premise of these investigations was that based on the recovery of a Civil War era map record of mud depths, the former pre-marsh topography of the drainage was not flat, but in fact varied in elevation with a range of 0 – some 30 feet near to the primary channel. Using 19th-century topographic data, Grossman georeferenced the 19th-century mud-depth bathymetric readings and plotted the known depth of marsh deposits over the entire Meadowlands for the first time (Grossman and Associates, Inc. 1994: Figure 5b, included here as Figure 1.6). The base of these marsh deposits was taken as marking the ground surface prior to inundation in the last few millennia. By relating this data to currently understood levels of sea level rise, it was possible to delineate shifting shoreline levels through time as the sea level rose.

Several geoarchaeological studies were undertaken by Geoarcheology Research Associates in the early 1990s. Schuldenrein 1995 describes the detailed stratigraphy from a boring designated NC-04 adjacent to Bellman's Creek in North Bergen, close to Area 20 (Meadowlark Marsh), but also discusses nearby borings in the Carlstadt area undertaken in 1990-1, and borings at North Arlington on the west side of the Meadowlands. The latter investigations were also the subject of a separate report (Thieme and Schuldenrein 1996). These investigations are shown on Figure 1.2 as H through I. The North Arlington study obtained a date of 5030±160 B.P. from the lowest peat level at 10-12 feet below surface. This is a similar depth to those reported by Heusser and Carmichael, but the date is some 3000 years older than those previously obtained. At NC-04, by contrast, mean sea level. A date of 930±50 B.P was obtained from a highly organic accumulation or "meadowmat." Former water table levels were also noted within the organic layer, below which was a fluviatile sand interpreted as a deposit from pre-marsh flooding.

These studies suggested that a major cause of the development of peat in the Meadowlands and related environments in New England from 3000 B.P or so was a slowing of the rate of sea level rise. This slowing may have precipitated a change from "open muddy estuaries to tidal marshes" (Schuldenrein 1995:212), and permitted the development of the environments now documented through pollen analysis.

The Carlstadt data was subsequently revisited in a paper by David Rue and Alfred Traverse (1997). This study presents somewhat different conclusions about the Meadowlands and does not reference some of the other key studies, particularly those by Carmichael,

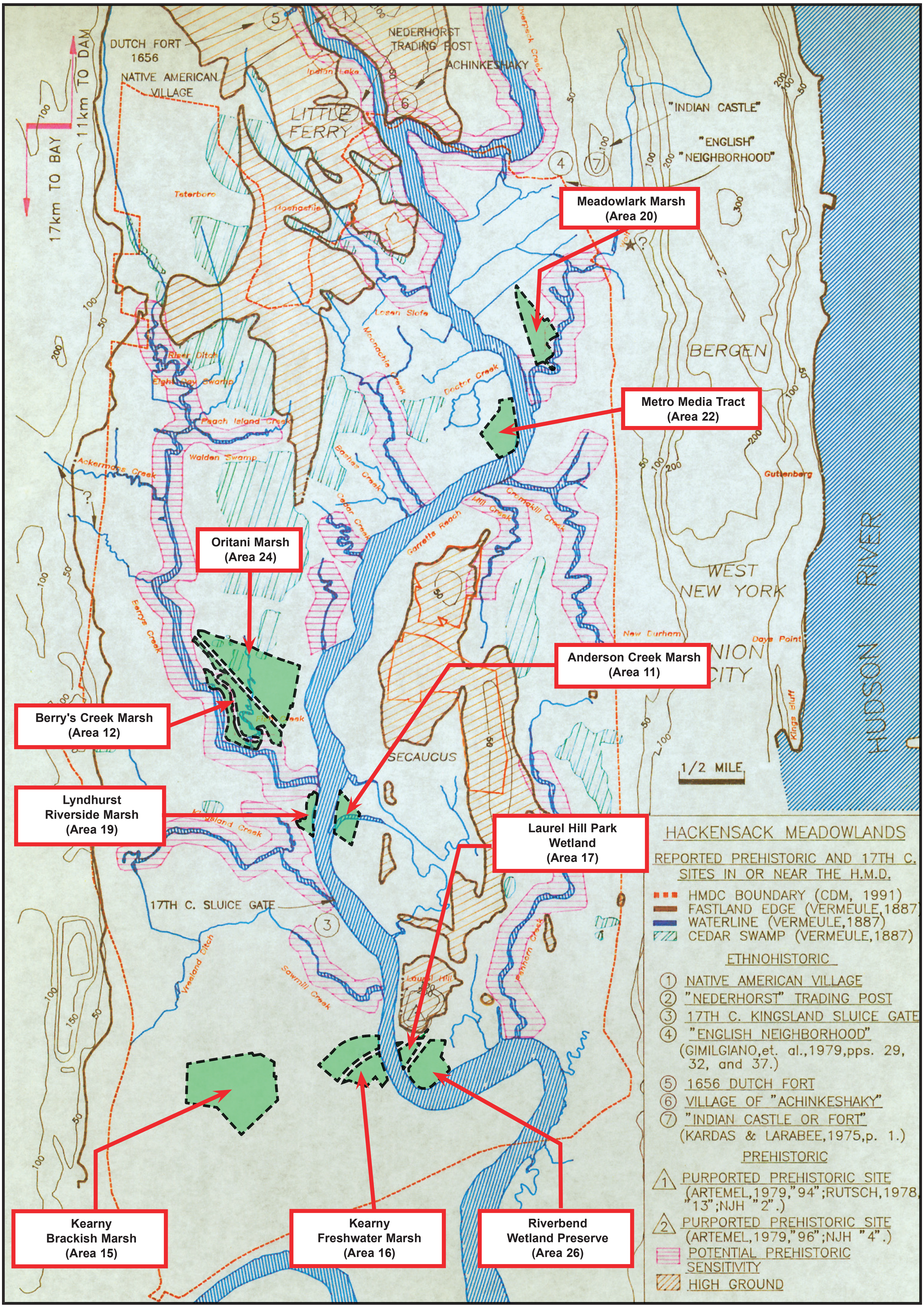

Figure 1.5. Prehistoric and 17th-century Resources in the Meadowlands as Modeled in 1982. The map also shows the cedar swamps as mapped in 1887. Source: Grossman and Associates, Inc. 1992a: Map A.

Grossman and Schuldenrein. Efforts to obtain the full report from which this paper is derived, prepared by Woodward-Clyde in 1990, have been unsuccessful.

A radiocarbon date of 2160±90 B.P. was obtained from "the upper meter of sediment" in core 91-2 (Rue and Traverse 1997:212). Schuldenrein (personal communication, January 7, 2006) believes that the lake sediments below the peat are being referred to here, rather than the upper 1 meter of the profile. A similar date was obtained from wood "at approximately 1 m depth" (Rue and Traverse 1997). Compaction and loss of segments of the samples render the stratigraphic integrity of these samples problematic. Two anomalously early dates of 22,000+ B.P. were also obtained from the upper lacustrine silts (Rue and Traverse 1997:213).

The paper addressed the continuing issue of the hiatus between the lake sediments and the initiation of peat formation. It is suggested that eolian silt and loess lie between the upper desiccated varved clays of the lakebed (Rue and Traverse 1997). The lakebed was therefore first exposed as a dry surface and was then at least partly covered through eolian processes. It is considered possible that humans may have inhabited some settings within the dry lakebed, although motivations for doing so are not made explicit. Overall, the Rue and Traverse study suffered from sampling problems, compounded by inadequate contextual research. No reference was made to Carmichael's 1980 paper or the Grossman studies, for example, and there seems little awareness of the complexities of post-glacial succession in this area.

Investigations at several locations on the eastern edge of the Meadowlands at the toe of the Bergen Ridge were reported on in the following year (Thieme and Schuldenrein 1998 in Richard Grubb and Associates, Inc. 1998). Productive auger borings were undertaken at locations CSO 008, 010, and 011 in Union and Jersey Cities, Hudson County (J on Figure 1.2). Borings 010 and 011 yielded the most complete sequences. Of particular interest for the present study was the identification of stratigraphy between the varved lake deposits and the organic peat. Above a desiccation level (cf. Rue and Traverse 1997) lay a four-foot, upwardly fining alluvial or colluvial deposit, capped with gray silty clay. This clay had a radiocarbon date of 3650±70 B.P and lay immediately below the peat, possibly pushing back the age of initial sea level rise and initiation of peat formation 1000 years earlier than suggested by Heusser. The base of the peat lay at about 10 feet below sea level.

Study of the history of the white cedar stands in the Meadowlands was advanced significantly by work undertaken in the late 1990s near Mill Creek at Secaucus: the area of Heusser's pioneering work (Zimmerman and Mylecraine 2000) (K in Figure 1.2). 625 cedar stumps, exposed by wetland mitigation measures, were studied through diameter measurement, tree ring counts and radiocarbon dates. A date of 630±40 B.P was recovered from a log that was 505 years old at death, placing its initial growth well over 1000 years ago, several centuries older than Heusser had estimated, but still relatively recently in the vegetation succession. The average age of the trees was 257 years when cut. The cutting age could not be determined but was estimated to be in the 18th or 19th century, placing the initial growth of most of the trees close to the time estimated by Heusser. The authors suggest, however, that there was at least one previous stand (generation) of trees before this one.

Most recently, in 2003, Grossman, in an invited paper before the Meadowland Commission, returned to the issue of prehistoric landscape reconstruction he had first addressed in 1994. Much of this paper is dedicated to identifying problems of establishing the rate and scale of sea level changes over the last 2000 or so year. As his review demonstrates, there is as yet little hard data or consensus on this subject, and it appears that rates of rise may have been far from constant. Grossman employs data from mid- and late 17th-century barrel cisterns in Manhattan and the Chesapeake to suggest that sea levels in the 17th century may have been significantly lower in the New York area. This has implications for the early land grant areas in the Secaucus and Snake Hill areas of the Meadowlands, which may have been significantly drier and more viable for agriculture than seems apparent today.

2. Research on the Historic Development of the Meadowlands

The focus of historical background research was to identify known historic resources, previously conducted surveys in the vicinity of the project areas and development of the Meadowlands from the 17th century through the present. The most succinct and authoritative account of the history of the Meadowlands is by Kevin Wright (*The Hackensack Meadowlands: Prehistory and History* 1988). This well-researched work formed the basis for much of the historical abstract contained within Chapter 4 of the present report and was particularly useful in its accounts of the patents acquired by William Sandford, Isaac Kingsland and John Berry. The work also addressed subsequent improvements, industries and transportation development.

There are numerous published secondary sources on the counties and municipalities comprising and surrounding the Meadowlands. These include C.H. Winfield's *History of the County of Hudson* (1874) and *History of the Land Titles in Hudson County, New Jersey 1609-1871* (1872), Shaw's *History of Essex and Hudson Counties, New Jersey* (1884), Van Winkle's *History of the Municipalities of Hudson County, New Jersey, 1630-1923* (1924), Clayton's *History of Bergen and Passaic Counties* (1882), Van Valen's *History of Bergen County, New Jersey* (1900), Westervelt's *History of Bergen County, New Jersey, 1630-1923* (1923) and Bogert's series on Bergen County's history and heritage, particularly Volume II (1983). These were all useful in comprehending the region's development.

A large number of historic maps are available for the project area. These comprise manuscript maps, published 19th- and 20th-century maps and atlases, riparian maps, maps produced by the Bergen County Mosquito Extermination Commission and geological maps. Included within this report are maps by Hills (1781), A Map of Part of the Inbanked Meadows (1821), United States Coast Survey (1837 and 1839), Sidney (1849), Hopkins (1861), Hopkins (1873), Walker (1876), Vermeule (1896), Miller (1903), Hopkins (1909), and Bromley (1912,1913).

20th-century improvements to the Meadowlands are documented in several sources. The Annual Reports of the State Mosquito Control Commission of the State of New Jersey (1961-1965), and reports of the Bergen County Mosquito Commission are both significant sources of information. These were used in *An Historical Consideration of Tidal Flow in the Hackensack Meadowlands* (Hackensack Meadowlands Development Commission 1973). Other relevant studies include an overview of the Meadowlands authored by Stephen Marshall that was published online in 2004, a report on the Kearny meadows prepared by the Hackensack Meadowlands Development Commission (1976), Miller's thesis on marsh reclamation (1968), a series of articles published by John Cunningham in the Newark Sunday News in the late 1950s, and various articles in vertical files at the New Jersey Historical Society and the Bergen County Division of Cultural and Heritage Affairs Office.

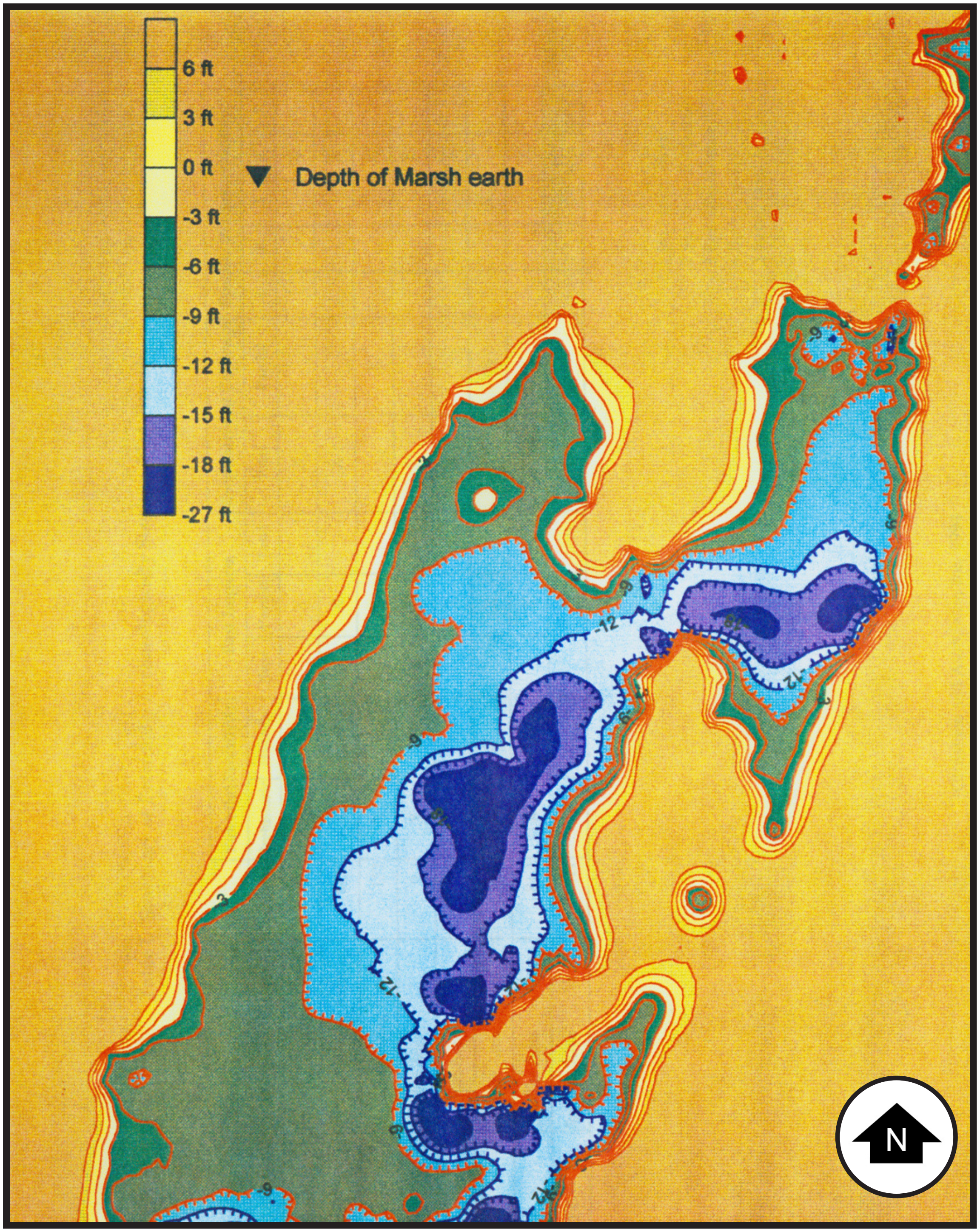

Figure 1.6. Grossman's 1994 map showing the approximate depth of marsh earth (i.e. peat deposits) below present sea level. The shoreline in about 3000 B.P. lay between the 9 and 12 foot contours. According to this model, at 4000 B.P. possibly only areas below 18 feet were inundated. Extensive areas, particularly in the western and northern portions of the Meadowlands, would therefore have been exposed at these periods. Source: Grossman and Associates, Inc. 1994: Figure 5b.

Chapter 2

GEOGRAPHICAL SETTING OF THE PROJECT AREA

A. GEOLOGICAL HISTORY TO THE LATE PLEISTOCENE

The Hackensack Meadowlands are located in northeastern New Jersey a short distance west of New York City. Physiographically they lie in the Newark Basin portion of the Piedmont Physiographic Province (Figure 2.1). The Hackensack River flows south-southwest across the Meadowlands and into Newark Bay where it is joined by the Passaic River flowing in from the west and north. Numerous tributaries feed into the Hackensack, draining the Meadowlands and the adjacent upland areas.

The bedrock underlying the study area is composed of sedimentary deposits and intrusive igneous formations of late Triassic age (*circa* 225-200 million years B.P.). The sedimentary deposits, collectively known as the Newark Group, consist of fluviate and lacustrine reddish-brown shales and fine-grained sandstones. The Palisades sill to the east, and other smaller, local diabase outcrops such as Granton sill, Laurel Hill (also known as Snake Hill), and Little Snake Hill resulted from late Triassic lava flows that intruded into the sedimentary rocks. The Watchung Mountains to the west are, by contrast, remnants of extensive surface flows that covered vast areas of the Triassic landscape. Post-Triassic erosion subsequently carved valleys such as the Hackensack out of the weaker shales while the more resistant basaltic deposits remained as topographic outcrops (Schuberth 1968). Mesozoic and Tertiary developments, chiefly involving the ancestral Hudson River, are not further discussed here.

The Quaternary Period geology of the Hackensack Valley has been extensively studied because of the area's location near the southern limit of the Wisconsinan continental glaciation and early recognition that a massive pro-glacial lake covered the Hackensack lowlands during the period of glacial retreat. These topics are anthropologically relevant in that they broadly correspond with current understanding of the first appearance of *homo sapiens sapiens* in North America. The discovery of mastodon remains at two locations north of the Meadowlands raises the so-far unsubstantiated possibility of human interaction with late Pleistocene megafauna (Hunter Research Inc. 1992: 3.1; Figure 2.2).

During the third quarter of the 19th century State Geologist George Hammell Cook showed a particular interest in mapping the terminal moraine and the limits of the pro-glacial lakes in northern New Jersey (Cook 1868; Cook 1879; Sidar 1981). However, it was Henry B. Kummel, who became State Geologist in 1900, who provided the first detailed geologic mapping of these features, including both surficial distributions and geologic cross-sections (Kummel 1908). Kummel also contributed to and supervised the New Jersey Geological Survey's first volume, which was devoted entirely to the state's glacial geology (Salisbury *et al*. 1902). A sequence of 2,500 annual glacial varves for Lake Hackensack was first reported by C.A. Reeds (1933). The geologic history outlined below is based primarily upon the study by Averill and others (1980). This includes extensive data recently obtained from geologic cores and systematic radiocarbon dating.

Accounts of the Quaternary Period geology of the Hackensack region have traditionally emphasized three major phenomena: the emplacement of the Harbor Hill terminal moraine, glacial retreat, and the formation and subsequent drainage of Lake Hackensack. However, recent studies (notably Averill

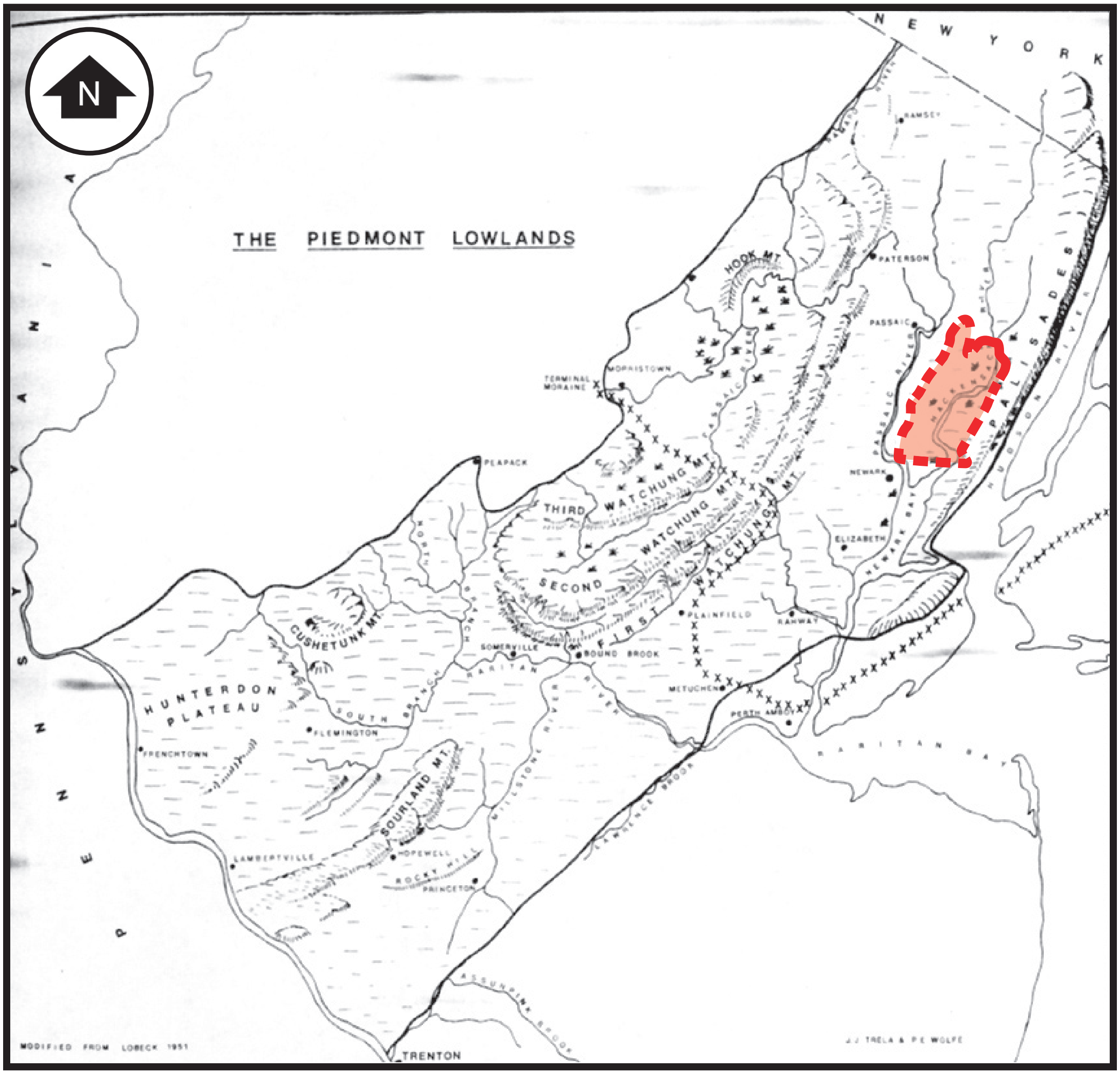

Figure 2.1. Physiographic Location of the New Jersey Meadowlands. Meadowlands District Boundary shown. Source: Wolfe 1977:245

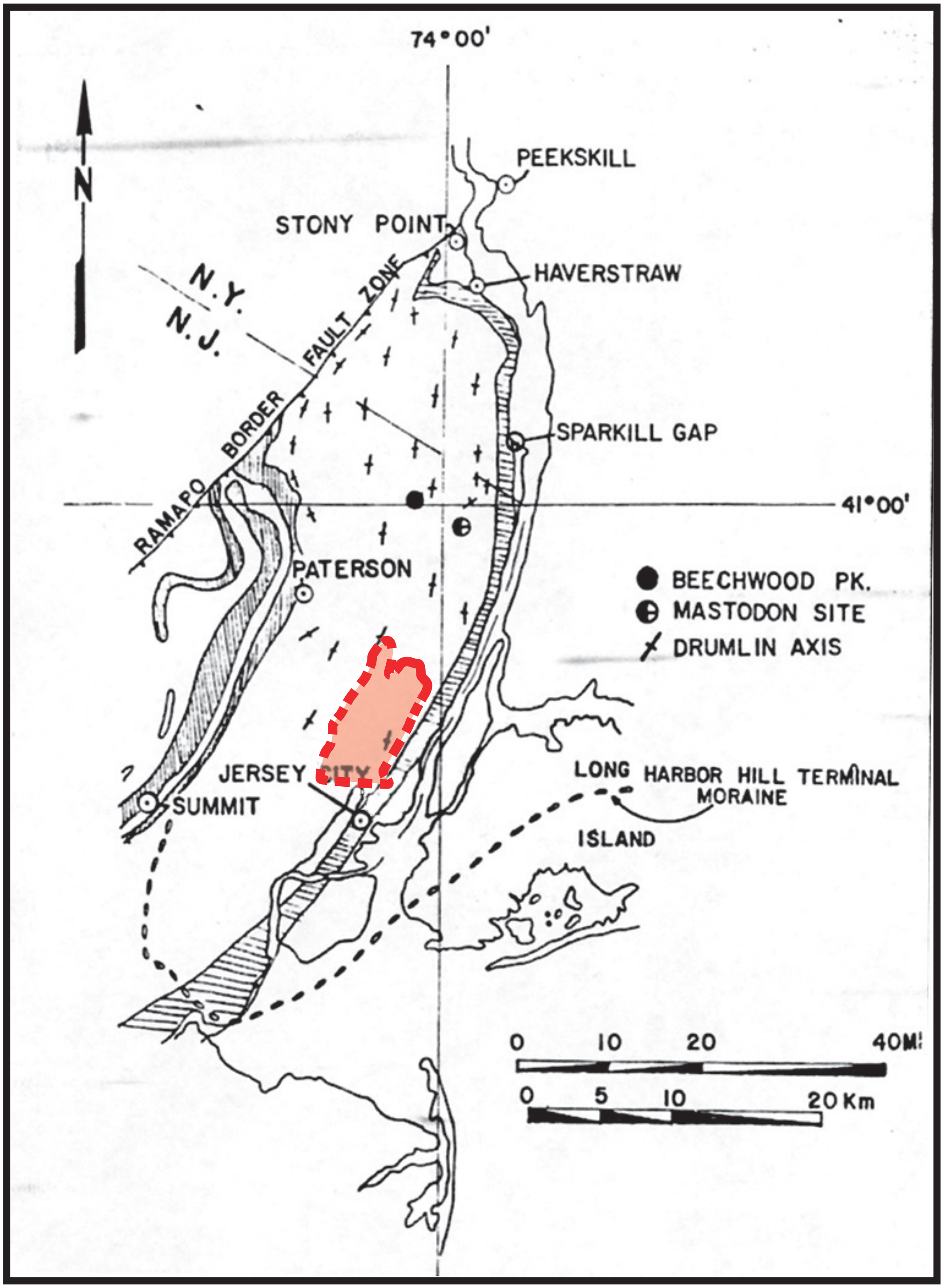

Figure 2.2. Geomorphological Features in the Meadowlands Vicinity. Meadowlands District Boundary shown. Vertical shading: Watchung lava flows. Horizontal shading: intrusive lava flow of the Palisades sill. Late Pleistocene mastodon discovery sites shown. Source: Averill et al. 180: 161.

et al. 1980) indicate that the sequence of events was considerably more complex and included a glacial re-advance into the lower Hudson valley following an interstadial of approximately 1,000 years. Glacial Lake Hackensack existed for a minimum of 3,350 calendar years, and recent work has suggested that there may be at least two stages of the lake, as reflected in two episodes of varve accretion, separated by drainage and desiccation (Schuldenrein 1995:209).

The maximum extent of the Hudson lobe of the Woodfordian ice sheet – the final advance of the Wisconsinan glaciation – is marked by the Harbor Hill terminal moraine. This deposit is discernible as the spine of Long Island and as an irregular ridge extending across the Newark Basin from Perth Amboy to Summit (Figure 2.2). Sometime after 22,800 B.P., the glacier began its retreat and by 19,250 B.P. pro-glacial Lakes Flushing, Hudson, Hackensack, and Passaic were emerging.

A sequence of 2,550 red varves has been recorded at Little Ferry where an unknown portion of the top of the sequence was removed by erosion. Each varve consists of a pair of thin sedimentary deposits, one of which is coarser in texture and lighter in color than the other. The glacial melt water draining into Lake Hackensack contained high concentrations of clays, silts, rock flour, and fine sand. Wind-generated ripples kept the finer particles in suspension during the summer months, allowing only the coarser material to settle. During the winter months the lake ice reduced water movement, allowing the darker-colored, finer-grained clay to settle. The clearing of the lake ice in spring resulted in a sharp stratigraphic break as the next year's coarse sediments were deposited. The presence of a minimum of 2,550 annual varves at Little Ferry indicates that the portion of the lake south of that position existed considerably longer (Schuberth 1968: 192-195).

Towards the end of the glaciation, at about 12,500 B.P (Schuldenrein 1998:208), Lake Hackensack was catastrophically drained. Because of the northward isostatic tilt, part of this drainage was toward the north through Sparkill Gap, with the remainder flowing south and east through the lowlands near Jersey City and through breaches in the terminal moraine at the Narrows and Arthur Kill. For the remainder of this interstadial period the Hackensack River continued to flow north through the Sparkill Gap where it joined the Hudson River as a hanging falls. Subsequent ice re-advance created further complexities in the geological record to the north that will not be discussed further here. The post-glacial developments are described in Chapter 3 below.

B. CURRENT CONDITIONS (FAUNA, FLORA AND TIDAL CONDITIONS) AND LAND USAGE

This summary of current conditions is largely derived from The New Jersey Meadowlands *Draft Master Plan* (1994). Today, the Meadowlands present themselves as wide areas of wetlands interspersed with channels and open water, and dominated by towering *phragmites* reeds. Numerous transportation routes cross the area. The 1994 Master Plan identifies 14 land use types in the *circa* 20,000 acre Meadowlands District (Table 2.1). Water and Wetlands make up 39% of the area. 3400 of the 5783 acres of classified wetlands, or almost 59%, are under the management of the New Jersey Meadowlands Commission. Transportation and industrial uses make up *circa* 35% of the District. Land altered through solid waste disposal and other land uses make up 7.4%. Recreational uses (including the Sports Complex) form 3.9% of the total.

Tidal marsh soils, composed primarily of fibrous peat formed from partially decayed vegetation, occupy the majority of the District.

Table 2.1.
Existing Land Uses in the Meadowlands District

CATEGORY	ACRES	PERCENT
Wetlands	5,783.6	29.5%
Transportation	4,018.4	20.5%
Industrial	2,793.3	14.3%
Water	1,869.7	9.6%
Altered Land	1,444.0	7.4%
Public/Quasi Public Services	965.0	4.9%
Recreational Land	756.6	3.9%
Industrial & Commercial Complexes	419.7	2.1%
Vacant Land	360.4	1.8%
Residential	291.4	1.5%
Communication & Utilities	261.5	1.3%
Commercial Retail	231.4	1.2%
Commercial Offices	209.8	1.1%
Hotels and Motels	80.7	0.4%
TOTAL ACRES	**19,485.4**	**100%**

Sources: NJMC Geographic Information Systems and staff field inspections, 2002

The Hackensack Valley within the Meadowlands District is today a brackish tidal estuary with a tidal range of about 5.6 feet (5.2 feet at Carlstadt, 5.7 feet at Kearny Point) (http://tidesandcurrents.noaa.gov/station_retrieve.shtml, accessed July 24, 2006). Limited freshwater inflow and an indirect link with the sea mean that the estuary waters are only gradually discharged to the ocean, meaning that pollutants remain in the water for longer periods than would otherwise be the case.

The current flora is dominated by invasive *phragmites australis*, or common reed. The origin of this plant is unclear, and there was debate as to whether it is native or introduced. This debate has been largely settled with the recent discovery of a native strand of *phragmites* in the local paleoenvironmental record (Brett Bragin, personal communication, July 2007). The major expansion of phragmites is ascribed to its colonization of dyked areas isolated from saline waters in the 19th and 20th centuries. The presence of these dense stands over much of the District is held to reflect degradation of the unaltered ecosystem (*Draft Master Plan*: 5-12). Nevertheless, the Meadowlands supports a range of fauna, with surveys identifying 53 species of invertebrates, 34 species of fish, 250 bird species, at least 13 mammal species and several amphibians. In number and variety, these figures probably only hint at the biodiversity of prehistoric and early historic times.

Chapter 3

MEADOWLANDS ENVIRONMENTS FROM THE LATE PLEISTOCENE TO THE PRESENT AND THEIR ARCHAEOLOGICAL IMPLICATIONS

A. OVERVIEW

The environmental development of the Hackensack Meadowlands from the end of the Wisconsin Glaciation to the present is now well understood in broad terms (see above, Chapter 2). The history and topography of this former lakebed surface between about 10,000 to about 2,000-4,000 years ago remains, however, quite obscure. Developments over the last few millennia are becoming better understood. Their implications for human activity remain to be fully explored, but advances in sampling and dating techniques (*e.g.* Pederson *et al*. 2005) hold considerable promise in this area. This chapter synthesizes and summarizes the current state of knowledge, and presents a framework for establishing the archaeological potential of these changing environments.

At a time variously dated to between 2,000 and 4,000 or even 5,000 years ago peat formation began over the top of the lakebed and over intermittently surviving fluvial and organic surfaces that had developed over the varved clays. The record from the peat shows early dominance of hardwood tree species giving way to sedges and then to grasses, with an episode of white cedar growth in the last millennium. Plants such as ragweed signal European settlement and land clearance, and in the recent past the floral record is dominated by *phragmites*. The apparently rapid spread of the latter is a complex issue, influenced by a number of factors, including drainage, disturbance of the soil, salinity and the appearance of invasive species.

B. KEY ISSUES

While there is consensus on this general development of the Meadowlands there are many details that remain unclear. While these issues remain unresolved, it is difficult to develop strong predictive models of prehistoric and early historic land use in the area. The purpose of this chapter is to characterize these issues and their implications for archaeological resources. For this discussion, Table 3.1 assembles some of the key data relating to these questions, and is a condensation of the source literature reviewed in Chapter 1.

1. The Unconformity between the Lake Hackensack Varved Clays and the Overlying Peat

It has been recognized for more than 40 years that there is a considerable stratigraphic hiatus between the youngest of the varved clays, dating to about 10,000 -12,000 years ago (Thieme and Schuldenrein 1996:3), and the overlying peat deposits. As Figure 3.1 shows, such sediments appear to be absent on the west side of the Hackensack, not being identified at Kearny (Heusser 1963), East Rutherford (Heusser 1963, Carmichael 1980), or at North Arlington (Schuldenrein 1996).

By contrast, a range of materials have been found at this stratigraphic position in Ridgefield (Rue and Traverse 1997), Secaucus ("coarse sand over gray clay": Heusser 1949b, 1963), North Bergen ("fluviatile sands" at Bellman's Creek: Schuldenrein 1995; four feet of alluvial/colluvial material and gray silty clay east of Secaucus: Schuldenrein 1998) and south of Snake Hill ("fine gravel": Historic Sites Research 1982). For the most part, these sediments seem to represent moderately high-energy events not conducive to the development of stable soil horizons and vegetation. The Rue and Traverse 1997 study and the 1998 Schuldenrein investigations both also identified evidence for desiccation involving both deposition of loess and the erosion of the upper varve levels. Marine transgressions and regressions (Carmichael 1980) cannot be ruled out. Given the long time span and the limited amount of data it is not possible to draw any firm conclusions, but the apparent absence of such sediments west of the Hackensack is certainly something that calls for further evaluation. The Bellman's Creek area around Meadowlark Marsh stands out as holding particular potential for holding coherent pre-peat deposits (see below, Chapter 5).

2. Marine Transgression and the Initiation of Peat Development

Peat is partially composed vegetative matter, developing where drainage of water is blocked, precipitation is retained, and decomposition of organic matter is slowed. Such conditions, probably caused by rising sea levels, appear to have developed at different times at different locations

Radiocarbon dates from the base of the peat range from 2025±300 B.P at Secaucus (Heusser 1963), through 2610±130 B.P. on the west bank of the Hackensack in East Rutherford, Bergen County (Carmichael 1980:515), 3650±70 B.P. (*terminus post quem* in North Bergen), to as old as 5030±160 B.P. in North Arlington, Bergen County on the western edge of the Meadowlands (Thieme and Schuldenrein 1996:1). Generally, these dates get older downstream, reflecting the progressive nature of the ponding-back of the Hackensack in response to rising sea levels in Newark Bay. The estimate of 5000 years for the earliest brown organic clays south of Snake Hill (Historic Sites Research 1982) is consistent with the radiocarbon dates.

If these dates are correct, they imply a period of about 3,000 years in which drainage was progressively impeded up the Hackensack Valley. This time frame broadly covers the Late Archaic and Early Woodland Periods. The process was locally complex because of the range of topography within the valley, as emphasized by Grossman (1994 and Figure 1.6 of this report).

3. The Vegetation Sequence

For much of its history over the last few millennia the Hackensack Meadowlands has been a fen: an area where peat never accumulates to the point where plants lose contact with water moving through mineral soil, and is normally dominated by grasslike sedges (*cyperaceae*) ("Peatland," Microsoft® Encarta® Online Encyclopedia 2005 http://encarta.msn.com © 1997-2005 Microsoft Corporation. All Rights Reserved. Accessed January 22, 2006). Changes in salinity, sea level, runoff and climate can affect the character of such ecosystems in a complex manner through time. These changes can now be studies through the analysis of plant remains (pollen, spores and plant fragments) preserved within the peat, linked to established pollen sequences and dated through radiocarbon assays.

Studies in the northern portion of the Meadowlands identify a forested environment at the beginning of the sequence, at roughly 3,000 years B.P. Trees like alder, indicative of non-saline or non-brackish freshwater conditions, and ash and birch, requiring moist cool soils, are prominent in the record north of Secaucus. To the south, tree pollen was specifically noted as absent at North Arlington, with freshwater sedges, grasses and ferns being found at the lowest levels of

Table 3.1. Selected Paleoenvironmental Data from the Hackensack Meadowlands.

Study	Location	Lake Hackensack	Sediments Post-dating Lake	Depth of Peat Below Sea Level	Dates for Base of Peat	Vegetation succession
Heusser 1949	Secaucus	Varves not identified in clay	Coarse sand over gray clay	10 feet	"marsh peat" overlies "forest peat	Black ash-larch-spruce-white cedar. Brackish conditions at 6 feet
Heusser 1963	Secaucus, East Rutherford, Kearny		Eroded by transgression 5000-6000 BP? Organic silts at Secaucus	10.5 feet	2025+/-300 BP	Alder/birch-Larch/spruce/ hemlock - herbaceous types predominate late
Carmichael 1980	W bank of Hackensack, Carlstadt	not penetrated	Absent: fluctuating sea levels or fluvial erosion preventing development of soils	12 feet	2610+/-130 BP	birch prominent to c. 2000 BP. - Sedges (bullrushes) -grasses, ragweed etc
Historic Sites Research 1982	South of Snake Hill	not penetrated	fine gravel, possibly above clay	31 feet (gray-brown organic clays with peat)	5000 years BP?	Tree pollen declines through time. Grasses prominent
Schuldenrein 1995	Bellman's Creek	yes: two phases?	Fluviatile sands	6.5 feet	930+/-50 BP	No details
Thieme and Schuldenrein 1996	North Arlington	yes	no	10-12 feet	5030+/-160 BP	Sedges, grasses ferns at lowest peat level
Rue and Traverse 1997	Each side of Hackensack, Carlstadt and Ridgefield	yes	yes	"up to 20 feet"	after 2160+/-90 BP? (sediment below peat?	Generalised
Thieme and Schuldenrein 1998	North Bergen, Jersey City (Base of Bergen Ridge)	yes, dessication upper portion	4 foot alluvial/colluvial, with gray silty clay immed. below peat. 3650+/-70 BP	5 feet	After 3650+/-70 BP; 1340+/-60 BP within peat	"mostly phragmites"
Zimmerman and Mylecraine 2000	Secaucus	n/a	n/a	n/a	n/a	White Cedar starts at 1000+ BP

the peat there (Thieme and Schuldenrein 1996). The fairly shallow peat at North Bergen was characterized as "mostly phragmites" (Thieme and Schuldenrein 1998) and may be fairly recent. Tree pollen was found in the lower levels south of Snake Hill and declined higher up the column, but there is no discussion in this report of whether the identified pollen is regional or local (Sirkin in Historic Sites Research 1982: 69-72).

From the point of view of human occupation, this moist woodland environment, which was probably quite varied, would have provided a variety of food resources for people in the Late Archaic and Early Woodland periods, and may have provided topographic settings suitable for longer-term seasonal encampments.

The forest conditions gave way to open fenland dominated by sedges and rushes (*Cyperaceae)*, apparently no later than about 2,000 years B.P. Such vegetation implies wet ground conditions over extensive areas. Unlike the forest, such environments would not invite long-term settlement or encampments, and it may be suggested that Middle and Late Woodland sites will be largely absent from the sedge fen areas of the Meadowlands, although they can be expected on "fast" land like the Secaucus "island."

4. Climate and Vegetation Changes Over the Last 1,200 years

Striking documentation for a warm and dry period from about AD 800 to 1300 (termed the Medieval Warm Period) has recently been published from the Piermont Marsh on the Hudson, just north of the New Jersey/New York state line (Pederson *et al*. 2005). Earlier studies in the Meadowlands (particularly Carmichael 1980) had produced similar, though less detailed evidence. Higher inorganic sediment content and evidence of localized fires present a picture of conditions rather different from those of today. The drier conditions may have made the Meadowlands more attractive than before or since during the earlier part of the Late Woodland. It may even be wondered if some of the fires were anthropogenic, reflecting Native American manipulation of the environment to encourage certain types of game.

It is clear that the stands of Atlantic white cedar (*Chamaecyparis thyoides*) characteristic of parts of the Meadowlands at the time of European settlement and into the 19th century were a specific episode lasting for up to a millennium or so (Zimmerman and Mylecraine 2000). A combination of radiocarbon and tree-ring counts now puts the commencement of growth of the oldest known tree at about 1,000 years B.P., within the Medieval Warm Period. Since the Meadowlands are at the northern end of the range of this species, it is probable that these warmer conditions permitted its growth during this period. The fairly rapid decline of the cedar stands in the later 19th and 20th centuries is considered to be largely the result of human alteration to drainage patterns, perhaps combined with a slight rise in sea level. This resulted in an increase in salinity that the cedar could not tolerate. Somewhat cooler temperatures *circa* AD 1300 may also have made the cedar less viable. The fuller understanding of this episode underscores the dynamic and changing character of the Meadowlands environment through time.

5. European Influence

The upper portions of the palynological cores show an increase of adventive (*i.e.* introduced) plant species, including *Ambrosia* (ragweed), compositae (flowering plants), and chenopods (plants of the goosefoot family, some of which were used as food sources by Native Americans). These arrivals probably reflect ground disturbance as a result of Dutch, English and American attempts to make the Meadowlands more productive agriculturally (Carmichael 1980:522).

It is clear from colonial and early 19th-century accounts that salt hay meadows, together with the cedar sands, were the chief resource exploited in the Meadowlands (Wright 1988: 43-47). The regular mowing of salt hay would over time alter the vegetation, and it is clear that efforts were also made to convert salt meadow to fresh and to introduce English grasses. It would be of interest to identify such species, and perhaps cereal grains, in palynological investigations, as indicators of conditions in the 17th and 18th centuries, particularly in the Secaucus area where settlement began in the 1660s (see below, Chapter 4).

The drainage efforts of the Swartwouts (beginning in 1813), the New Jersey Land Company (beginning in 1867), and the mosquito commissions in the early 20th century, would have provided opportunities for the adventive species, at least in the short term, as presumably would clearance for landfills, railroads and industrial activities. Generally, however, the vegetation of the Meadowlands has been dominated by *phragmites* for the last century or so.

C. ARCHAEOLOGICAL IMPLICATIONS

There is no doubt that, in general terms, the Meadowlands environments were attractive to prehistoric Native American groups as seasonally prolific sources of food and other animal products (*e.g.* hides, quills, bone and sinew), and of other resources such as plant fibers, edible roots and seeds, medicinal herbs, and timber (Wright 1988:9). What is much less clear is whether these resources were procured through short-term forays from the surrounding uplands, or from longer-term or repeatedly utilized locations within the Meadowlands themselves. Given the variability of the environment through time, it may be that both patterns were present at different periods.

The archaeological literature on the Meadowlands has not usually addressed these questions in any detail. One viewpoint is that the dry adjacent uplands would have generally been more attractive to settlement since they would provide ready access to the marshland areas, which were essentially for hunting and procurement (*e.g.* Hartz Mountain Industries 1978:xi-1; Historic Sites Research 1982:14). Other studies, citing evidence from the Passaic Basin and the Trenton/Hamilton Marsh, have suggested that longer-term sites may be present within the Meadowlands proper, especially along the margins (*e.g.* Research & Archaeological Management, Inc. 1989:11-13; Hunter Research Inc. 1992:Chapter 8; Richard Grubb and Associates, Inc. 1998:3-2).

In general, these studies have not sufficiently taken into account the changing and unique character of the Meadowlands through time as this has been increasingly well characterized through palynological studies. It is only with the work of Grossman (1992, 1994), Schuldenrein (1995) and Thieme and Schuldenrein (1996) that a more structured approach has been adopted. Grossman, placing emphasis on evidence for lower water levels at 2,000 B.P. and earlier, suggests that many areas within the Meadowlands may have been attractive for settlement in at least the Late Archaic, Early Woodland and perhaps the earlier part of the Late Woodland. Schuldenrein proposes that limited activity sites of the Late Archaic and later may be present below shallow peats both on the fringes of the Meadowlands marshes and in riverine and confluence locations, while recognizing that much of the area would be unattractive for settlement because of the marshland conditions. The recent strong evidence for the Medieval Warm Period also raises the possibility more intensive use in the Late Woodland than had previously been envisaged.

There has been very little discussion of historic archaeological resources in the Meadowlands. The assumption has been that Dutch, and later English and American, settlement sites were on “fast” or dry ground and therefore not within the Meadowlands themselves. This is probably a legitimate approach, but relies on the premise that water tables were at roughly modern levels in the 17th and 18th centuries. The implications of Grossman’s (2003) research on water tables revealed by 17th-century barrel privies or cisterns in the Chesapeake and in Manhattan is that this was not the case. Areas now waterlogged may therefore have been dry in the earlier historic period. This may have particular implications for the early land grant locations on the Secaucus Island, including Penhorn Creek and the Snake/Laurel Hill area.

Given the general inaccessibility and invisibility of any sites that may exist and the still-limited understanding of earlier topography and conditions, it is legitimate to address the potential value of such resources, particularly in relation to National Register eligibility criteria. In particular, would such sites possess characteristics that would make them more important than similar sites in more accessible locations?

Any archaeological resources identified in the Meadowlands will probably be assessed for eligibility under 36CFR 60.4, criteria C and D:

> (c) embody(ing) the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
>
> (d) have yielded, or may be likely to yield, information important in prehistory or history**.**

The Meadowlands has the potential to preserve sites with characteristics not normally found in other settings:

1. Stratigraphic Integrity. From the inception of peat accumulation, it can be assumed that in most locations archaeological sites will have been minimally disturbed once human activity ceased. Except for local high-energy events along waterways, the expected situation is one of gradual site immersion in peat. Such a situation will result in the significant survival of intrasite patterning and coherence, which will enable past behaviors to be studied. This situation may also hold true even for prehistoric sites showing repeated use, since thin peat accumulations may separate occupations, permitting them to be distinguished and examined diachronically.

2. Organic Survival. Archaeological plant materials such as wood, bark and fibers can be expected to survive at such sites. Given the general absence of such items from much of the prehistoric archaeological record in the Mid-Atlantic, their identification would be of great significance. Artifact types that could reasonably be anticipated include tool hafts, basketry and bark containers, and even boats. Whether conditions permit the survival of faunal soft tissue or bone is uncertain. This question could be addressed as part of the coring program proposed in Chapter 6. Sites with materials of this type surviving would probably be eligible under criterion C as well as the more commonly invoked criterion D.

3. Environmental Context. It is quite clear that any buried archaeological resources in the Meadowlands will be directly associated with palynological remains that will enable their environmental settings to be characterized with considerable precision. Information on both the local and regional flora should be recoverable. Such recovery, coupled with the specific archaeological data, will enable the interaction of environment and culture to be examined to a high level of detail.

The information gain from identified sites will obviously be dependent on the quality of the three classes of data above. Two other variables, site size and site age, are also relevant. Small, low-density sites associated with short-term procurement activities may provide a "snapshot " of past behavior, but will necessarily be more limited in the data they provide than larger, more long-term sites where a broader range of behaviors and complexity may be expected. The age of a site may also affect its significance assessment to some degree. As has been discussed, any site pre-dating the initiation of peat accumulation is likely to date to the first portion of the Late Archaic or earlier. Sites of these periods are significantly less common than those of later periods. They would probably be determined eligible even if their integrity was less complete than those of later date. Within the peat accumulation, sites that can be associated with the initial dryer, forested period might be ascribed a somewhat higher value than those of later periods because of their emplacement in a now-vanished setting.

The above discussion has chiefly focused on prehistoric resources. Historic archaeological sites of the pre-industrial era (before about 1830) are likely to comprise agricultural features such as drainage ditches and boundaries, farmsteads, and limited industrial and transportation features (Grossman 1991). Of these, 17th- or 18th-century farmsteads in now-inundated locations, if they exist, would be of very substantial importance, sharing many characteristics with prehistoric sites in terms of their information potential. From *circa* 1830 to the 20th century resources specific to the Meadowlands are the plank roads and the several episodes of attempted drainage and improvement. Physical evidence for the iron reinforced embankments and tide gates built by the New Jersey Land Reclamation Company from the 1860s would probably merit consideration for National Register eligibility under criteria C and D.

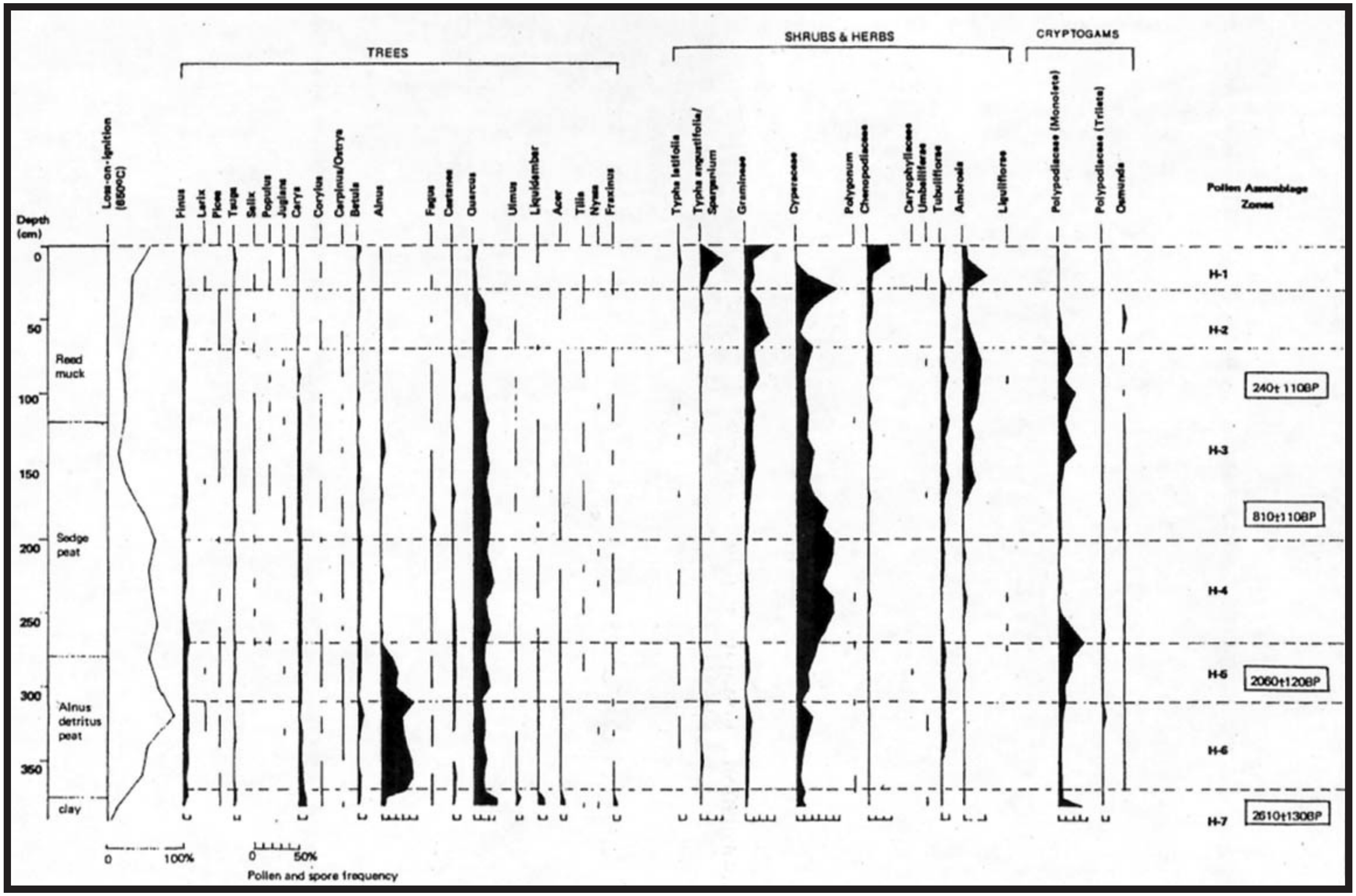

Figure 3.1. Vegetation diagram from Carmichael's 1980 study. The left column broadly characterizes the vegetation, from alder forest at the base, to a sedge fen through to a reed muck environment at the top. Loss-on-ignition (second column) demonstrates rather wetter environments prevailing in recent centuries, an indication supported by a simultaneous increase in ferns and mosses. Changes near the top of the profile, for instance the spike in ragweed (Ambrosia), reflect adjacent European land clearance and cultivation. Note also the rapid decline of alder (Alnus) after 2060±120 B.P., coinciding with an increase in fern and moss pollen. (Source: Carmichael 1980:516).

Chapter 4

OVERVIEW OF THE HISTORY AND PREHISTORY OF THE PROJECT AREA

A. PREHISTORY

Overviews of the prehistory of the Hackensack Meadowlands all note the long-standing absence of site information from the Meadowlands themselves, while offering various opinions as to the extent to which they were used or settled (Hartz Mountain Industries 1978:x-1 to x-2; Cultural Resource Management Services 1979:13-21; De Leuw Cather/ Parsons 1979:30; Historic Sites Research 1982:12-14; Wright 1988:1-13; Research and Archaeological Management 1989:10-13; Grossman and Associates, Inc. 1992b:31-32 Hunter Research, Inc. 1992:Chapter 4; Viet and Walezak 1997:15-18; Richard Grubb and Associates, Inc. 1998:3-3 to 3-4). It is normally noted that sites are recorded, rather imprecisely for the most part, from the Bergen ridge to the east of the Meadowlands. A palisaded village or "castle" mentioned in Dutch accounts appears to be in the vicinity of the Overpeck Creek-Hackensack confluence, but has never been firmly located or identified archaeologically. The Secaucus "island" and the eminences of Laurel (Snake) and Little Snake Hill are frequently cited as probable sites of prehistoric settlements, and there is an unsubstantiated account of prehistoric artifacts being recovered along Penhorn Creek (De Leuw Cather/Parsons 1979:30).

The state of archaeological knowledge of the Meadowlands in 2006 remains much as it was 20 years ago, in that no specific sites or artifacts have been recorded to date. The most significant change has been in the fuller understanding of the environmental development of the area, and the growing realization of its relevance to prehistory on the part of archaeologists.

B. THE 17TH CENTURY

Dutch settlement on Manhattan Island in the 1620s was soon followed by plantations on Bergen Neck on the Jersey shore of the Hudson. By 1639 there were farms at Pavonia (Jersey City), Hoboken and Weehawken. In 1641 a large frame building was established at "Achter Col" in present-day Bogota on the eastern bank of the Hackensack River by Johannes Winckleman, acting as agent for absentee landlords. This appears to be the first European settlement close to the Meadowlands.

The local Indians razed Achter Col in 1643 during a period of considerable tension with the Dutch, during which settlements were attacked or destroyed. Following this turmoil the Dutch adopted a more defensive and careful settlement policy. They built Fort Hackensack in 1656 at the confluence of the Hackensack River and Overpeck Creek. The fortified village of Bergen was established within the present Jersey City in 1660 (Winfield 1872:8; Hunter Research, Inc. 1992).

Expansion of Dutch settlement to the west of Bergen Neck quickly followed these initiatives. In 1663 Peter Stuyvesant granted a patent for the 2,000-acre "Sekakas Plantation" on the east bank of the Hackensack to Nicholas Varlet and Nicholas Bayard. These two subsequently purchased an adjoining 2,000-acre property between the Secaucus "island" and the Bergen Ridge (later dubbed the Secaucus Common Lands). Varlet, who married a widow of a Bayard family member who was the sister of Peter Stuyvesant, was involved with the Bayard family in a number of other real estate ventures in the Bergen area, most notably the Hoboken and Weehawken tracts (Winfield 1872; Hunter Research, Inc. 1992). This land grant signals the beginning of the European exploitation of the eastern portion of the Meadowlands between Cromakill and Penhorn Creeks.

Nicholas Bayard and the administrators of Varlet's estate sold the landholdings to Edward Earle Jr. of Maryland in 1676. Buildings on the Secaucus plantation were concentrated mostly on the "island" of Secaucus (Winfield 1872:129-131, 192-193, 291-293; Hunter Research, Inc. 1992), but the area clearly was attractive to settlement and was presumably agriculturally productive.

The replacement of Dutch authority by English rule and decline of the Indian problem after 1664 encouraged a change in the settlement pattern in the Bergen region. The defended nucleated village system was no longer needed. Newcomers increasingly began to establish themselves on scattered farmsteads through the region. In 1682-1683, Bergen County was established as one of the original counties of East Jersey (Wacker 1975:133; Hunter Research, Inc. 1992). The later 17th century therefore saw a number of significant land grants or patents to lands in the Meadowlands. Several, of these were in the extensive New Barbadoes Township:

Capt. Wm. Sanford: New Barbadoes Patent, 15,000 acres in Kearny, Lyndhurst, Rutherford and N. Arlington 1668

This patent marks the expansion of European settlement onto the west side of the Meadowlands, occupying as it did the southern portion of the neck between the Passaic and Hackensack valleys. Sandford, who served as the presiding judge of the court of Bergen in 1673, retained the lower third of the property and the remainder was granted to his uncle Nathaniel Kingsland (Van Valen 1900:15; Bogert 1983 II:30). Sandford gave the East Jersey Proprietors 200 pounds for the property. The Indians were given various items, including wampum, guns, knives, blankets and axes (Bogert 1983 II:30).

John Berry: East Rutherford, Carlstadt, Moonachie and Little Ferry 1669

Berry's tract lay adjacent to Sanfords' and extended six miles northward. The northern limit of his tract is believed to have been just north of Hackensack (Bogert 1983 II:30). Relocated to Bergen *circa* 1670. John Berry's son Richard established himself on a tract called New Barbadoes in Newark Township, west of the Hackensack River.

Major Nathaniel Kingsland, Harrison and Kearny 1668

Kingsland purchased 5,300 acres of upland and 10,000 acres of meadowland. Nathaniel Kingsland, the uncle of William Sandford, was also from the island of Barbadoes. Kingsland was an absentee landholder of 235 acres in Bergen County.

Pinhorne at Secaucus

Intensification of settlement at Secaucus (derived from the Indian word that denoted "the place where the snake hides") is reflected in conveyance of lands on the "island" to Judge William Pinhorne in 1679 for 500 pounds (Winfield 1872:130). A division in 1682 gave Edward Earle Jr. the northern half of the tract. Snake (Laurel) Hill, at the lower portion of the property, would have been owned by William Pinhorne, who lived in vicinity of Mount Pinhorne just north of Snake Hill and gave his name to the Creek to the east.

By 1700, therefore, there were several large landholdings on each side of the Hackensack River, and it is clear that the meadows were being exploited by that time, as they were in Peter Kalm's account of 1751:

> the country was low on both sides of the river, and consisted of meadows. But there was no other hay to be got than such as commonly grows in swampy grounds; for as the tide comes up in this river, these low plains were sometimes overflowed when the water was high. Mosquitoes were prevalent in such conditions (Quinn 1997:79).

C. THE 18TH AND EARLY 19TH CENTURIES (FIGURES 4.1-4.4)

The extent to which some areas of the Meadowlands were capable of conversion into productive farmland in the 18th century is revealed by advertisements for sale of properties in local newspapers (Hackensack Meadowlands Commission 1973:25; Wright 1988:42-45). In addition to salt meadows and cedar swamps, references are made to the possibilities of conversion to freshwater meadow.

During the Revolutionary War the Meadowlands were subjected to constant low-level conflict as the British garrison of New York raided the area for supplies and American troops sought to stop them and harass outposts such as Paulus Hook. This area, the "Neutral Ground" was also affected by Loyalist and Patriot antagonisms (Munn 1976). Skirmishes and engagements took place at Secaucus, Little Ferry, Hackensack, Moonachie and elsewhere. Snake (Laurel) Hill was reputedly used as an encampment and lookout.

Both before and following the Revolutionary War, various measures were taken to improve communications in the area. In 1759, John Schuyler had constructed a cedar plank road from his copper mine in modern North Arlington to Barbadoes Neck between the Hudson and Passaic Rivers. This road became the Belleville Turnpike. In 1790, the New Jersey Legislature approved the construction of a road between Newark and Paulus Hook, with drawbridges across the Passaic and Hackensack Rivers. These structures were finished in 1795. Two years later, the structures came under the control of "The Proprietors of the Bridges over the Rivers Passaic and Hackensack." The New Jersey Railroad acquired the bridges in 1832 for the first railroad across the Meadowlands (see below).

Other roads followed. The Bergen Turnpike and the City of Jersey and Newark Turnpike were both chartered in 1804. Cedar plank roads, which were durable and smooth and could be constructed across the marshlands that provided the necessary white cedar, became popular in the first half of the 19th century. The Belleville and Newark Plank Road was created in 1849, and the ambitious Paterson Plank Road, connecting its namesake town with Hoboken through Secaucus, was built in 1855-6, one of the last plank roads to be built in New Jersey (Hunter Research, Inc. 1993:5-19 through 5-21).

D. CANAL AND RAILROADS

The first railroads and the Morris Canal arrived at the west shore of the Hudson during the 1830s. The challenge for these transportation systems, as for the roads, was to find the best route across the Hackensack Valley and its marshes. The Morris Canal was completed between Newark and Phillipsburg in 1831, and was extended to the Paulus Hook area in 1836. The new canal was soon overshadowed, however, by a new technology. The New Jersey Railroad (crossing

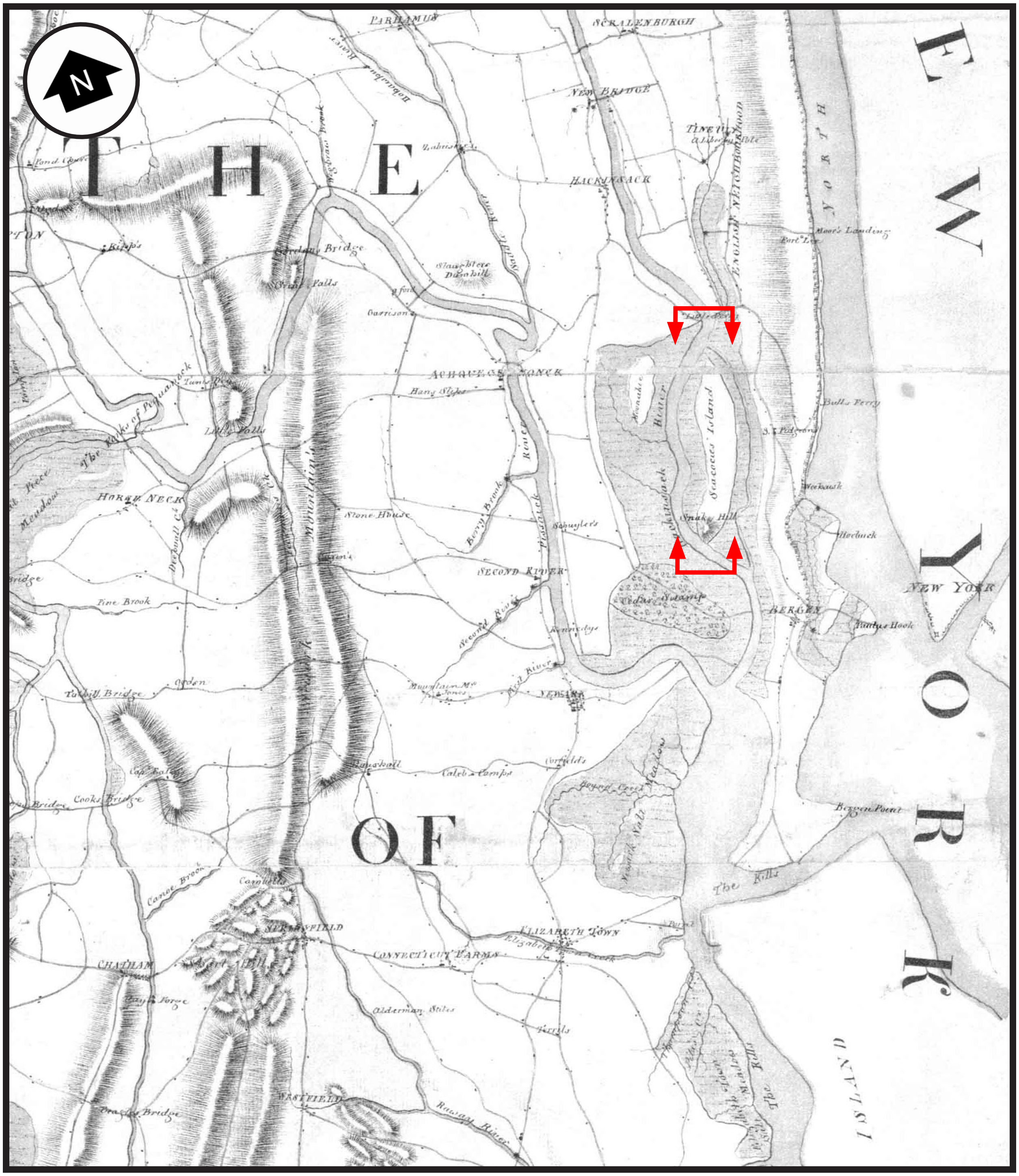

Figure 4.1. Hills, J. *Sketch of the Northern Parts of New Jersey*. 1781. Scale: 1 inch= 4.9 miles (approximately). Northern and southern limits of Meadowlands District Boundary indicated with brackets. For precise boundaries see individual site descriptions in Chapter 5.

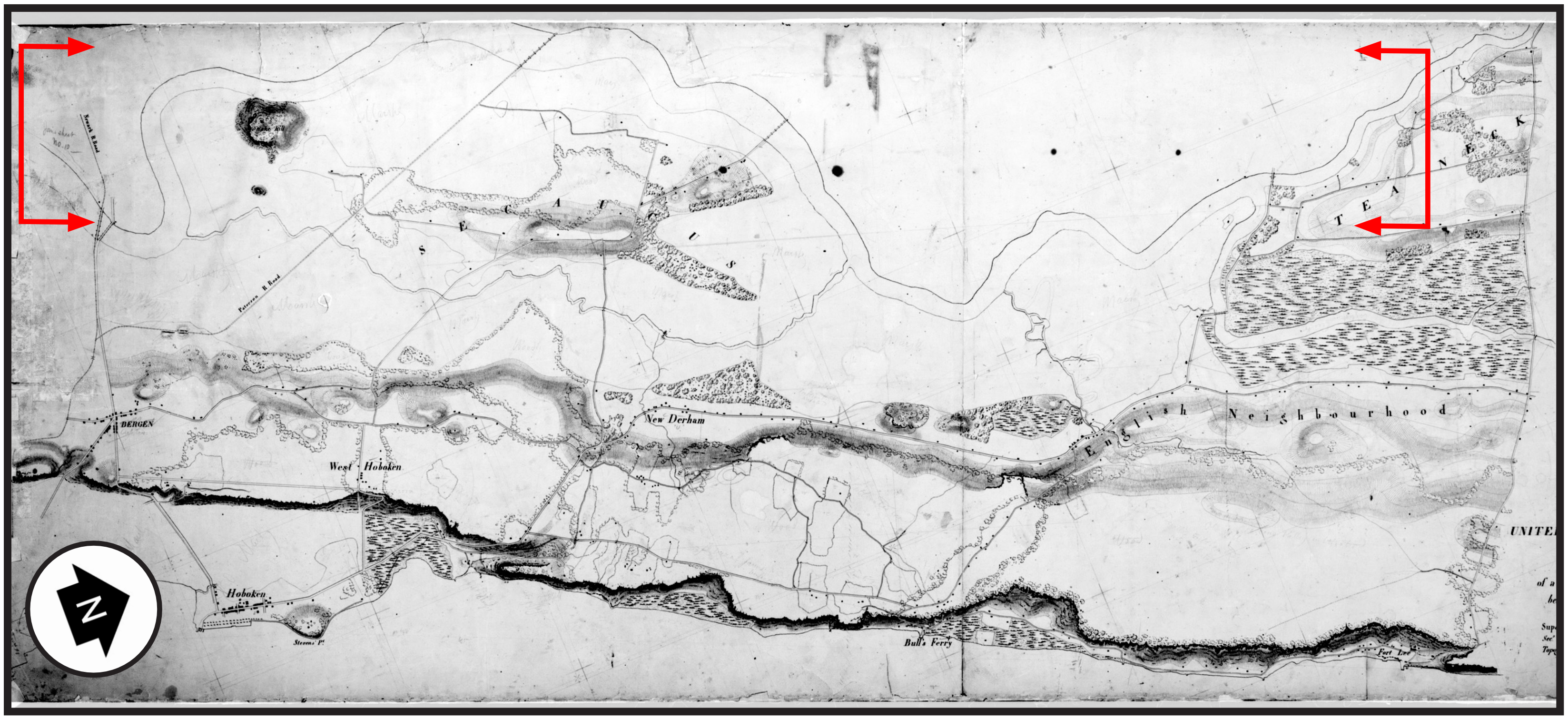

Figure 4.2. United States Coast Survey. *Map of the State of New Jersey Between Hackensack and Bergen*. 1837. Scale 1 inch= 1.3 miles (approximately). Map shows areas on the east side of the Hackensack River. Northern and southern limits of Meadowlands District Boundary indicated with brackets. For precise boundaries see individual site descriptions in Chapter 5.

Figure 4.3. United States Coast Survey. *From Hackensack to Newark and Elizabethtown New Jersey*. 1839. Scale:1 inch= 1.2 miles (approximately). Map shows areas on the west side of the Hackensack River. Northern and southern limits of Meadowlands District Boundary indicated with brackets. For precise boundaries see individual site descriptions in Chapter 5.

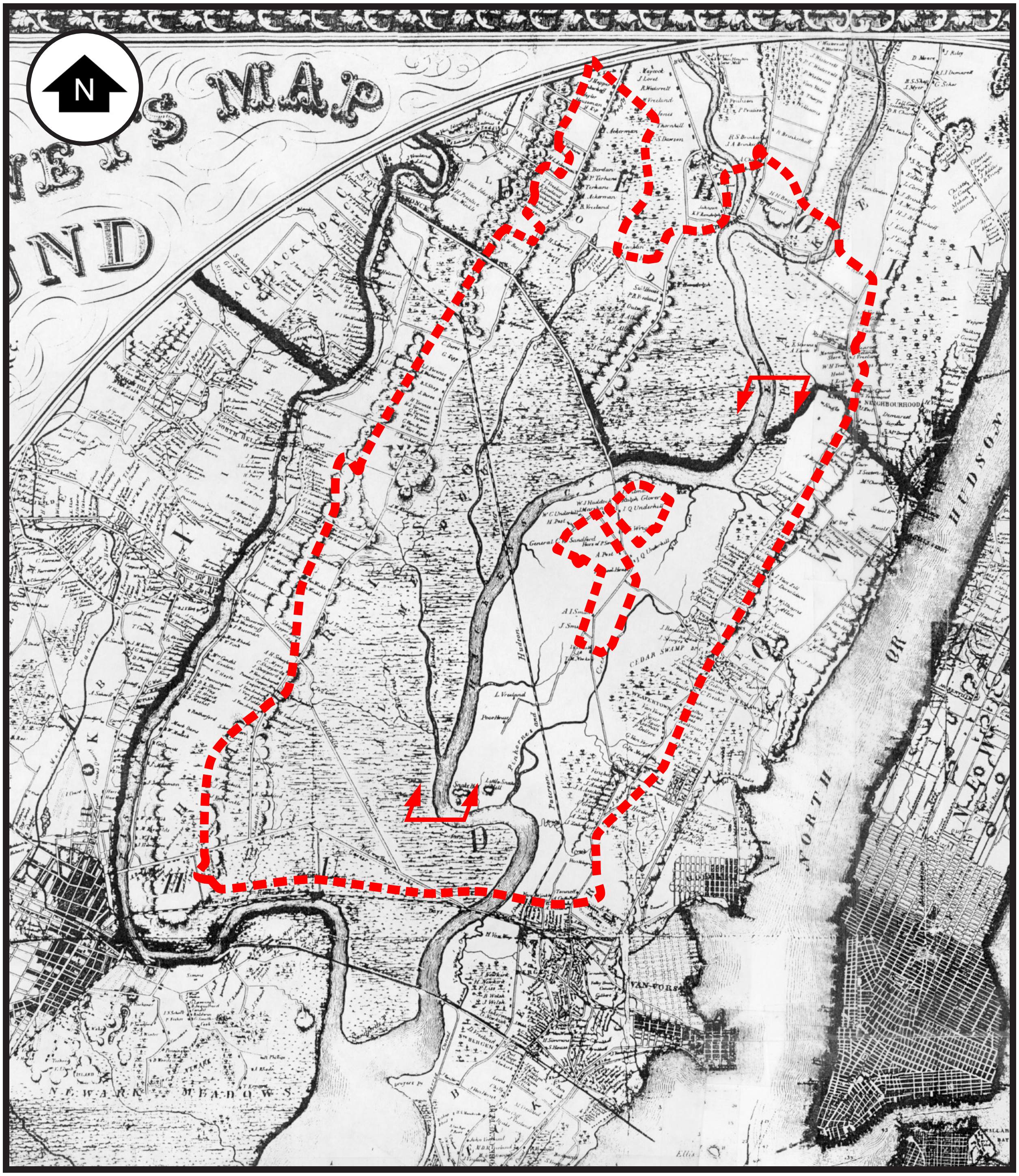

Figure 4.4. Sidney, J.C. *Map of Twelve Miles Around New York*. 1849. Scale: 1 inch= 1.85 miles (approximately). Meadowlands District Boundary outlined. For precise boundaries see individual site descriptions in Chapter 5. The area west of the Hackensack is labeled Salt Meadow and contrast with the Secaucus area on the east bank between Cromakill and Penhorne Creek, which is chiefly shown as improved land with surviving areas of cedar swamp.

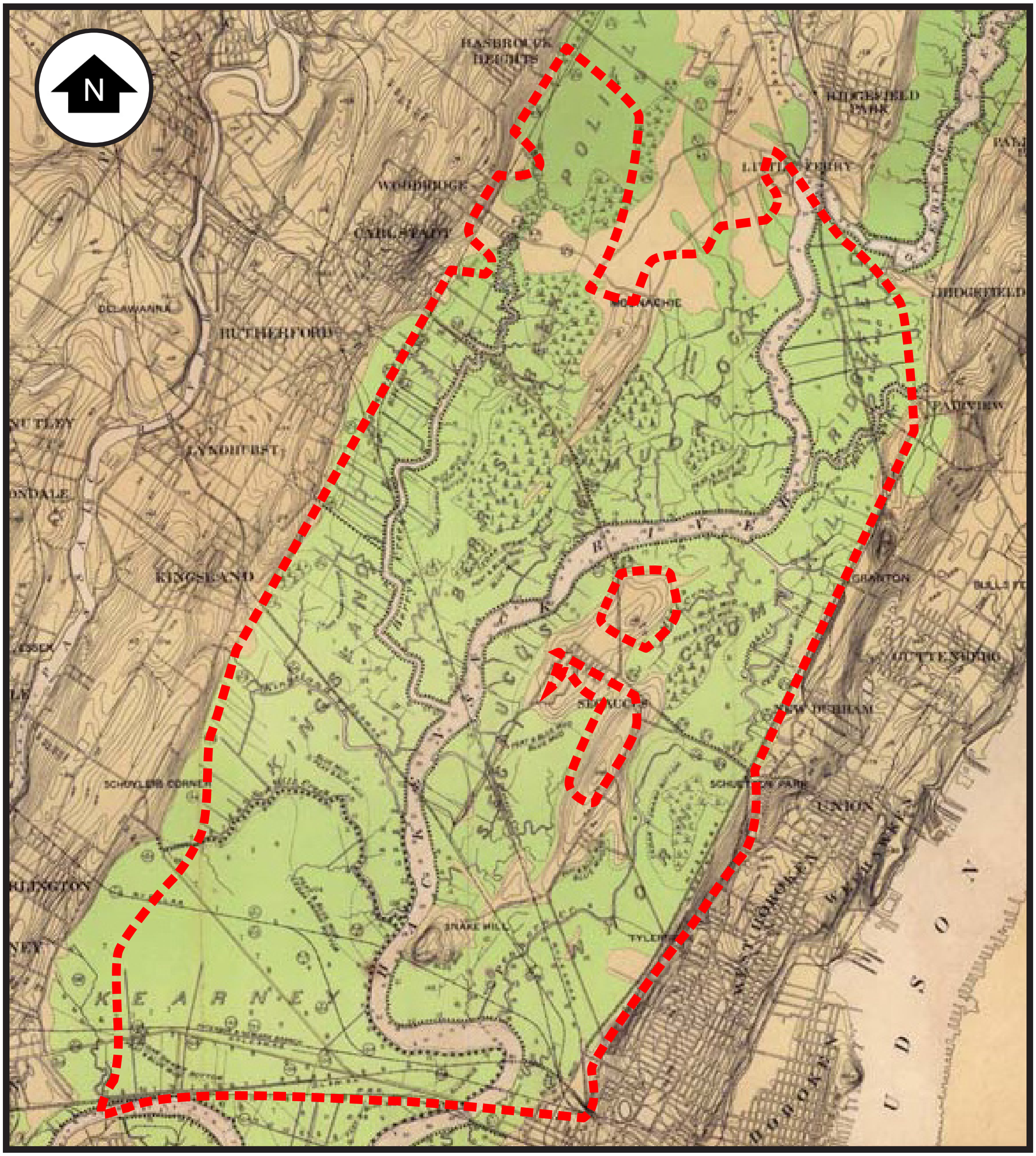

Figure 4.5. Vermeule, C.C. *Map of the Hackensack Meadows*. 1896. Scale: 1 inch= 1.3 miles (approximately). Meadowlands District Boundary outlined. For precise boundaries see individual site descriptions in Chapter 5. This map reflects the renewed interest in the Meadowland at the end of the 19th century. Vermuele, the State Geologist, promoted the idea of developing the area for planned urban and suburban development rather than for agriculture. The map shows cedar swamps northeast of Secaucus and in the Mooonachie area.

from Newark on the alignment of the 1790s turnpike) and the Paterson and Hudson River Railroad, running southeast from East Rutherford and the Passaic, were connected with the Paulus Hook ferry terminal in 1838. These were the first of many rail lines with waterfront terminals in what later became Jersey City (Lane 1939:230-249; Snyder 1969; Hunter Research, Inc. 1992).

Several competing railroads appeared over the following decades, either crossing the meadowlands or hugging the west side of the Bergen Ridge. Crossing the Meadowlands were the Morris and Essex (1835), Delaware Lackawanna and Western (1869), and Montclair (1869). A number of railroads (Northern, New Jersey Midland, and New York Susquehanna and Western) were constructed along the west side of the Bergen Ridge in the middle decades of the 19th century (for the complex history of these enterprises see Hunter Research, Inc. 1992:Table 5.1).

E. LAND RECLAMATION IN THE 19TH CENTURY

Localized efforts had probably been made to drain areas of the Meadowlands since the 17th century, with the emphasis being placed on reducing salinity in order to produce grass from freshwater meadows. These would be more profitable than the salt hay meadows that reflected exploitation and control of existing vegetation rather than any ambitious modification of the landscape.

Significant investment in land reclamation, meaning efforts to drain and convert marshlands into arable farmland, was begun by the Swartwout brothers. Beginning in 1813 Samuel Swartwout began purchasing large tracts of marshland, chiefly in the southern portions of the what is now the Meadowlands District, although the Swartwout holdings eventually included much of the meadows on the east side of the river as far north as Overpeck Creek. On the west side their extensive property lay south of Sawmill Creek. Between 1813 and 1820 the Swartwouts excluded the tides from about 1,300 acres of marsh through the construction of 120 miles of drainage ditches and several miles of embankments (Wright 1988:59). The scheme foundered in the 1820s because of legal proceedings and the failure of the drainage systems.

The project was revived in 1867 when Spencer Driggs and Samuel Pike's New Jersey Land Reclamation Company acquired some of the former Swartwout lands south of Sawmill Creek. A system of dikes cored with iron plates, and tidal gates and drainage ditches was put in place within a year and there were high hopes for the scheme, which was to produce crops for the exploding New York metropolitan market. Like the Swartwout scheme, this too failed. A principal reason was the shrinkage of the peat and the consequent lowering of the ground level. Gravity drainage was no longer feasible, necessitating the use of pumps, and if the embankments were breached the areas became flooded (Wright 1988:61-65). Other drainage and reclamation efforts were made north of Sawmill Creek through the end of the 19th century. The condition of the Meadowlands after these efforts is shown on Vermuele's map of 1896 (Figure 4.5).

F. OTHER LAND USES IN THE 19TH CENTURY

After the Civil War, only two agricultural activities—pig farming and floriculture—continued to prosper, although salt hay continued to be cut throughout the Meadowlands. Pig farmers took advantage of the now-expanding refuse dumps in the meadows and supplied hogs to the slaughterhouses in Jersey City and New York (Shaw 1884:1291; Van Winkle 1924:437; Hunter Research, Inc. 1992).

The Snake Hill area started to become the focus of Hudson County institutional establishments in the mid-19th century. 300 acres of the Pinhorne estate was purchased, and an alms house, capable of housing 500 hundred residents, was completed in the 1860s. This was followed by a penitentiary in 1870 and an insane asylum in 1873. Orphanages, hospitals, the county agricultural farm and piggery, and three cemeteries were also eventually located here. The early 20th-century cemetery associated with this site was archaeologically excavated in 1996-2003 (www.culturalresourcegroup.com/projects/secaucus1.htm accessed 2/2/06).

G. MOSQUITO CONTROL

In the late 19th century the role of mosquitoes in spreading diseases, particularly malaria, was firmly demonstrated, triggering public health efforts to eradicate them by destroying their breeding areas. Shortly thereafter the New Jersey State Entomologist, John Smith, identified the Hackensack Meadowlands as an area of the state where problems were particularly acute. In 1912 the Mitchell Act authorized the creation of mosquito control commissions in each county, and in 1914 the Bergen County Mosquito Commission was created. In the same year the Counties of Bergen, Essex, Hudson and Union jointly surveyed the Meadowlands to locate breeding locations. The resulting report provides detailed information on the conditions in the area at the time. While large portions of marsh had been converted into truck farms along Berry's Creek north of the railroad in Rutherford, conditions elsewhere were deplorable. Throughout the marshes, the commissions noted raw sewage, garbage and factory waste. The Hackensack River had become heavily polluted from industrial effluent.

The meadows were divided into 27 districts and diking began with the objective of draining the breeding grounds. Bergen County was particularly active in this effort, making use of existing earlier ditches and dikes where possible. In April of 1916, the Commission began cutting 100,000 feet of ditches in the Bergen County Meadow near the copper mines. To the west and north of Moonachie Creek, 35,000 feet of ditching was cut at Carlstadt Meadow (Leslie 1916). It appears that this extensive campaign, which reduced the salinity of the marshlands, was a key factor in the invasion of the cattails and especially the *phragmites* reed that now dominate the landscape (Wright 1988:87).

The era of active diking came to an end in the 1950s, when chemical spraying became the norm. Dikes at upper Berry's Creek, on the Hackensack River and in East. Rutherford between N.J. Route 3 and Paterson Plank Road were maintained (Passaic Valley Citizens Planning Organization 1958).

H. THE 20TH CENTURY: AUTOMOBILES AND REGIONAL PLANNING

The completion of the Pulaski Skyway in 1932 was a milestone in large-scale highway planning for automobiles. Like the railroads of 100 years earlier, it was designed to transport people and goods between New York (via the Holland Tunnel) and New Jersey west of the Meadowlands. N.J. Route 3 was constructed between Rutherford and Secaucus in the early 1930s. In 1948, the New Jersey State Legislature established the New Jersey Turnpike Authority. The new road was completed in 1951, with the spur on the west side of the Hackensack added in 1966-8 (Wright 1988:108).

Ever-increasing development pressure and growing awareness of environmental degradation led to the creation of ever-more effective regional planning bodies (Goldman 1975). In 1955 the Meadowlands Regional Planning Board (MRPB) was created, with a focus on transportation and land use in Carlstadt, East Rutherford, Rutherford, Lyndhurst and North Arlington. In 1960 the MRPB was replaced by Meadowlands Regional Development Agency (MRDA), which included the five municipalities in MRPB plus Kearny, Moonachie, Secaucus, North Bergen and Teterboro (NJMC Master Plan). In 1969 the Hackensack Meadowlands Development and Reclamation Act created the Hackensack Meadowlands Development Commission and added Ridgefield, Little Ferry, Jersey City, Hackensack to the list of municipalities. The Commission, renamed the New Jersey Meadowlands Commission in 2001, holds mandates to plan for environmental protection, economic development and solid waste management over an area of 19,485 acres (30.4 square miles).

Chapter 5

CULTURAL RESOURCE SENSITIVITY ASSESSMENT OF PROPOSED REMEDIATION SITES

This chapter provides an account of the proposed remediation sites. It gives a detailed history of ownership, based on primary and secondary sources, a description of field conditions and investigations, and an assessment of the cultural resource sensitivity of each location. In the majority of cases it proved impossible to trace ownerships earlier than about 1800. Evaluation of potential impacts from remediation actions, and recommendations for survey are addressed in Chapter 6. Current environmental and ownership data are presented in Appendix C, extracted from MESIC (*Meadowlands Environmental Site Investigation Compilation.* U.S. Army Corps of Engineers, New York District 1994).

Five sites (Anderson Creek Marsh, Kearny Freshwater Marsh, Lyndhurst Riverside Marsh, Meadowlark Marsh and the Riverbend Wetland Preserve) are considered to have a higher construction priority than the others. These sites were subjected to closer field inspection than the others, but all sites are treated together for the purposes of this analysis. For the sites in broader context, see Figures 1.2 and 1.3. Data on the sites is summarized in Table 5.1.

A. MEADOWLARK MARSH - AREA 20 (FIGURES 5.1-5.4; PLATES 5.1-5.5)

1. Site-Specific Background Research and History

In the late 18th century, the Meadowlark Marsh site was part of a much larger estate owned by David Ogden (1707-1798) a lawyer and prominent member of the province's legal community. A loyalist, David Ogden left his home during the Revolutionary War and journeyed to New York to seek safety among British troops. In 1783, Ogden departed for England but would later return to the United States. David Ogden and his wife Gertrude Governeur Morris had six children—Isaac, Abraham, Peter, Nicholas, Samuel and Sarah (New Jersey Historical Society, Ogden Family Papers).

The first identified transaction including this property dates to1775. In that year David Ogden of Newark, New Jersey conveyed 539 acres of "land and meadow" in Bergen County to Nicholas Hoffman, a merchant from New York City and Abraham Ogden of Morristown, New Jersey. Hoffman and Ogden (possibly David Ogden's son) purchased the property described as "whereon Captain Josiah Banks now lives" bounded partially by "Bellamount's" (Bellman's) Creek to the south and by the Hackensack River on the west for 2,000 pounds (East Jersey Deed H3/87).

By 1805, the estate had passed to Samuel Ogden (referenced in Bergen County Deed U/70 and possibly another of David Ogden's sons). Samuel Ogden and his wife Euphemia consequently deeded the property to Governeur Morris of Morrisania, Westchester County (modern Bronx) New York. A prominent figure from a wealthy family, Morris partook in the signing of the Articles of Confederation and played a major role in the Constitutional Convention. Morris constructed a residence at Morrisania in the early 19th century (Americans.net 2005). In 1805 he paid $10,000 for the Ogden estate. At this time the waterway to the south (modern Bellman's Creek) was referred to as "Bellamiss Kiln" (Bergen County Deed U/70).

In 1819, litigation took place in the court in chancery where Ann. C. Morris and Moss Kent, executors of Governeur Morris were complainants and John Swartwout, Mary Swartwout, Samuel Swarwout and others were defendants. The Swartwout brothers played a prominent role on the early 19th-century history of the Meadowlands with their land reclamation activities. These mostly took place in the southern portion of the Meadowlands and are detailed in the Kearny Freshwater Marsh Section (G) of this chapter.

The property was subsequently advertised and sold to the highest bidder, William Post, for $10,510 (Bergen County Deed Q2/362). A few years later, William Post (a merchant from New York) and his spouse Emily conveyed the 535-acre estate to Vincent LeRay de Chaumont, a Frenchman of Leraysville, Jefferson County, New York who served as a trustee of the creditors of James LeRay de Chaumont (Bergen County Deed W2/335).

Vincent and James LeRay de Chaumont deeded the farm to Henry Eagle in 1825 for $5,000 (Bergen County Deed Y2/208). Eagle retained the property until his death at which time his executors sold the estate to Francis Price for $2,770.70 (Bergen County Deed Q4/286). This indenture excluded a ten-acre lot situated near the mouth of the English Creek that had previously been conveyed to John Terhune by Samuel and Euphemia Ogden. Eight years later, the Hopkins map of 1861 identifies the estate, which extended north to the Overpeck Creek, as the property of Edmund M. Price (Figure 5.1). The Walker atlas of 1876 (Figure 5.2) depicts the marshy area north of Bellman's Creek, east of the Hackensack River and west of the proposed line of the Hudson County Aqueduct and the Midland Rail Way in Bergen County.

After Francis Price died, the matter of the estate was presented to the chancery court. The executors of Price's estate were identified as the complainants while James McMasters, William E. Lawton and others were the defendants. The property and another to the north (the whole measuring approximately 827 acres) were consequently sold to Walter Ellis Lawton. It appears that Lawton neglected to pay his taxes and by 1889 the property was acquired by the "Inhabitants of the Township of Ridgefield." The sale comprised 13 different properties and included the 600-acre "Little Ferry Farm" (Bergen County Deed R12/244). In 1893, Thomas M. Lanahan and William H. Cranford, the administrators of John C. Grafflin, acquired the property for $2,254.58 (Bergen County Deed 372/374).

By 1898, a division of the farm had taken place as evidenced by a map filed with in the Bergen County Clerk's office (not reproduced in this report). The Bromley atlas of 1912 (Figure 5.3) shows the corresponding various parcels of the Grafflin farm at the study location. In 1917, Frank Dorsey Grafflin deeded the two southern tracts (165 acres containing the modern study area and another tract containing 166 acres) to the New York Acreage Estates Company for $100 (Bergen County Deed 954/346). The company subsequently sold the land to the Belle Mead Development Corporation (Bergen County Deed 1867/21). The study area is shown on aerial photographs of 1931 (Plate 5.1) and on an aerial of 1968 (Plate 5.2). The Hartz Mountain Development Corporation later purchased the property and sold it to the New Jersey Meadowlands Commission in 2004 (Bergen County Deed 8742/656).

2. Site Description

The Meadowlark Marsh site consists of 90 acres and is bounded on the west by the New Jersey Turnpike, on the south by Bellman's Creek, and on the east by Railroad Avenue and the Conrail line. A substantial amount of environmental and cultural resource assessment has previously been undertaken

Table 5.1. Summary of Candidate Restoration/Preservation Sites.

	Construction Priority	Area (acres)	Current Land Use/ Vegetation	Significant Topographic Features	Confluence	18th/19th-century usage	Drainage/ Reclamation Features	20th-century usage	Estimated Peat Depth	Pre-peat Deposits likely?	Figures	Plates	Assessment
Meadowlark Marsh (Area 20)	1	90	Landfill and freshwater impoundment in center. Phragmites dominant, but sumac and black cherry present on higher ground (fill)	Confluence of Bellman's Creek and Hackensack at south end.	Yes	Swartwout & later reclamation efforts? Marsh 1861, 1876, 1912 (east-west ditches at n. end)	Yes, pre 1870's	1931 linear landfill in place. By 1956 utility lines, additional ditches and NJTP. By 2002 gas tanks on east side	10-15 feet	Yes	5.1 -5.4	5.1-5.5	Confluence location, fluviatile deposits and proximity to Bergen Ridge suggests high potential
Metro Media Tract (Area 22)	2	74	Tidal marsh dominated by phragmites	Doctor's Creek immediately N	Yes	1876 marsh. 1913 Marsh parcels map	20th century	1931 largely unimproved. By 1956 new ditches, Doctor's Creek changed, communications installation at SW corner. In 2002 NW partly submerged	10-15 feet	No	5.5-5.7	5.6-5.8	
Oritani Marsh (Area 24)	2	224	Tidal marsh with upland, high and low marsh		No	1876 meadows. 1913 unchanged on map, but Berry's Creek Canal built 1902-8 along N. boundary	Yes, pre 1830's	1931 marsh. Some drains southern portion. 2002 extensive removal of dredge along Berry's Creek Canal	15 feet	No	5.8-5.10	5.9	
Berry's Creek Marsh (Area 12)	2	168	Tidal marsh dominated by phragmites	Berry's Creek and Fish Creek adjoin	Yes	1876 meadows. 1913 marsh with subdivisions shown	Yes, pre 1830's	limited change 1931 to 2002, but water levels higher	15 feet	No	5.8-5.10	5.9	Along main tributary stream
Lyndhurst Riverside Marsh (Area 19)	2	31	Tidal marsh dominated by phragmites	Berry's Creek immediately to N	Yes		20th century only?	1931 marsh. 1962 some dredge spoil?	20 feet	No	5.8, 5.9, 5.11	5.10-5.11	
Anderson Creek Marsh (Area 11)	1	52	Tidal marsh impacted by mosquito ditching and tide gates	Anderson Creek flows through site	Yes	Swartwout & later reclamation efforts? 1873 planned street grid. 1909 long lots reflecting ditches on 1962 air view	Late 19th century?	1931 only Anderson Creek visible crossing marsh? 1962 several linear ditches. 2002 many ponds and water levels higher	20 feet	Yes	5.12-5.14	5.12-5.14	On edge of Secaucus island
Kearny Freshwater Marsh (Area 16)	2	327	Freshwater impoundment, former freshwater wetland	inundated	No	Swartwout & later reclamation efforts. 1821 part of "inbanked meadows". No detail 1873, 1903, 1909	Not visible, probably destroyed	1931 limited information on air view. 1953 some ditching at east end. 2002 largely inundated. Road at SW corner	10-15 feet	No	5.15-5.19	5.15-5.16	Former cedar swamp area. Close to upland. Shallow peat at west end could cover prehistoric sites.
Kearny Brackish Marsh (Area 15)	2	116	mostly open water, former tidal marsh	inundated	No	Swartwout & later reclamation efforts. 1821 part of "inbanked meadows".	Not visible, probably destroyed	1953. Former Erie R.R. alignment visible. Several ditches. 2002 inundated	25+ feet	No	5.17, 5.19, 5.20-5.21	5.15, 5.17,5.18	Former cedar swamp area
Laurel Hill Park Wetland (Area 17)	2	20	Tidal marsh and public park. Phragmites and salt marsh hay	Adjacent to high ground of Laurel Hill	No	Swartwout & later reclamation efforts. 1876 Heirs of Abel Smith. Do. 1909		1931 multiple ditches. 1962 similar. 2002 water level higher. Dredge spoil close to Hackensack.	25+ feet	Yes	5.22-5.24	5.19-5.20	Probably very deep deposits with little early forest development. Early Dutch/English Settlement in area. 19th century drainage?
Riverbend Wetland Preserve (Area 26)	1	57	Tidal marsh with high marsh vegetation and phragmites	Adjacent to high ground of Laurel Hill	No	Swartwout & later reclamation efforts. 1876 Jay Gould. 1909 Erie Railroad		1931 multiple ditches. 1962 similar. 2002 water level higher. Dredge spoil close to Hackensack.	30+ feet	Yes	5.22-5.24	5.19-5.24	Probably very deep deposits with little early forest development. Early Dutch/English Settlement in area. 19th century drainage?

Table 5.2. Cultural Resource Sensitivity Factors and Ranking for Candidate Restoration/Preservation Sites.								
	Construction Priority 1=1, 2=0	**Confluence: Yes=2, No=1**	**17th- and 18th-Century data?[1] Probable=2, Possible=1, Unlikely=0**	**Drainage/ Reclamation Features[2] Pre-1870s=1, Post 1870s=0**	**Pre-Peat Deposits likely?[3] Yes=2, No=1**	**Proximity to "Fast" Land[4] 0 to 2000 feet=2, 2000+ feet=1**	**Score**	**Rank**
Meadowlark Marsh (Area 20)	1	2	2	1	2	2	10	1
Metro Media Tract (Area 22)	0	2	1	0	1	1	5	6=
Oritani Marsh (Area 24)	0	1	1	1	1	1	5	6=
Berry's Creek Marsh (Area 12)	0	2	1	1	1	2	7	4=
Lyndhurst Riverside Marsh (Area 19)	1	2	1	0	1	1	5	5
Anderson Creek Marsh (Area 11)[5]	1	2	2	0	2	1	9	2
Kearny Freshwater Marsh (Area 16)	1	1	0	0	1	2	4	7
Kearny Brackish Marsh (Area 15)	0	1	0	0	1	1	3	8
Laurel Hill Park Wetland (Area 17)	0	1	2	0	2	2	7	4=
Riverbend Wetland Preserve (Area 26)	1	1	2	0	2	2	8	3

Notes:

1. Reflects both historical documentation and palynological potential
2. Pre-1870s features considered of more potential historic significance and possibly less damaging to earlier strata
3. Based on previous observations in adjacent locations
4. Means lands mapped as not marsh in historic times
5. Possible building prior to 1836 raises third column score

Figure 5.1. Hopkins, G.M. *Map of the Counties of Bergen and Passaic, New Jersey*. 1861. Scale: 1 inch= 4910 feet (approximately). Meadowlark Marsh site outlined.

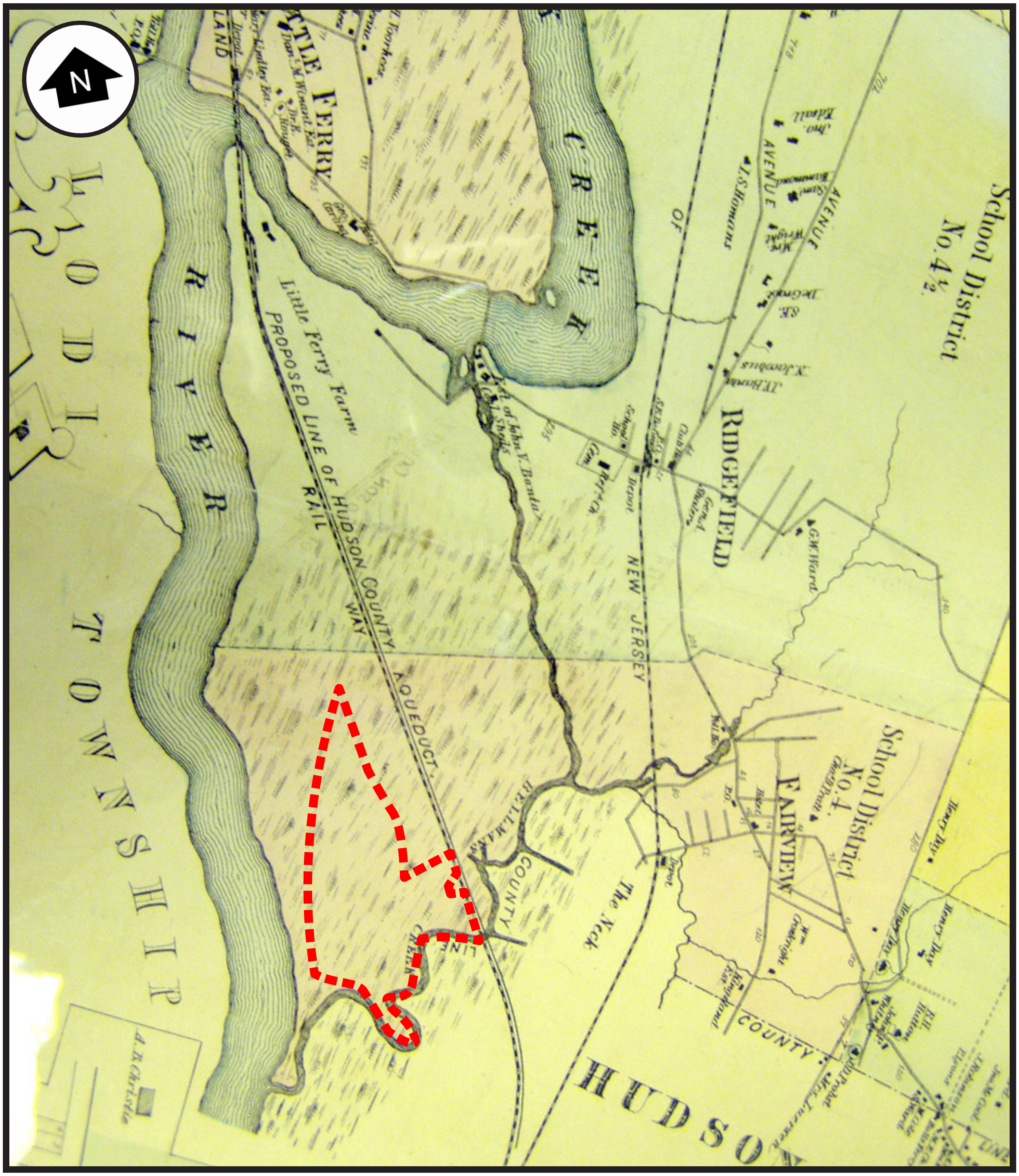

Figure 5.2. Walker, A.H. *Map of Ridgefield Township in Atlas of Bergen County, New Jersey*. 1876. Scale: 1 inch= 2590 feet (approximately). Meadowlark Marsh site outlined.

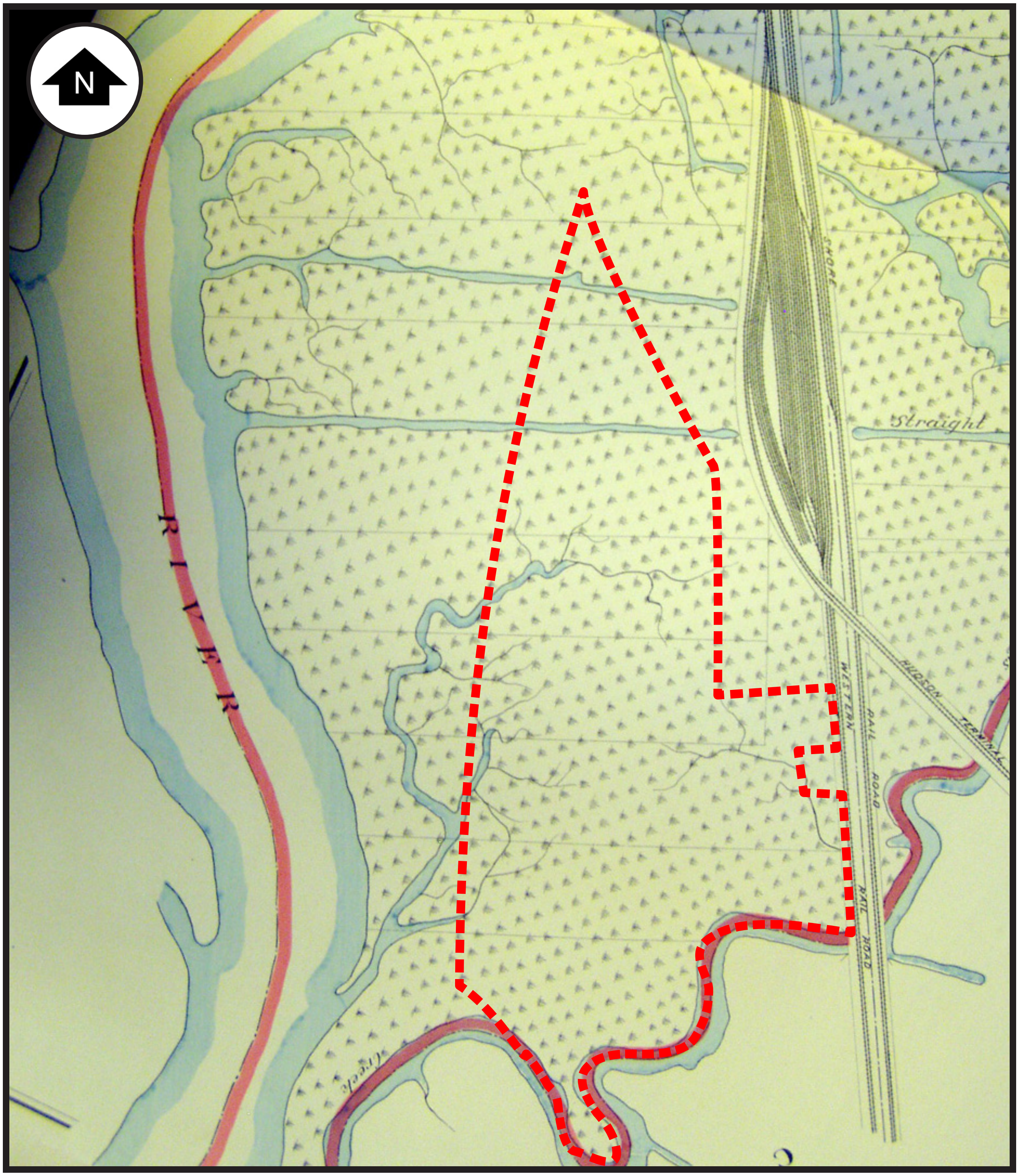

Figure 5.3. Bromley, G.W. Map of Ridgefield Township in *Atlas of Bergen County, New Jersey*. 1912. Scale: 1 inch= 945 feet (approximately). Meadowlark Marsh site outlined.

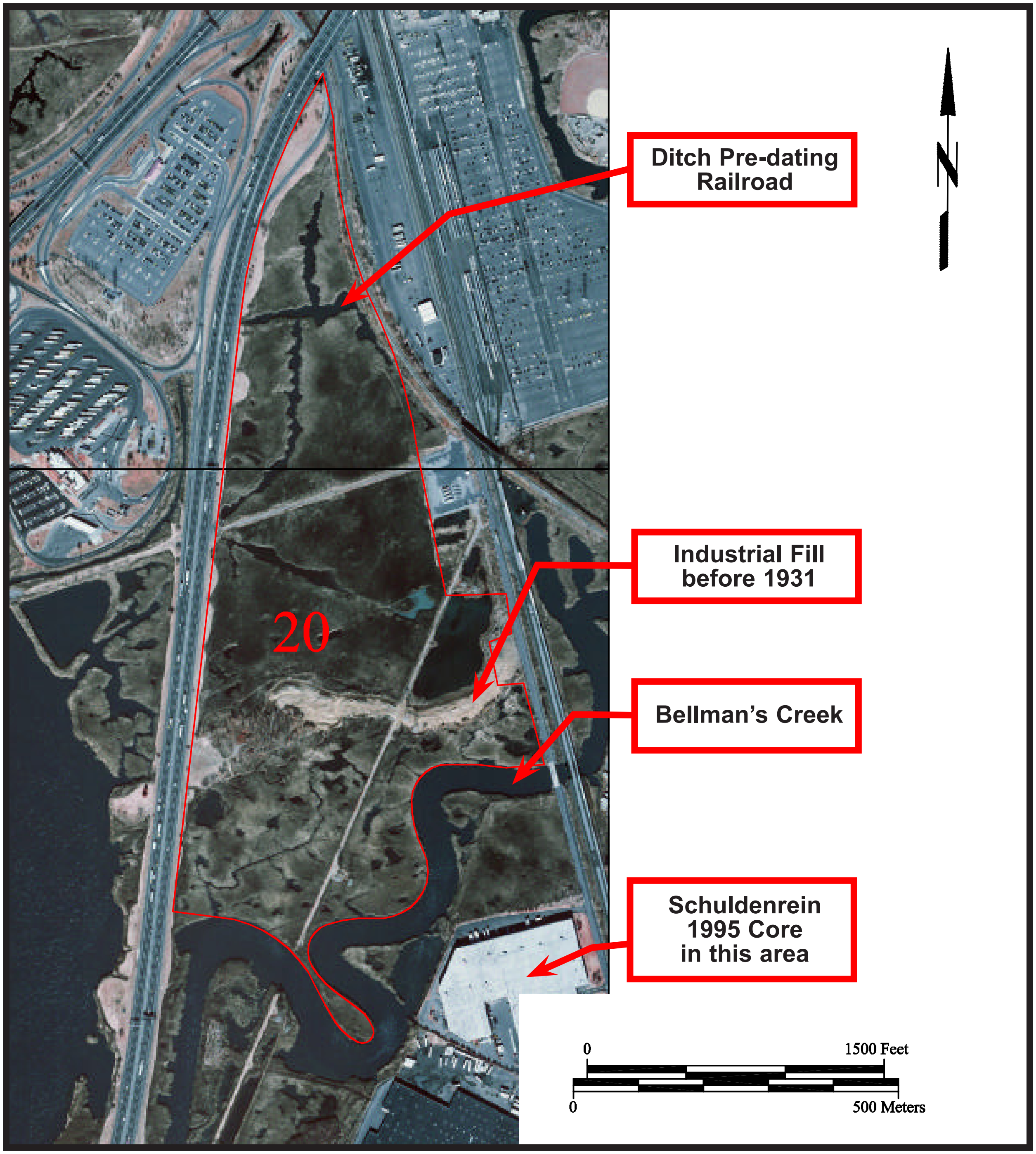

Figure 5.4. Annotated 2002 Aerial Photograph of the Meadowlark Marsh. Source: New Jersey Department of Environmental Protection 2002.

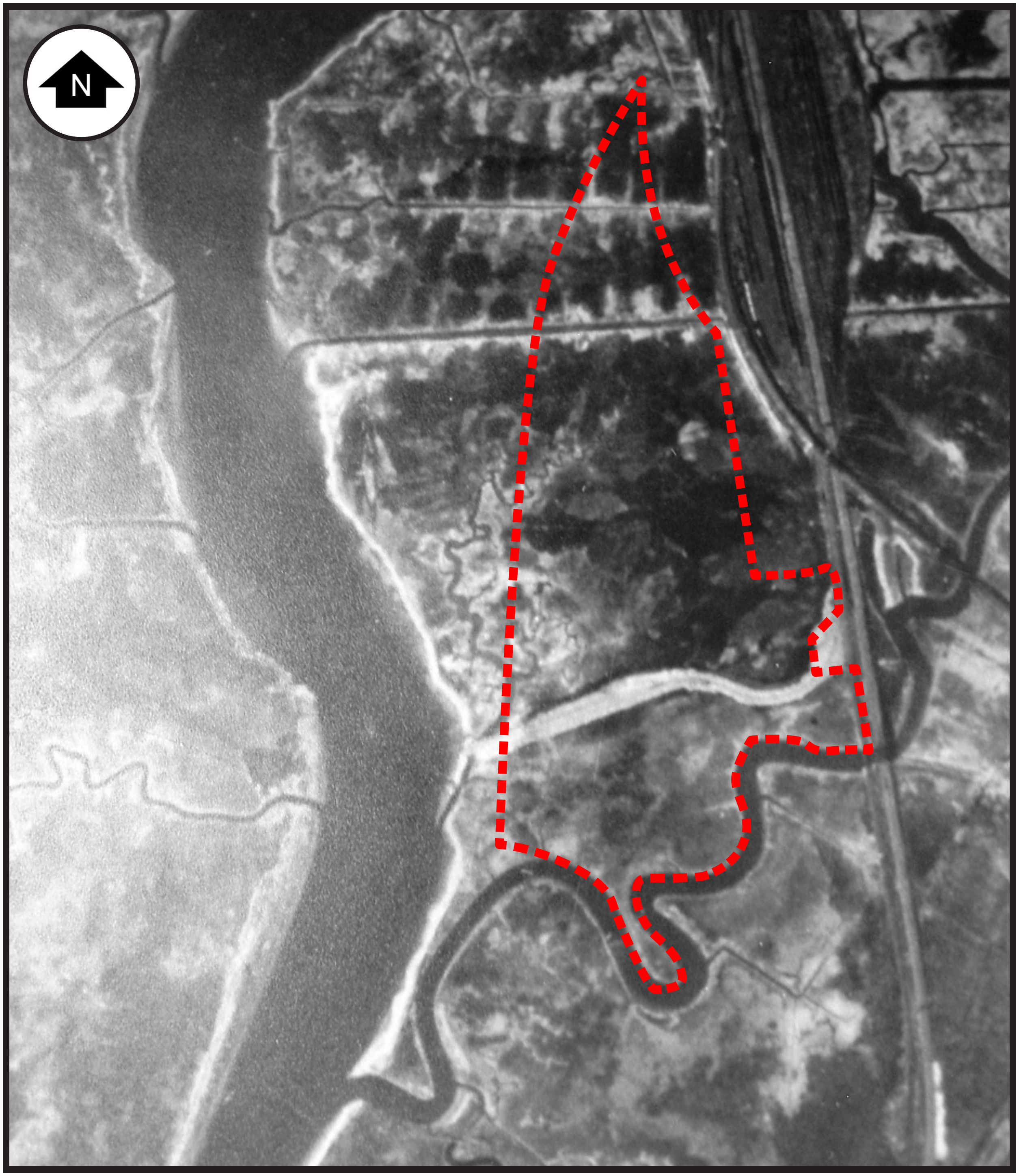

Plate 5.1. Aerial Photograph of the Meadowlark Marsh site. 1931. Source: New Jersey Meadowlands Commission. Meadowlark Marsh site outlined. Note line of fill material already in place across southern part of site.

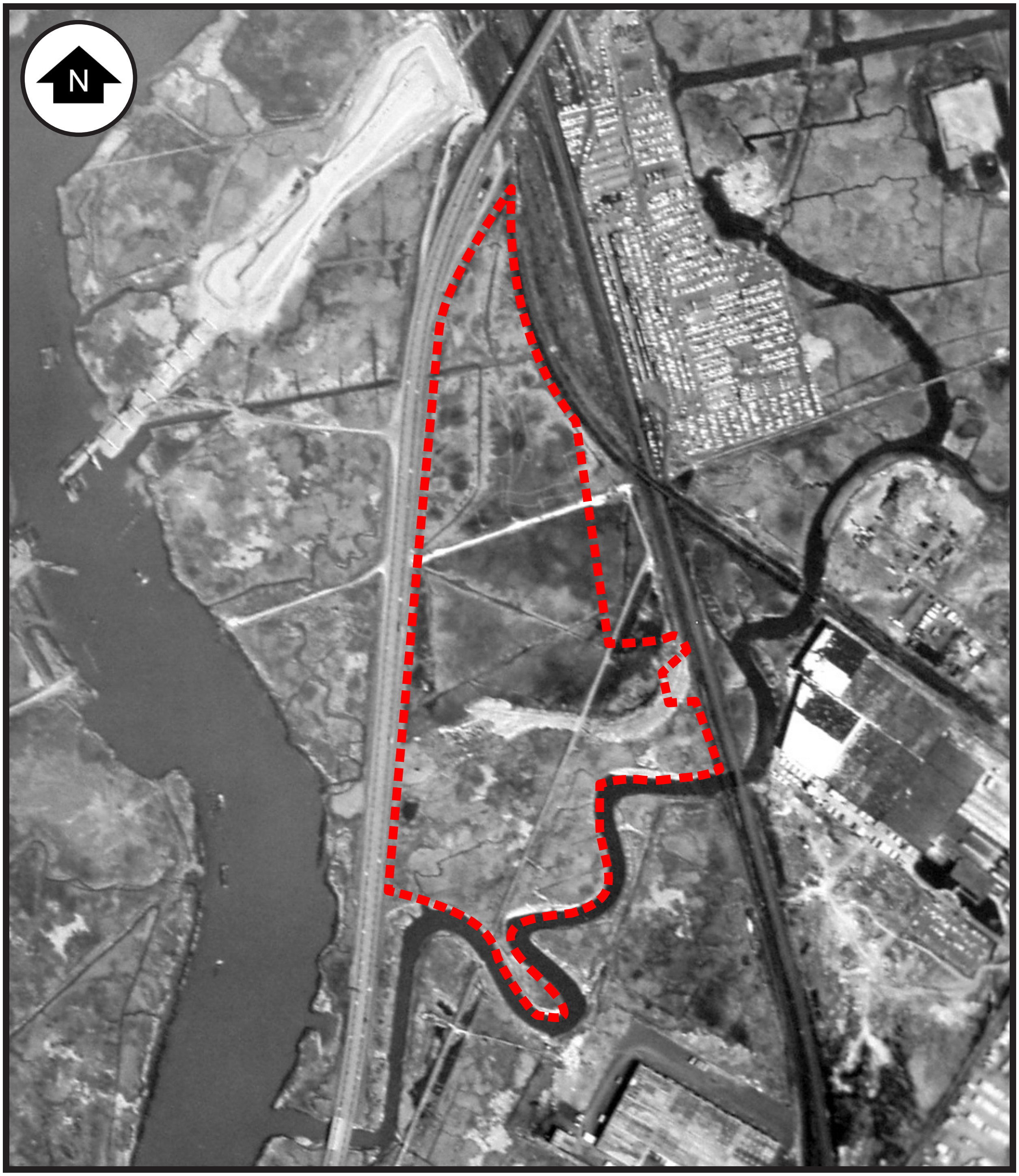

Plate 5.2. Aerial Photograph of the Meadowlark Marsh site. 1968. Source: New Jersey Meadowlands Commission. Meadowlark Marsh site outlined. New Jersey Turnpike construction has altered confluence of Berry's Creek with the Hackensack. New roads and utility easements have been constructed, and drainage has been altered in the northern section.

Plate 5.3. The Meadowlark Marsh site #20: View of dirt access road leading towards the New Jersey Turnpike looking southwest (Photographer: Ian Burrow, August 2005)[HRI Neg. #05025/D8-15].

Plate 5.4. The Meadowlark Marsh site #20: View of dirt strip of fill running east/west located near the southern end of the site, unofficially used by local residents for a motocross track. View looking southeast (Photographer: Ian Burrow, August 2005)[HRI Neg. #05025/D8-9].

Plate 5.5. The Meadowlark Marsh site #20: Bellman's Creek south of the remediation area, showing dominant phragmites with other grasses and sedges at the water's edge. View looking south (Photographer: Joel Grossman, November 2005)[HRI Neg. #05025/D12-3].

on this property (see Appendix B; PMK Group 2003). The site is currently undeveloped and vegetated mainly by common reed (*Phragmites australis*) with minor amounts of staghorn sumac (*Rhus Hirta*) and black cherry (*Prunus serotina*) trees growing in filled areas of the site. Elevations range from one foot along Bellman's Creek to 15 feet in areas containing artificial fill. There are several freshwater ponds and ditches located across the site. A northeast by southwest road runs across the middle of the site. This road, which formerly led to the Hackensack River, was cut off by the construction of the eastern spur of the New Jersey Turnpike (Plate 5.3). A pipeline and electrical transmission lines run northeast/southwest from Railroad Avenue to Bellman's Creek. A dirt road runs along the top of the pipeline providing access to the high-tension towers within the site.

The chief cultural feature is a curved embankment of fill running east/west located near the southern end of the site (Plate 5.4). This was already in place by 1931, and was partially removed on the west for the construction of the New Jersey Turnpike by 1968 (Plates 5.1, 5.2). Examination of the fill during a pedestrian survey revealed that it consists of ground flint cobbles and cobble fragments (most of which exhibited intense charring) and specialized industrial brick wasters (some are shaped like cogs). This filled area is used by local residents for a motocross track. This material was deposited before 1931, and probably after 1912 (Figure 5.3), and possibly after 1917 when the property probably ceased to be farmed (see above).

The linear east-west ditch towards the northern end of the site was in place by 1912, and apparently predates the construction of the New Jersey Midland Railroad, completed in 1872 (Hunter Research Inc. 1992:5-16).

3. Evaluation of Cultural Resource Potential

a. Surface and Shallow Sediments

Based on an examination of the site during pedestrian survey, the site has limited potential to yield cultural resources within the assumed depth of the *phragmites* root mass. The pre-1931 industrial fill across the center of the site is however of potential significance for two reasons. This material may contribute information on specialized industrial brick manufacturing from the pre-1931 period. The deposit located contains a vast amount of waster materials from what appears to be a single source. Examination of the waste should be able to identify the manufacturer and lend some insight into the manufacturing process not normally recorded.

The second contribution of this material is that it has sealed the pre-1931 land surface. It is quite possible that the vegetation growing at the time of the fill will be preserved in the anaerobic conditions beneath it. Analysis of this vegetation would provide a dated "snapshot" of conditions here about 75 years ago.

b. Deep Sediments

Schuldenrein (1995) has drawn attention to the topographically advantageous location of Bellman's Creek and its confluence with the Hackensack. The Meadowlands are quite narrow in this area, with Bergen ridge lying only about one half mile east of the east bank of the Hackensack, providing easy access to several different topographies and ecological zones. These locational factors are predictors of prehistoric frequentation, and suggest that Meadowlark Marsh has some potential in this respect. Extrapolation from nearby corings suggests a depth of up to 15 feet for the peat.

In addition to these general indicators, nearby borings (Schuldenrein 1990-1, 1995; Rue and Traverse 1997) have demonstrated the presence of well-preserved sequences in the vicinity. Of particular importance is core NC-04, placed east of Meadowlark Marsh. A date of 930±50 B.P. was obtained from a depth of 1.1m (3.6 feet) below sea level within the organic silts, clays and peats. These extended to a depth of 2 meters (6.5 feet) and overlay sands interpreted as evidence of higher energy inundations at this location predating the development of marshland conditions and vegetation. Problems with the data from the Rue and Traverse corings (a short distance to the north and west) have been identified above (Chapter 1), but pre-marsh and post-lake deposits (there interpreted as loess) were identified in test borings here also.

Following Schuldenrein (1995:213) it may be suggested that the Meadowlark Marsh site, particular its southern portion close to Bellmans's Creek (Plate 5.5), has some potential to contain seasonally occupied sites sealed by low energy sedimentary events and peat accumulation. These sites are likely to date from the Late Archaic onwards. Earlier occupations may remain within the underlying loess or fluviatile materials, but their locations are much more difficult to predict and are also dependent on their protection from high-energy erosional events whose extent and date remain unknown.

B. METRO MEDIA TRACT - AREA 22 (FIGURES 5.5-5.7; PLATES 5.6-5.8)

1. Site-Specific Background Research and History

In the early 19th century, Abraham D. Banta owned a portion of the modern Metro Media tract. In 1820, Banta sold a 59-acre tract to Richard Amos who subsequently deeded the property to Richard Amos Jr. in 1848 for $2,000 (Bergen County Deeds Q2/613 and M4/3). After Richard Amos Jr.'s death, Robert T. Amos inherited the property and it remained under Amos family ownership until the early 20th century. The Walker atlas of 1876 (Figure 5.5) does not provide ownership information for these meadows. However, a later map, the Bromley atlas of 1913, depicts the various subdivided lots in this area (Figure 5.6).

In 1919, Robert T. Amos conveyed a portion of the meadows (a 12-acre tract) to Edgar J. Hollister (Bergen County Deed 1020/182). A review of land records revealed that Hollister had acquired many acres of marsh between Berry's Creek and Doctor's Creek. The Riser Land Company purchased the acreage from Hollister in 1925 (Bergen County Deed 1313/247). An aerial photograph from 1931 indicates that most of this area was undeveloped, with only limited evidence for ditching on the northwestern side (Plate 5.6). The company retained the property until 1946 when they sold the marsh to John C. Connell (Bergen County Deed 2621/247). The same day, Connell sold the marsh to Hiram B. Blauvelt (Bergen County Deed 2999/313).

In 1949, the Borough of Carlstadt acquired various marsh tracts formerly in possession of Hiram B. Blauvelt (Bergen County Deed 2939/1). The same year, the parcels were sold to the Plank Development Corporation (Bergen County Deed 2987/268). Two years later, a large number of tracts were conveyed to Hiram B.D. Blauvelt, a conservationist (Bergen County Deed 3181/216). Blauvelt proceeded to purchase various tracts of meadow at modern Carlstadt in the mid-20th century. By 1968, a communications facility had been built at the western side of the property in lots 2-4 of tax block 138 (Plate 5.7). A mosquito control ditch had been dug to surround much of the southern portion of the site. Blauvelt died in 1957, a year after his properties were subject to foreclosure.

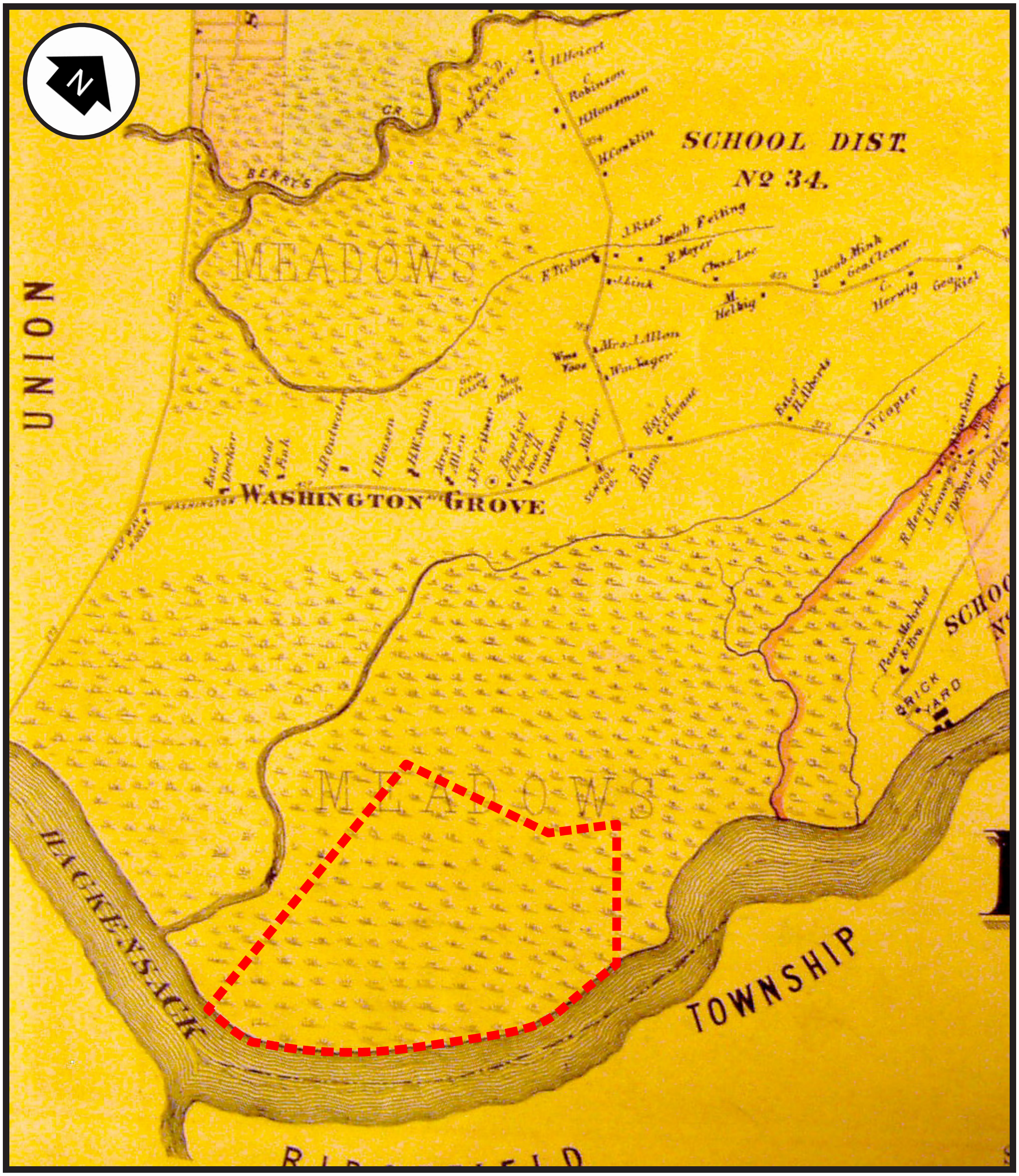

Figure 5.5. Walker, A.H. *Map of Lodi Township in Atlas of Bergen County, New Jersey*. 1876. Scale: 1 inch= 1170 feet (approximately). Metro Media Tract outlined.

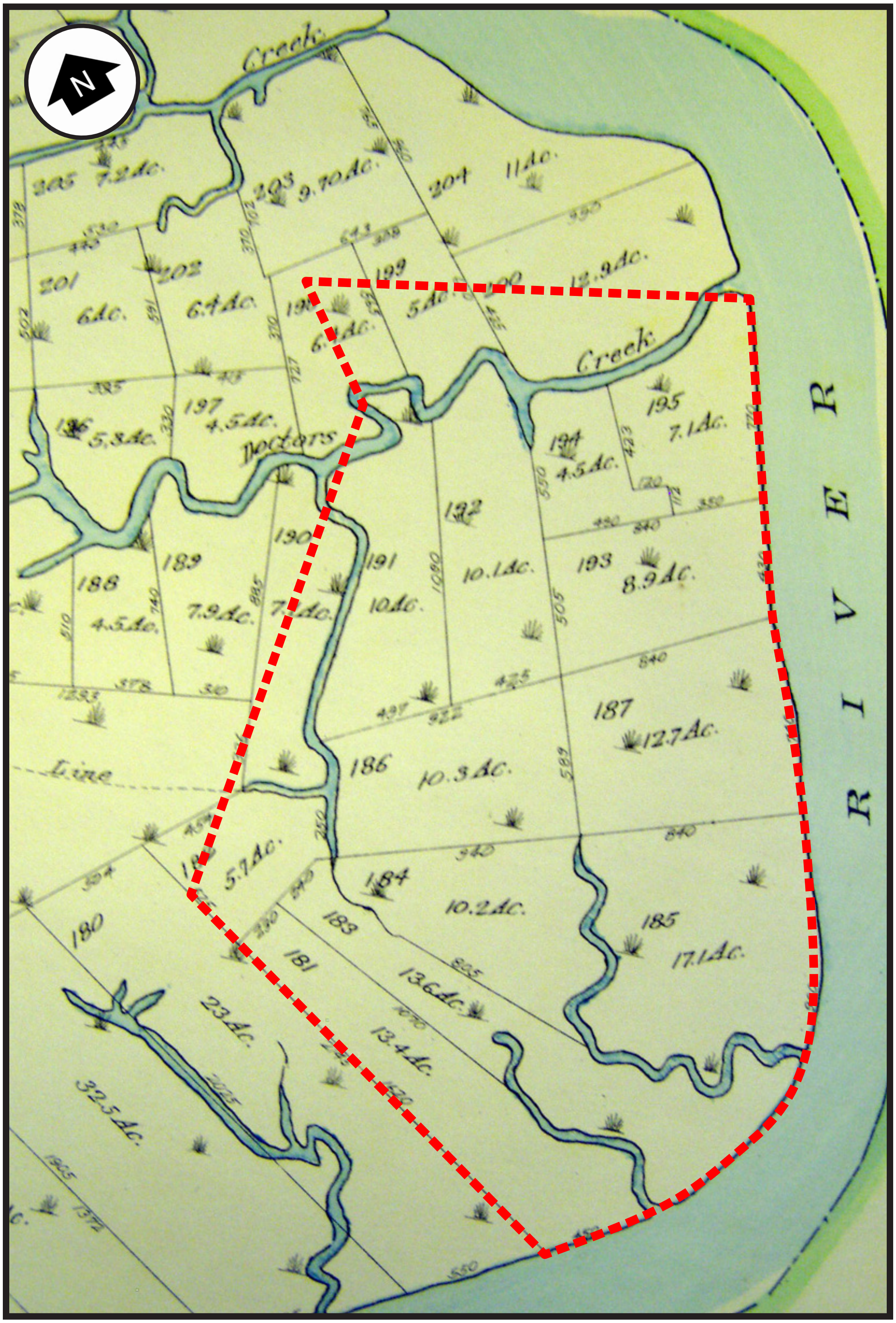

Figure 5.6. Bromley, G.W. *Map of Carlstadt Township in Atlas of Bergen County, New Jersey*. 1913. Scale: 1 inch= 640 feet (approximately). Metro Media Tract site outlined.

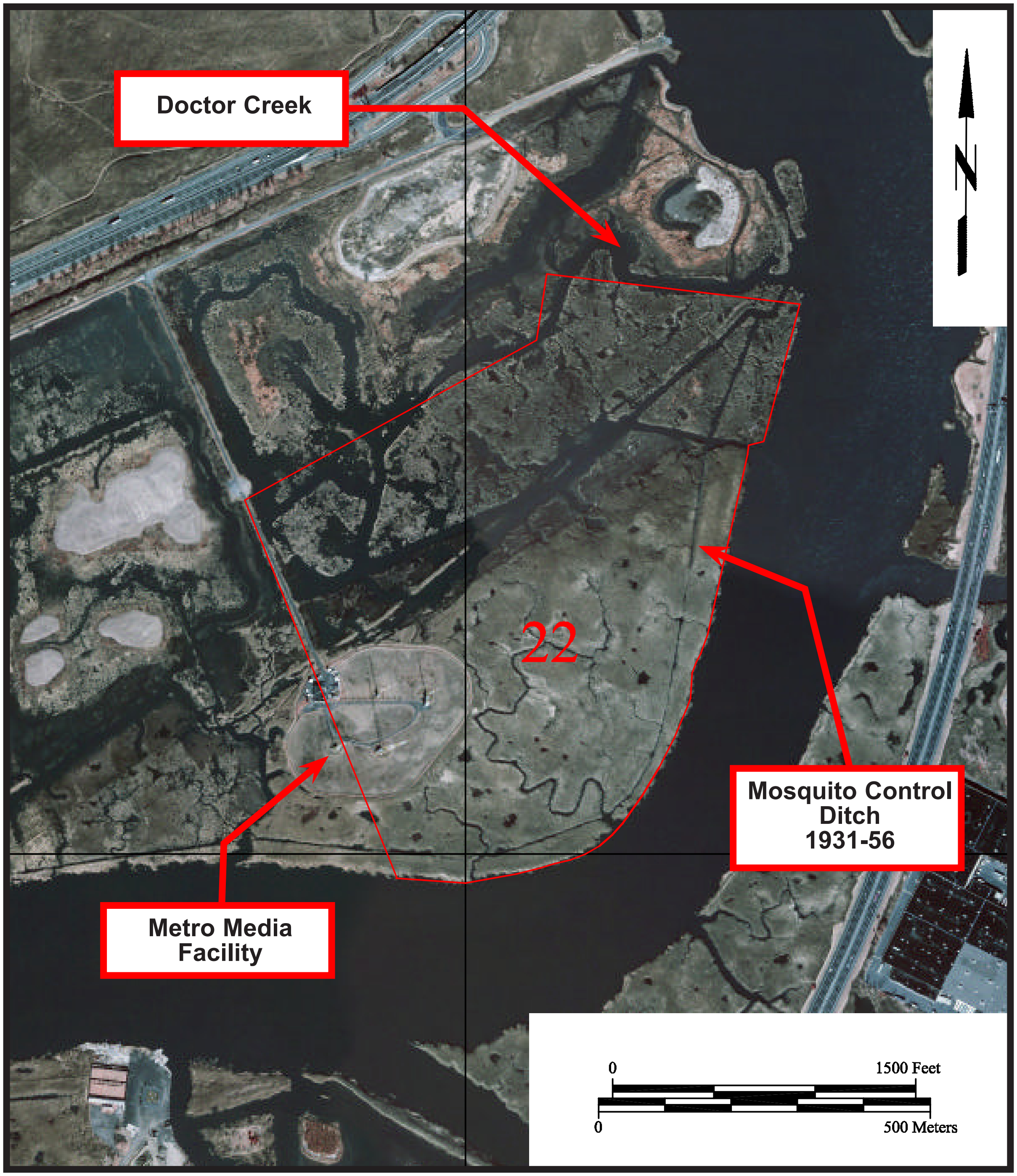

Figure 5.7. Annotated 2002 Aerial Photograph of the Metro Media Tract. Source: New Jersey Department of Environmental Protection 2002.

Plate 5.6. Aerial Photograph of the Metro Media Tract #22. 1931. Source: New Jersey Meadowlands Commission. Metro Media Tract outlined.

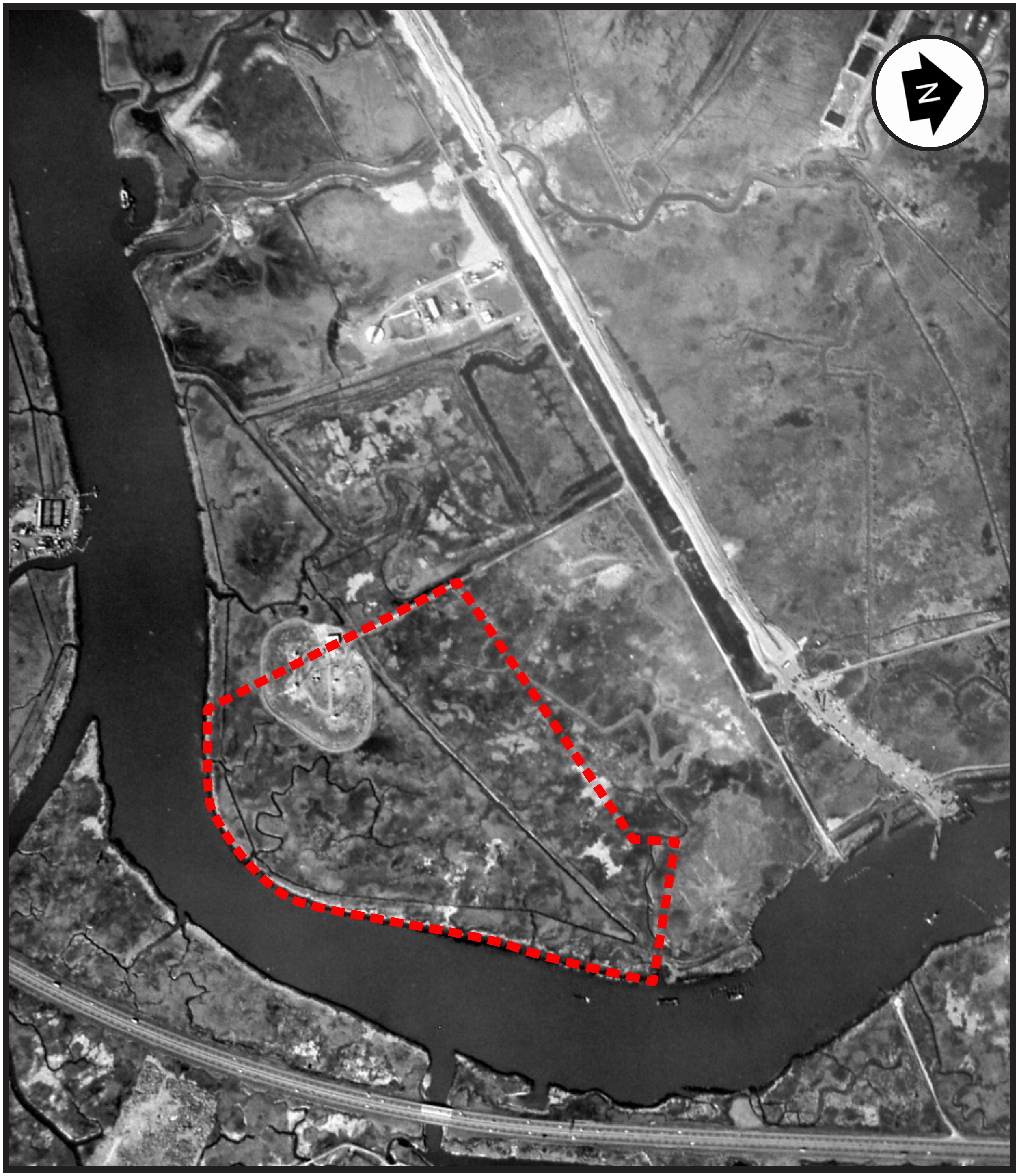

Plate 5.7. Aerial Photograph of the Metro Media Tract. 1968. Source: New Jersey Meadowlands Commission. Metro Media Tract outlined.

Plate 5.8. The Metro Media Tract: View showing the tract in the far background with vegetation and communication towers, looking south (Photographer: Ian Burrow, August 2005)[HRI Neg. #05025/D11-04].

Blauvelt's properties were acquired by Wendick Enterprises and the Empire Development Corporation in the 1960s (Bergen County Deeds 4172/53 and 4205/396). This study area is located just southeast of the Empire Tract, named for this company that owned hundred of acres if meadow in Moonachie, South Hackensack and Carlstadt. In 1963, the Empire Development Corporation sold approximately 493 acres of property to the Transcontinental Gas Pipe Line Corporation (Bergen County Deed 4460/332).

Metro Media, Inc. acquired 101.975 acres of meadow from the Transcontinental Gas Pipeline Corporation in 1966 (Bergen County Deed 5002/472). During the 1990s, the property was owned by Branford Associates, Blythe Eastman Payne Webber Servicing and Metro Media Company (Bergen County Deeds 8150/839 and 8150/248). In 2003, a portion of the meadows (Block 138 Lots 1-10) was conveyed to the New Jersey Meadowlands Commission (Bergen County Deed 8603/334).

2. Site Description

The Metro Media Tract consists of 74 acres and is bounded on the north and west by linear made-made mosquito control ditches, and on the south and east by the Hackensack River. The Metro Media Tract contains the Metro Media Broadcast site and four communication towers (Plate 5.8). With the exception of the Metro Media Broadcast site the tract is undeveloped and vegetated mainly by common reed (*Phragmites australis*). A small strip of land along the northwestern boundary of the site was formerly used as a staging area for a wetlands mitigation project on the adjacent property to the north. Compaction of the soils and vegetation in this area has eliminated the common reeds (*Phragmites australis*), leaving a mudflat. There are several small freshwater ponds and natural winding ditches located across the site, particularly on the north.

3. Evaluation of Cultural Resource Potential

a. Surface and Shallow Sediments

Based on an examination of the site during a windshield survey by boat (Plate 5.8), the site has limited potential to yield prehistoric or historic cultural resources within the *phragmites* root mass. It appears however that the site has not been subjected to much ditching and drainage other than the peripheral dikes, and was still divided into numerous small lots, probably used for salt hay, as late as 1913. Depending on the depth of the reed root mat, palynological data for the last few centuries might to be recoverable here.

b. Deep Sediments

Based on the nearby studies of Rue and Traverse (1997) and Carmichael (1980), peat depths of 10-15 feet can be anticipated here, with limited potential for underling deposits pre-dating the varved clay. The site, however, lies immediately south of the confluence of Doctor's Creek with the Hackensack. It is therefore similar to Meadowlark in this respect, although much more difficult to access by land than sites on the east bank.

C. ORITANI MARSH - AREA 24 (FIGURES 5.8-5.10; PLATE 5.9)

1. Site-Specific Background Research and History

In the early 19th century, John Rutherford owned large landholdings near Berry's Creek that would have encompassed the modern Oritani Marsh. Rutherford had purchased the property from Richard Kingsland in 1835 (Bergen County Deed P3/339). The same year, New Jersey's second railroad, the Patterson

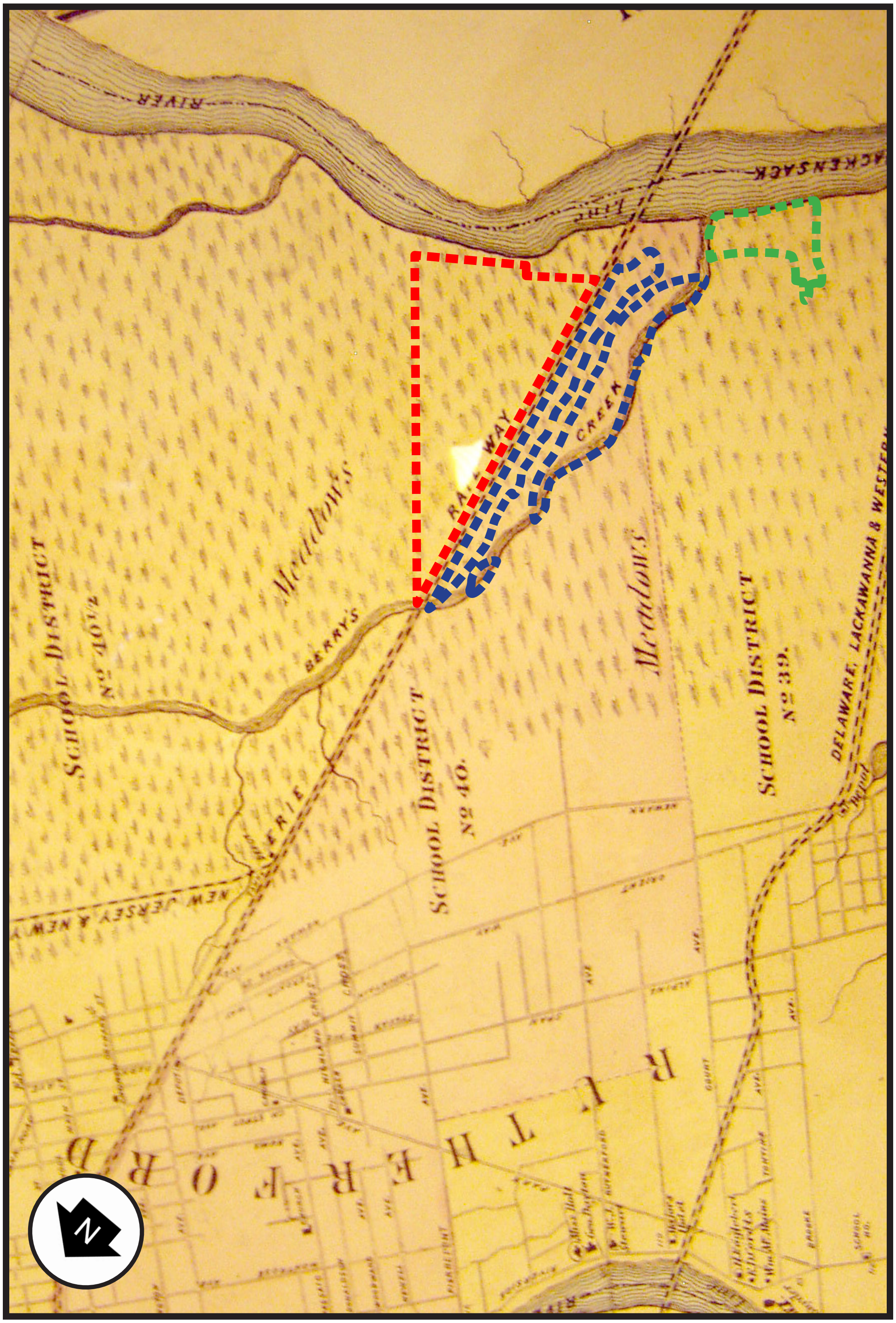

Figure 5.8. Walker, A.H. Map of Union Township in *Atlas of Bergen County, New Jersey*. 1876. Scale: 1 inch= 3150 feet (approximately). Oritani Marsh (red), Berry's Creek Marsh (blue) and Lyndhurst Riverside Marsh (green) sites outlined.

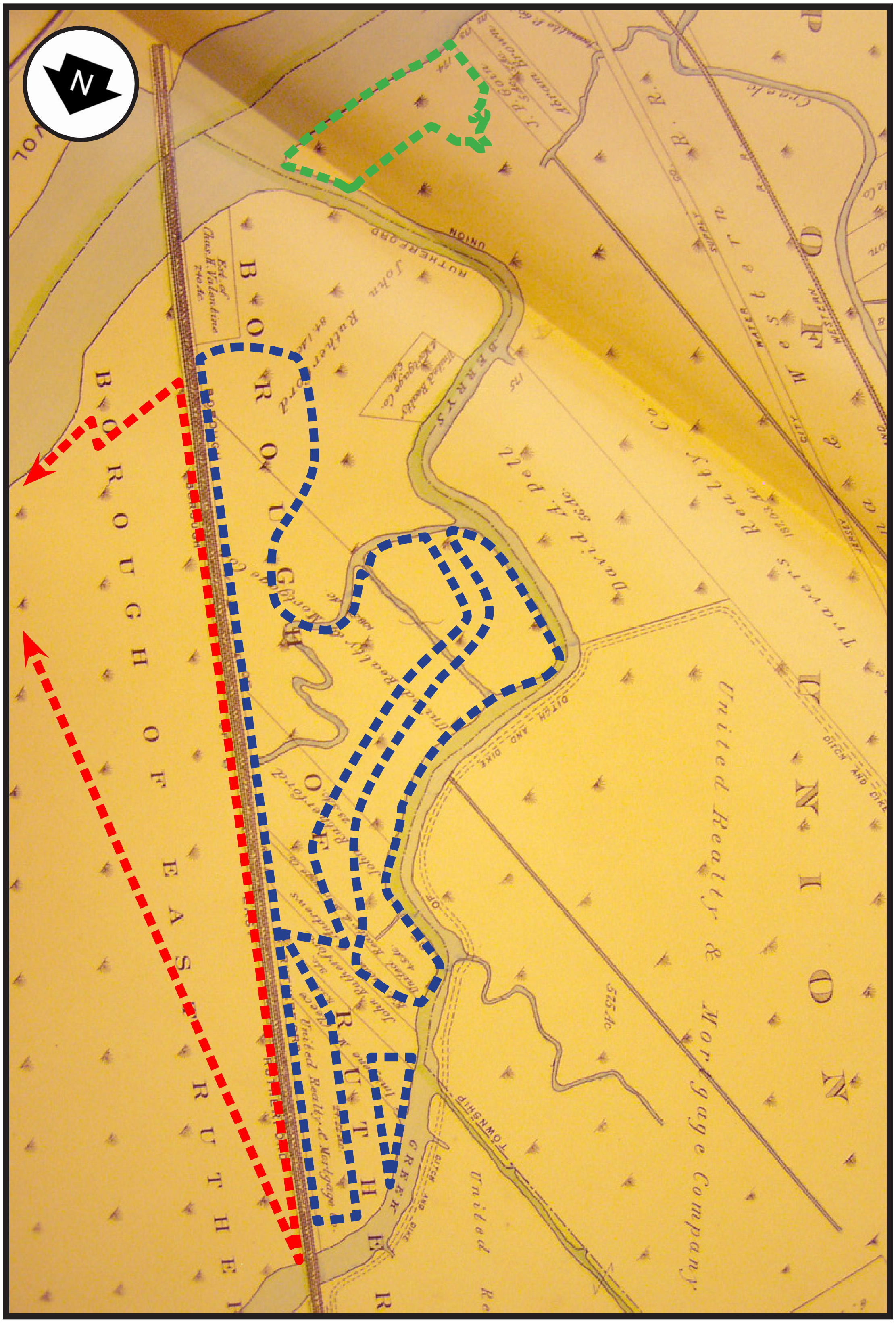

Figure 5.9. Bromley, G.W. *Map of Township of Union and Borough of Rutherford Atlas of Bergen County, New Jersey*. 1913. Scale: 1 inch= 1315 feet (approximately). Oritani Marsh (red), Berry's Creek Marsh (blue) and Lyndhurst Riverside Marsh (yellow) sites outlined.

Figure 5.10. Annotated 2002 Aerial Photograph of the Oritani and Berry's Creek Marshes. Source: New Jersey Department of Environmental Protection 2002.

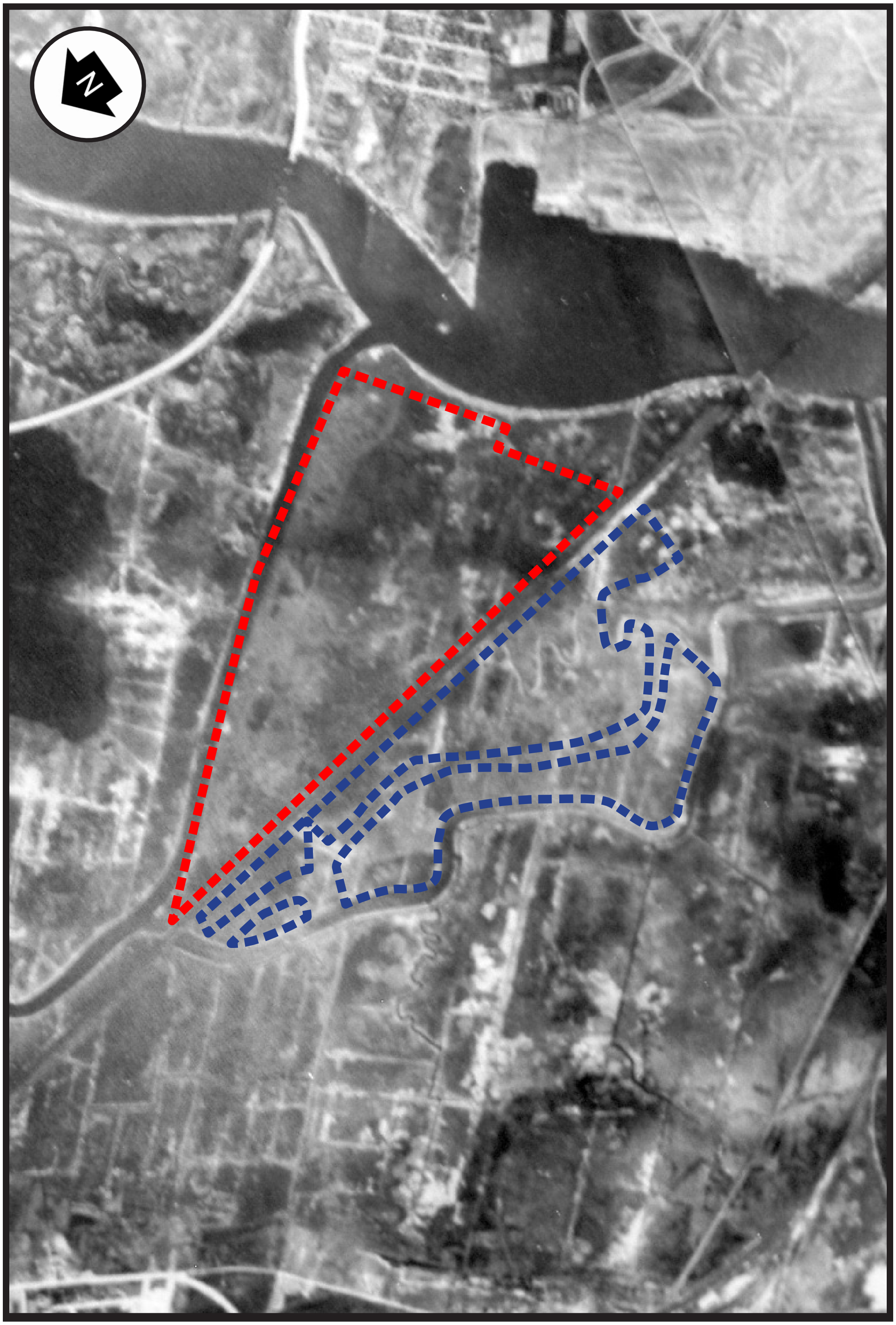

Plate 5.9. Aerial Photograph of Oritani Marsh #24 and Berry's Creek Marsh #12. 1931. Source: New Jersey Meadowlands Commission. Oritani Marsh site (red) and Berry's Creek Marsh (blue) outlined.

and Hudson, was constructed across this part of the Meadowlands. Linear ditches across this site and Berry's Creek Marsh to the south clearly predate the railroad (Figure 5.10, Plate 5.9), showing reclamation efforts in this area no later than the early 1800s.

John Rutherford died in about 1845 at which point the estate was contested. In the suit, Louisa M. Rutherford and others were identified as complainants while Mary Rutherford (the executor of John Rutherford's will) and others were involved as the defendants. It appears that at this time the estate was partitioned.

According to John Rutherford's last will and testament, the property was to be bequeathed to Louisa M. Rutherford. Furthermore, John Rutherford specified that one-seventh part of his estate was to be devised in trust for his grandsons—John Rutherford Jr., Walter Rutherford Jr., Lewis M. Rutherford and Robert W. Rutherford Jr. After their deaths, Jabez P. Pennington was substituted as trustee by the Bergen County Orphan's Court in 1857. The Rutherford estate is represented as meadowland on the Walker atlas of 1876 (Figure 5.8). Jabez P. Pennington resigned and was replaced by Richard Wayne Parker in 1886 (explicated in Bergen County Deed 735/263).

The construction of the Berry's Creek Canal in 1902-8 resulted in the placement of dredge materials along the northeast side (Appendix B). In 1909, Richard Wayne Parker, trustee, sold "tract number two of share one" to the Erie land and Improvement Company for $36,356 (Bergen County Deed 735/263). The parcel measured approximately 181 acres and was bounded by the Hackensack River, the Paterson Railroad and Berry's Creek, possibly chiefly falling within the adjacent Berry's Creek Marsh (12). The Bromley atlas of 1913 identifies the property as marshland in the Borough of East Rutherford (Figure 5.10). The adjoining sheet (not reproduced here) clarifies that John Rutherford owned the 900 acres of meadow.

When the Erie-Lackawanna Railroad was lengthened through the Hackensack Meadows, work was carried out at Berry's Creek. The waterway was divided in order to avoid the construction of a movable bridge for the railroad (Manganaro, Martin and Lincoln 1970). In 1911, the Erie Canal (Berry's Creek Canal) was opened to provide an unimpeded route for water traffic (Wright 1988:86).

The canal and the surrounding area can be observed on an aerial photograph of 1931 (Plate 5.9). The property changed hands in 1964 when the approximately 181-acre tract and four other lots were sold to H. Jerome Sisselman (Bergen County Deed 4655/499). Consequently, Sisselman Israel Associates conveyed Block 109.01 Lots 1-3 in East Rutherford to the Hackensack Meadowlands Development Commission in 1998 (Bergen County Deeds 5653/436 and 8053/615).

2. Site Description

The Oritani Marsh site consists of 224 acres and is bounded on the southwest by the Conrail line, on the southeast by the New Jersey Turnpike, and on the northeast by Berry's Creek Canal. The site contains upland areas completely vegetated by common reed (*Phragmites australis*), a high marsh dominated by saltmarsh hay (*Spartina patens*) and low marsh dominated by smooth cordgrass (*Spartina pupurascens*) and dwarf spikerush (*Eleocharis pavula*) (Appendix B). Several feet of fill exist in the northern portion of the tract resulting from the excavation of Berry's Creek Canal (between 1902 and 1908) and the construction of the New Jersey Turnpike in the mid-1950s. The southern portion of the tract exhibits several small freshwater ponds, linear man-made and natural winding ditches.

3. Evaluation of Cultural Resource Potential

a. Surface and Shallow Sediments

Based on an examination of the site during a survey by boat, the site has little potential to yield prehistoric or historic cultural resources within the *phragmites* root mass. Pre-1835 ditching is partially preserved in the southern apex of the site, but has been covered by fill elsewhere. The northeastern portion of the site along Berry's Creek Canal is covered by several feet of fill and the southern portion was inundated by tidal waters at the time of field reconnaissance.

b. Deep Sediments

Peat here is likely to be at least 15 feet deep, based on Carmichael 1980 and Grossman's model (see Figure 1.6). Pre-peat deposits are not predicted, and the area does not lie adjacent to a confluence.

D. BERRY'S CREEK MARSH - AREA 12 (FIGURES 5.8-5.10; PLATE 5.9)

1. Site-Specific Background Research and History

A large portion of the Berry's Creek Marsh can be traced to the ownership of Jacob G. Van Riper to the early 19th century. Van Riper died in 1817 and the property consequently passed to Walling Van Riper who retained it with his wife Ellen until 1871 when they sold it to George C. Brinkerhoff for $50,000 (Bergen County Deed Z7/530). The indenture recorded that the Van Ripers sold nine tracts to Brinkerhoff. Approximately six months later, George Brinkerhoff and his wife Kesia deeded 109 acres to Rensselaer Furman for $5,450 (Bergen County Deed D8/239). The land and premises excluded approximately nine acres that belonged to the heirs of Isaac Houseman. The 190-acre lot was bounded on the northwest by a ditch, on the northeast by Berry's Creek and southerly by another ditch. The Walker atlas of 1876 (Figure 5.8) does not provide ownership information in this vicinity, but shows the area as meadow.

After Rensselaer Furman's death, his executors Mary E. Furman and Andrew H. Calamin conveyed the above property and additional acreage to Wallace C. Andrews in 1893. The indenture observes that a portion of the 222-acre tract being transferred was subject to a lease to Darwin E. Hill that was set to expire in nearly a month (Bergen County Deed 353/562). Wallace C. Andrews, one of the directors of the Standard Oil Company and president of the New York Steam Company, relocated from Ohio to New York City in 1879. Andrews and his wife and 10 other individuals died in a catastrophic fire that ravaged their home on Fifth Avenue in 1899 (The Andrews School 2005).

Wallace C. Andrews' landholdings were subsequently reorganized and partially divided, since a later indenture records a total of 45 individual tracts. Andrews' executor and brother-in-law Gamaliel C. St. John sold the 45 parcels to The Andrews Institute for Girls in 1910 (Bergen County Deed 794/381). A sizeable portion of the modern study area was contained within the 26th tract recited in the land record. Wallace C. Andrews and his wife devised their wills in 1891 at which time they created a trust that would found a school where young women could be taught independence and self-reliance. After the Andrews' death in 1899, the wills were contested for several years. The school was eventually incorporated in 1902 in Ohio although the Andrews' wills would continue to be challenged (The Andrews School 2005).

On July 1, 1911, the Andrews Institute for Girls conveyed a total of 48 parcels to Henry B. Mahn (Bergen County Deed 794/398). The same day, Henry B. Mahn deeded the property, rearranged into a 575-acre parcel containing the study area and seven other lots to the United Realty and Mortgage Company (Bergen County Deed 796/257). A portion of this now larger property lay adjacent to the Yereance shipyard. The Bromley atlas of 1913 indicates that the United Realty and Mortgage Company was in possession of several parcels south of Berry's Creek in the Borough of Rutherford (Figure 5.10). Furthermore, the map depicts two ditches running southwestwardly from Berry's Creek through the 575-acre parcel. It is clear that these boundaries pre-date the 1830s railroad that forms the northeast boundary of the site.

In 1914, the Fidelity Trust Company sued the United Realty and Mortgage Company, the Rutherford Gardens Company and others. The same year, sheriff Robert N. Heath sold the eight parcels to Clarence P. Browning (Bergen County Deed 895/636). Browning deeded the same tracts to William D. Ackerson who soon after sold the landholdings to the Rutherford Truck Gardens Company (Bergen County Deeds 920/507 and 920/625). In 1917, the New York Acreage Estates Company purchased the tract and later conveyed the eight parcels to the Belle Mead Development Corporation (Bergen County Deeds 966/585 and 1436/10). The Belle Mead Development Corporation subdivided the parcels after it bought the properties. A portion of this study area, comprising Lot 231, Block 2 was acquired by Rolls-Royce Motors and has since been purchased by the Daewoo Electronics Corporation of America (Bergen County Deeds 6284/36; 7767/278 and 8679/777).

2. Site Description

The Berry's Creek Marsh site consists of 168 acres and is bounded on the south and west by Berry's Creek and on the northeast by the Conrail line. The site is divided into three sections by a dirt access road running generally north-south. This road crosses over the Fish Creek, which meanders through the southern portion of the tract terminating at the Conrail line. The Berry's Creek Marsh is undeveloped and vegetated mainly by common reed (*Phragmites australis)*. The site exhibits several early linear drainage ditches and small freshwater ponds.

3. Evaluation of Cultural Resource Potential

a. Surface and Shallow Sediments

Based on an examination of the site during a survey by boat, the site has little potential to yield prehistoric or historic cultural resources within the *phragmites* root mass. Early 19th-century land reclamation ditches are present, suggesting that vegetation changes may be discernible in the palynological record here if this is recoverable beneath the *phragmites.* The western portion of this project site was disturbed by the EnCap Golf wetland restoration project completed in 2005 (Brett Bragin, personal communication, July 2006).

b. Deep Sediments

Peat here is predicted to reach depths of 15 feet or more. The confluence of Fish Creek and Berry's Creek lies at the southern end of the site, and this may be a location of moderate potential, although probably not as high as confluences with the main river.

E. LYNDHURST RIVERSIDE MARSH - AREA 19 (FIGURES 5.8, 5.9, 5.11; PLATES 5.10-5.11)

1. Site-Specific Background Research and History

Deed research carried on tracts further to the south indicates that this area was known as Van Winkle's meadow in the 19th century. It appears that the acreage contained within the modern Lyndhurst Riverside Marsh was passed down though the Van Winkle family and would require additional genealogical research in order to trace a complete sequence of ownership. By the mid-19th century, the meadow at the mouth of Berry's Creek was in the tenure of Jacob Van Winkle of Union Township, Bergen County, New Jersey (referenced in Bergen County Deed T5/150).

Jacob Van Winkle may have been a descendant of Walling Van Winkle, who appears in records in 1768, when he was compensated for ironwork for a bridge over the Passaic River. During this time, Van Winkle owned 500 acres adjacent to the eastern end of the structure (Bogert 1983:62).

After Jacob Van Winkle's death in 1857, the sole executor of Van Winkle's last will and testament, Amzi Dodd, and Van Winkle's widow Harriet, came into possession of his landholdings. In 1863, Dodd and Van Winkle conveyed three tracts to James S. Watson of New York City for $18,000 (Bergen County Deed T5/150). One of the three lots contained approximately 187 acres and was partially bounded by Berry's Creek, Kingsland's Brook and the Hackensack River. In 1876, a financial dispute concerning the mortgaged premises was presented in the court of chancery (William R. Travers was the complainant and Frederick A. Watson and others were defendants). The property and seven other parcels were consequently sold to William R. Travers for $10,900 (Bergen County Deed U9/114). The Walker atlas of 1876 does not identify the owner of the parcel but does depict it as marshland (Figure 5.9).

After William R. Travers' death, the properties passed to his widow Maria L. Travers. After Maria L. Travers' death, her heirs sold the eight tracts to the Travers Realty Company for $35,000 in 1905 (Bergen County Deed 620/277). Worthy of note, a later indenture recorded in 1929 between the Standard Oil Company and the Travers Realty Company explains that in 1880, William R. Travers had "leased to John B. Barbour a right of way to lay pipes, construct and maintain a telegraph line and operate the same over land of Travers." The right of way would have been situated in a meadow between Berry's Creek, the Hackensack River, the Delaware Lackawanna and Western Railroad and property that belonged to James Brown (Bergen County Deeds 1647/601 and R10/366). The deed further indicates that Barbour had not constructed the pipe. In 1913, the Bromley atlas verifies that the Travers Realty Company owned the 187 acres of marshland (Figure 5.9).

The area is covered on an aerial photograph of 1931 (Plate 5.10). The aerial, however, is blurred in certain areas, particularly at the study location. In 1937, the Travers Realty Company sold the parcel to Clara M. Wolford of Bronx, New York for $100 (Bergen County Deed 2080/36). By 1940, Wolford had neglected to pay her taxes and her properties were confiscated and sold to the Township of Lyndhurst by the tax collector (Bergen County Deed 2208/637). A clearer aerial photograph from 1968 (Plate 5.11) indicates that some ditching activity had taken place at this location along with the deposition of possible dredge spoil along the Hackensack bank. The township later consolidated some of the lots and subsequently sold four lots to the Hackensack Meadowlands Development Commission in 1999 (Bergen County Deeds 7169/351 and 8163/397).

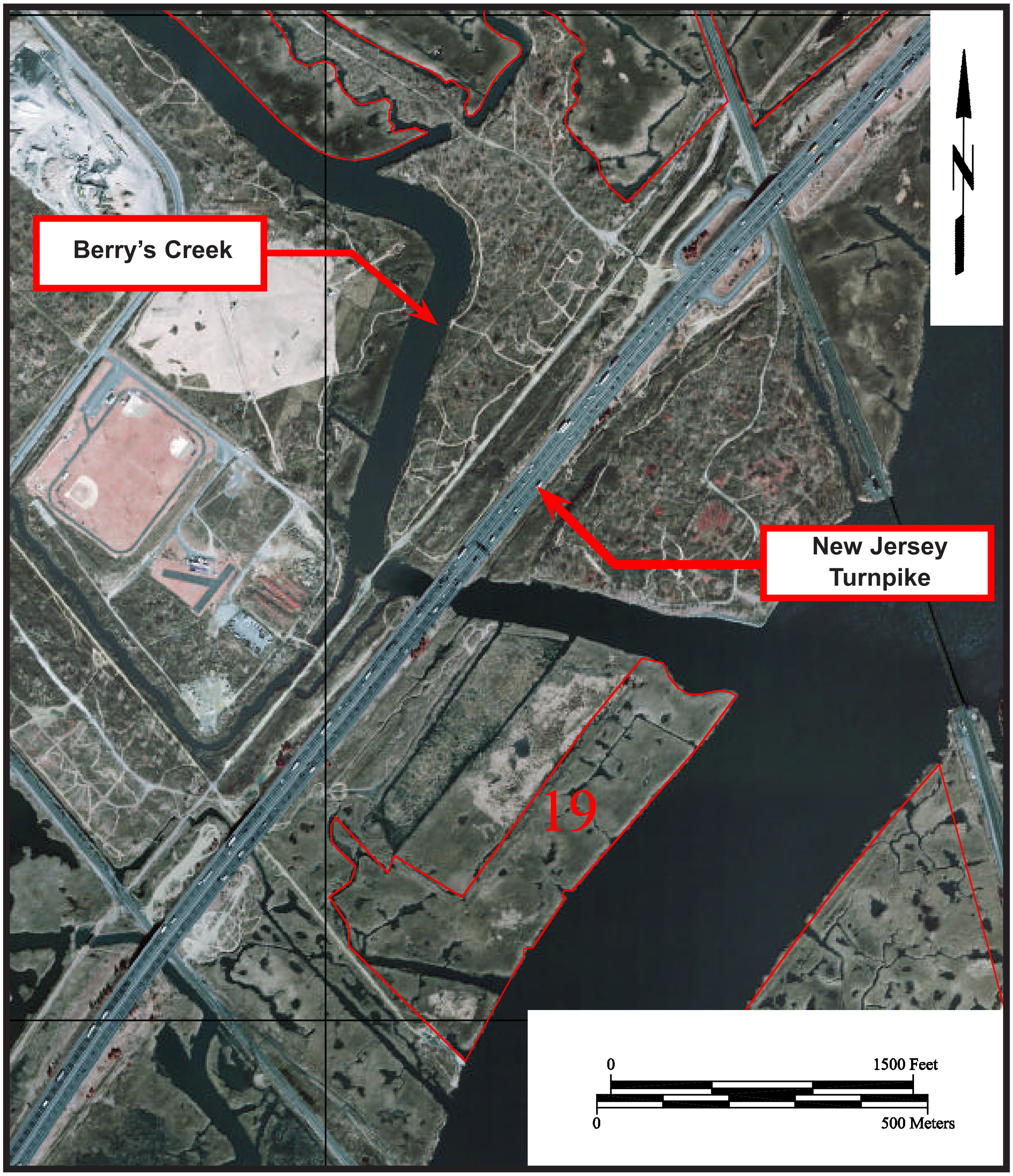

Figure 5.11. Annotated 2002 Aerial Photograph of the Lyndhurst Riverside Marsh. Source: New Jersey Department of Environmental Protection 2002.

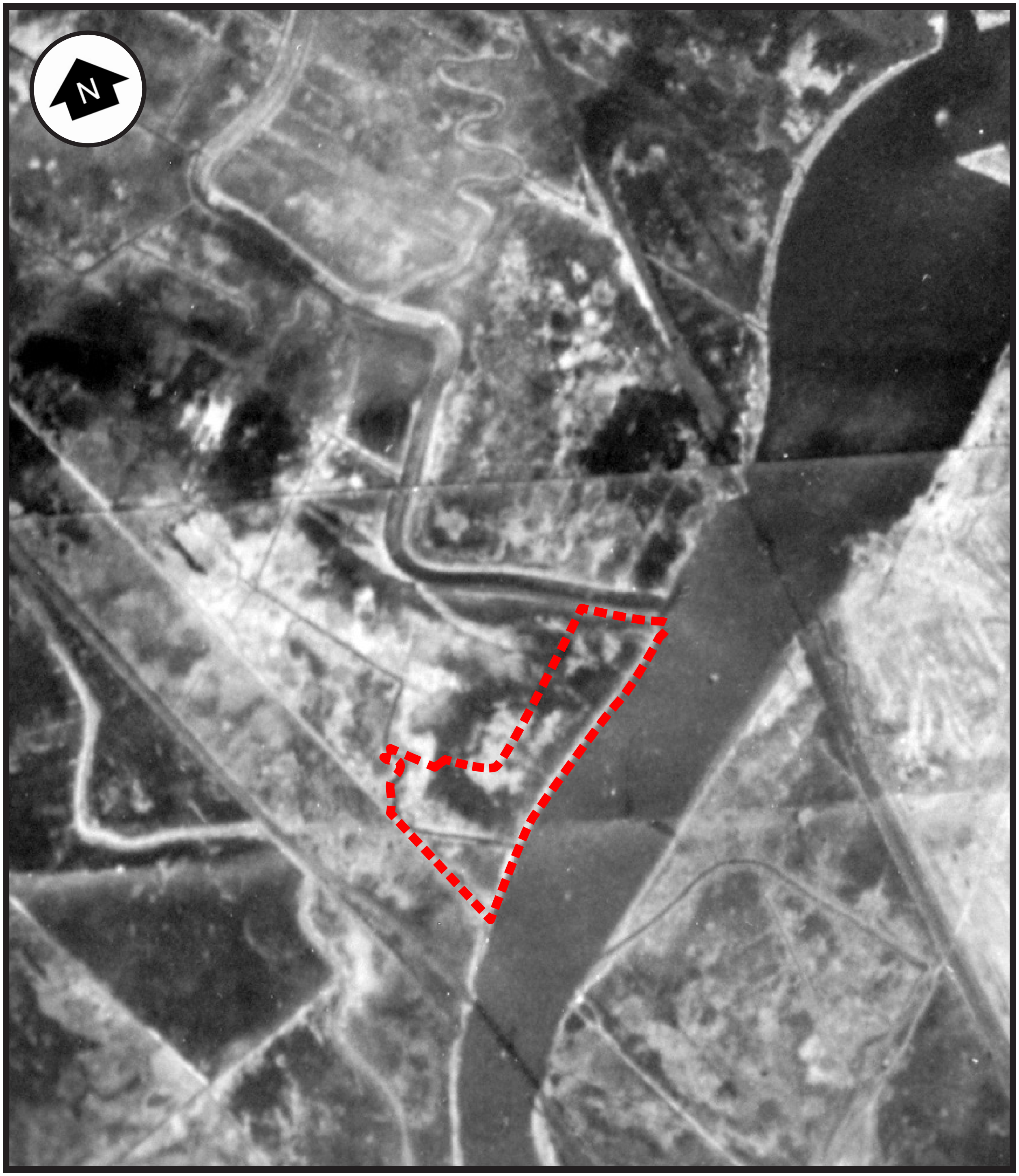

Plate 5.10. Aerial Photograph of the Lyndhurst Riverside Marsh #19 site. 1931. Source: New Jersey Meadowlands Commission. Lyndhurst Riverside Marsh site outlined.

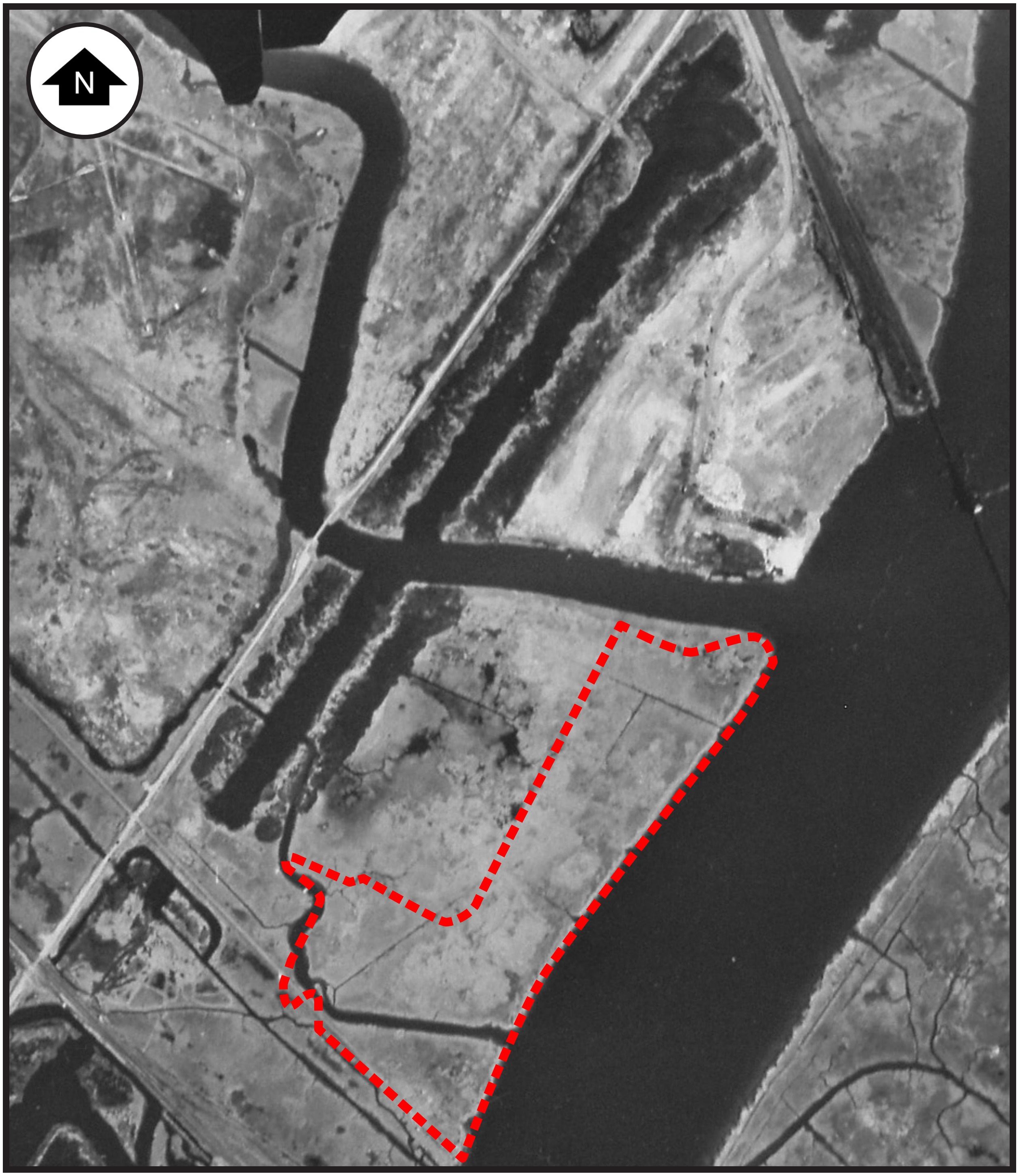

Plate 5.11. Aerial Photograph of the Lyndhurst Riverside Marsh site. 1968. Source: New Jersey Meadowlands Commission. Lyndhurst Riverside Marsh site outlined.

2. Site Description

The Lyndhurst Riverside Marsh site consists of 31 acres and is bounded on the southeast by the Hackensack River, on the southwest by a dirt access road overlying a waterline, on the northwest by the Bellemeade Mitigation site and on the north wetlands adjacent to Berry's Creek. The site is undeveloped and is dominated by common reed (*Phragmites australis*). The site exhibits a few small freshwater ponds and linear man-made ditches.

3. Evaluation of Cultural Resource Potential

a. Surface and Shallow Sediments

Based on an examination of the site during a survey by boat, the site has little to no potential yield prehistoric or historic cultural resources within the phragmites root mass. There is limited evidence for land reclamation activities before the 20th century.

b. Deep Sediments

The site adjoins Berry's Creek, the largest Hackensack tributary in the Meadowlands District and possibly a preferred location in prehistory. Peat depths may be as much as 20 feet. Pre-peat/post varve deposits are not anticipated.

F. ANDERSON CREEK MARSH, AREA 11 (FIGURES 5.12-5.14; PLATES 5.12-5.14)

1. Site-Specific Background Research and History

In 1814, John and Catherine Anderson of New Barbadoes Township, Bergen County, New Jersey, sold a tract of meadow to Samuel Swartwout for $2,000 (Bergen County Deed L2/316). See Section G below for a more detailed history of the Swartwout brothers' activities. The 102-acre lot was bounded partially by the Hackensack River and by lands formerly belonging to Philip Earle. Swartwout sold the property in 1828 to Henry Traphagen for $1,800 (Bergen County Deed A3/535).

Henry Traphagen descended from the prominent Traphagen family of Jersey City, New Jersey. Traphagen studied law and began the practice in 1864. Later in his lifetime, he served as Mayor of Jersey City and as counsel for the Board of Water Commissioners of Jersey City (Harvey 1900:606-607). The 1837 coast survey map may show a building just south of the railroad and a short distance east of the Hackensack River (Figure 4.2). The Hopkins atlas of 1873 (Figure 5.12) shows that the property south of the Erie Railway and east of the Hackensack River was owned by "H.M. Traphagen." The remainder of the area contained a planned or "paper" network of streets. After Henry Traphagen's death, his property passed to his heirs as depicted on the Hopkins atlas of 1909 (Figure 5.13). By this time, the estate had been divided into Tracts A-G and was bounded to the north and east by the Hudson Iron Company. Anderson Creek is shown on the western portion of the Traphagen estate. In addition to the Traphagen estate, the modern Anderson Creek Marsh included property owned by the Hudson Iron Company.

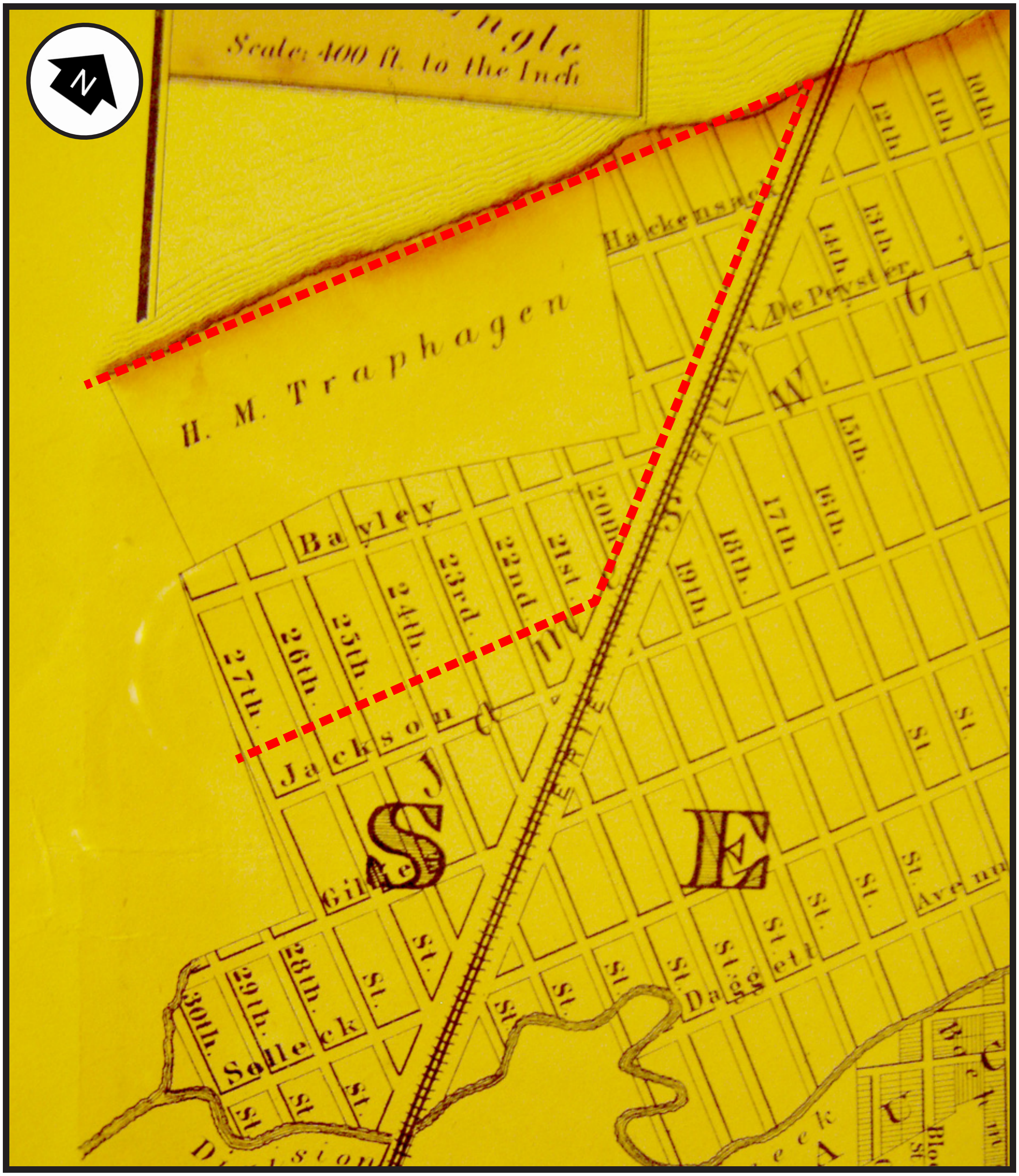

Figure 5.12. Hopkins, G.M. Map of Secaucus in *Atlas of Hudson County, New Jersey*. 1873. Scale 1 inch= 525 feet (approximately). Northern portion of Anderson Creek Marsh site outlined.

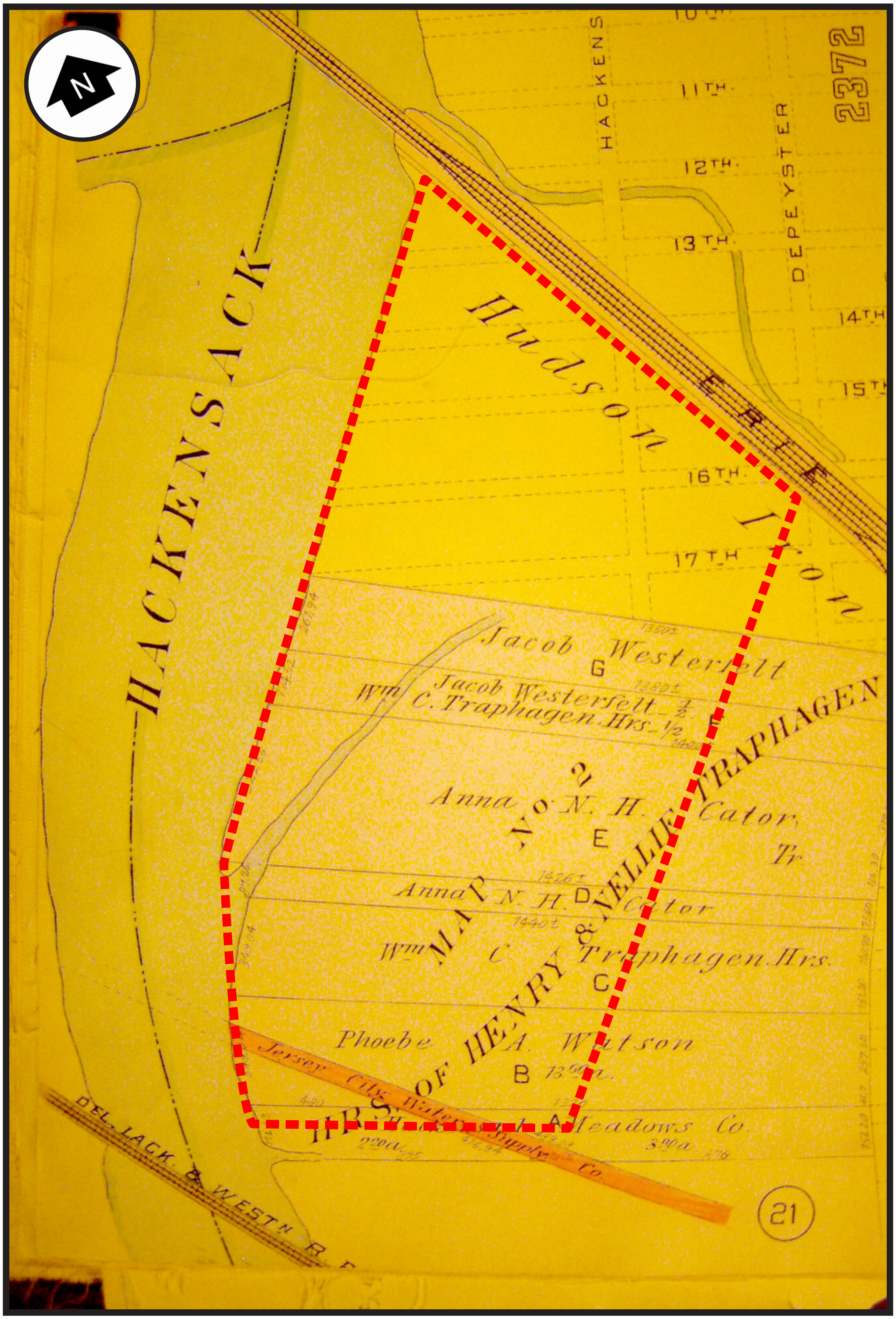

Figure 5.13. Hopkins, G.M. Map of Secaucus in *Atlas of Hudson County, New Jersey*. 1909. Scale 1 inch= 590 feet (approximately). Anderson Creek Marsh site outlined.

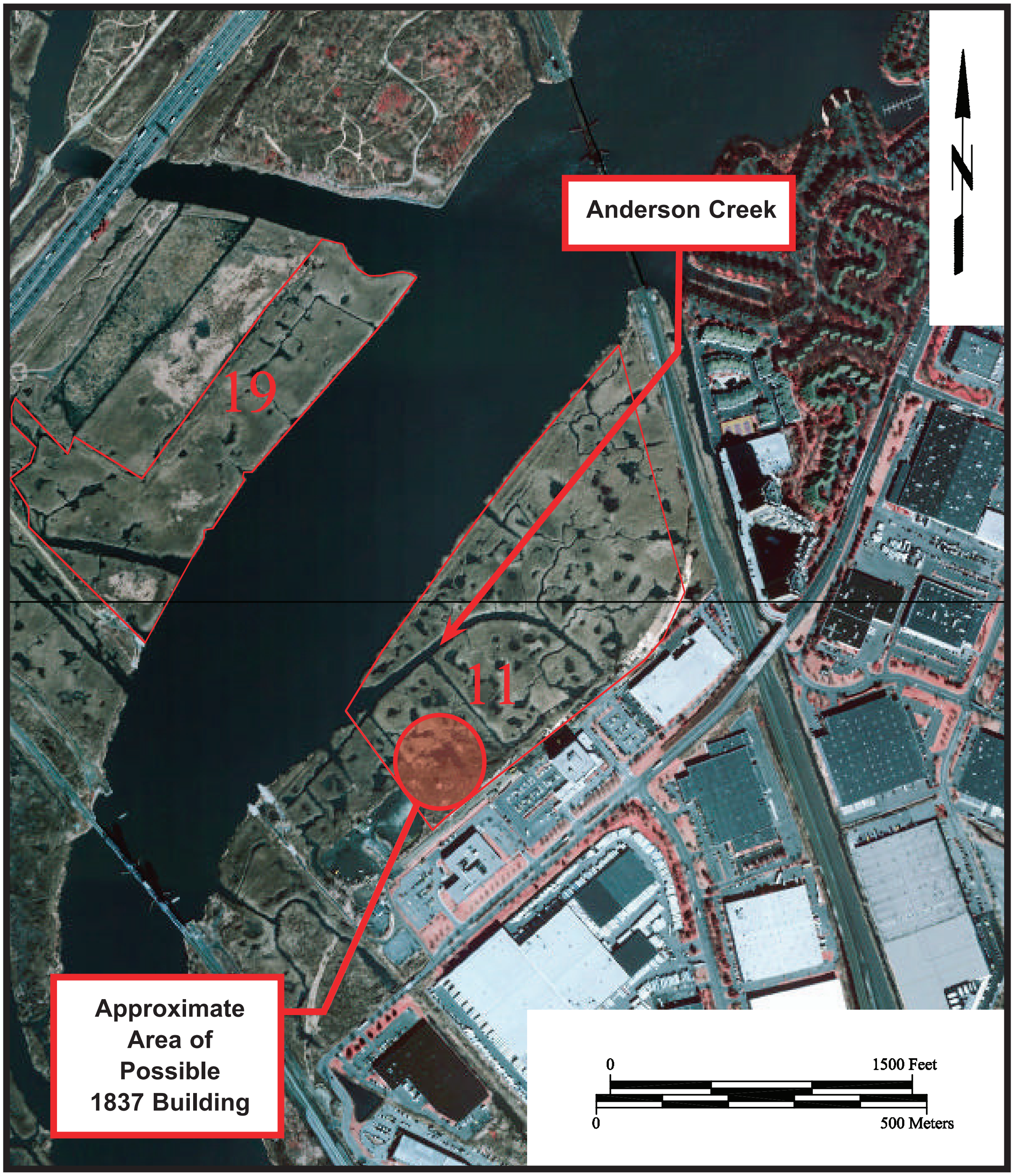

Figure 5.14. Annotated 2002 Aerial Photograph of the Anderson Creek Marsh Site. Source: New Jersey Department of Environmental Protection 2002.

Plate 5.12. Aerial Photograph of the Anderson Creek Marsh #11 site. 1931. Source: New Jersey Meadowlands Commission. Anderson Creek Marsh site outlined.

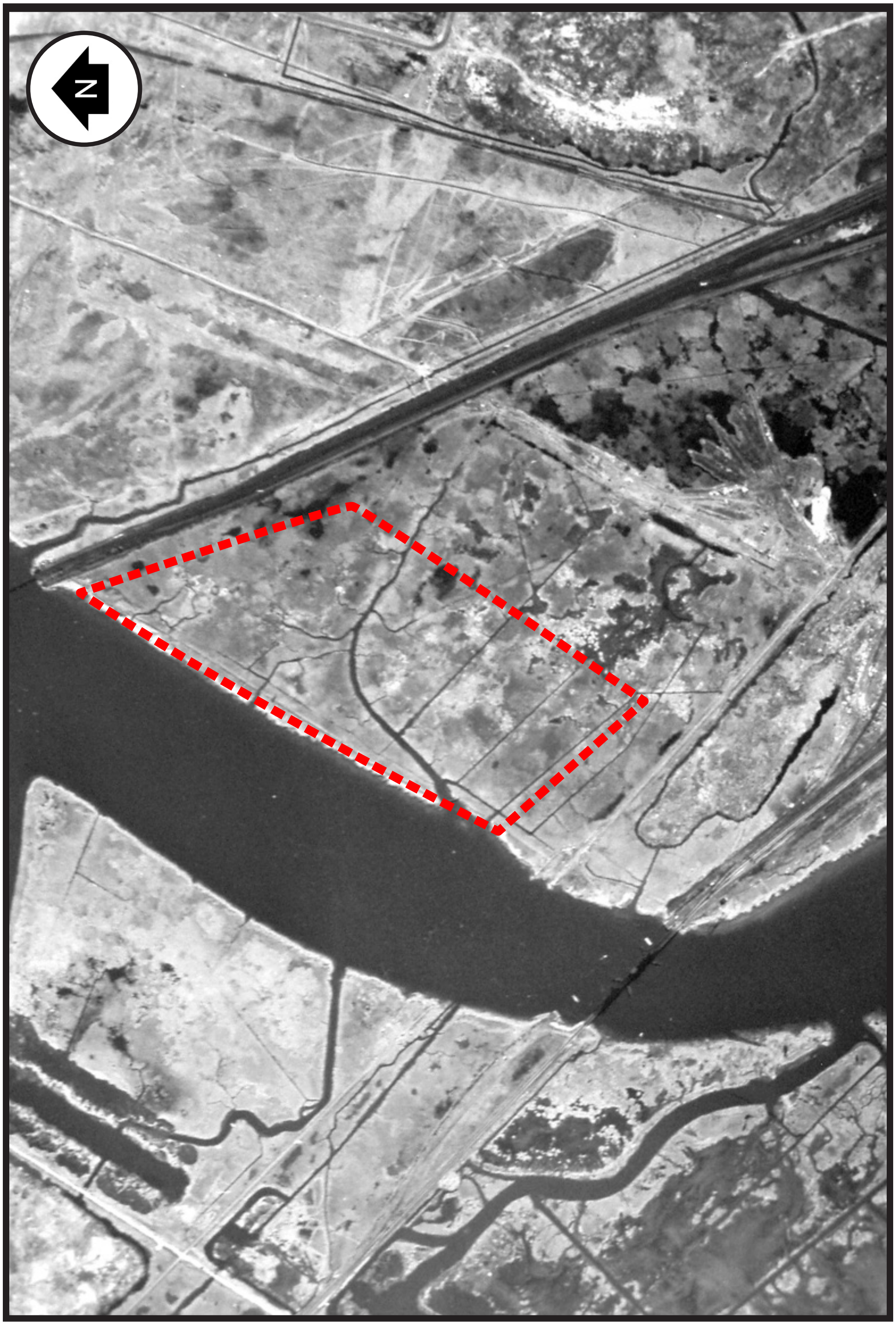

Plate 5.13. Aerial Photograph of the Anderson Creek Marsh site. 1968. Source: New Jersey Meadowlands Commission. Anderson Creek Marsh site outlined.

Plate 5.14. The Anderson Creek Marsh site: the Anderson Creek tide gate. Note dominance of phragmites. Source: New Jersey Meadowlands Commission.

The 1931 aerial photograph appears to show that the lower parts of the Anderson Creek Tract had been channelized (Plate 5.12). The sequence of ownership for the property during the early 20th century was complex and by 1936, James W. Adams had acquired a portion of the property from the Secaucus tax collector. Adams purchased various tracts, none of which were described in detail in the county mortgage books in which the transactions are recorded. James W. Adams and his wife Iva sold 12 parcels to the Curtiss-Wright Corporation who subsequently conveyed the modern study area to the Metropolitan Airport (Hudson County Deeds 2019/480 and 2144/340).

In 1950, the Chancery Court made writ of execution concerning a debt (Curtiss-Wright Corporation vs. Metropolitan Airport). The defendant in this case was a dissolved corporation. The property was sold to the Curtiss-Wright Corporation in May of that year who sold it to Racine Associates seven months later (Hudson County Deeds 4210/359 and 2439/407). The 1968 aerial photograph (Plate 5.13) depicts a series of ditches at this location running in a southeasterly direction. These correspond to the property lines on the 1909 map (Figure 5.13). The modern study area was later deeded to Hartz Mountain Industries and subsequently conveyed to the Hackensack Meadowlands Development Commission (Hudson County Deed 3062/1).

2. Site Description

The Anderson Creek Marsh site consists of 52 acres and is bounded on the northwest by the Hackensack River, on the northeast by the Conrail line, on the southwest by wetlands. The site is undeveloped and is dominated by common reed (*Phragmites australis*). The site exhibits a few freshwater ponds, natural winding and linear man-made ditches.

3. Evaluation of Cultural Resource Potential

a. Surface and Shallow Sediments

Based on an examination of the site during a survey by boat, the site has little to no potential to yield prehistoric or historic cultural resources within the phragmites root mass. The close proximity of the site to the fast ground of Secaucus "Island" immediately to the east means that the site was fairly easily accessible by land both in late prehistoric and historic times. Evidence for European-introduced cultigens can be anticipated here, and there is a possibility that a building was present here in 1837.

b. Deep Sediments

Peats may extend to about 20 feet at this location. The close proximity of the glacial deposits of Secaucus "Island" may have introduced other materials into the profile. These may provide a range of paleoenvironmental information. It seems likely that pre-peat deposits may also be present here. Anderson Creek is a small drainage running across the site from Secaucus, giving the property a confluence location.

G. KEARNY FRESHWATER MARSH - AREA 16 (FIGURES 5.15-5.16; PLATES 5.19-5.24)

1. Site-Specific Background Research and History

The ownership sequence of Kearny Freshwater Marsh and the Kearny Brackish Marsh (Section H of this chapter) are closely similar. Ownership was traced to the Swartwout brothers who owned the parcel during the first quarter of the 19th century. In 1821, Robert and Margaret Swartwout, Samuel and Alice Swartwout and John and Mary Swartwout provided John G. Coster with a $35,000 mortgage for a 969-

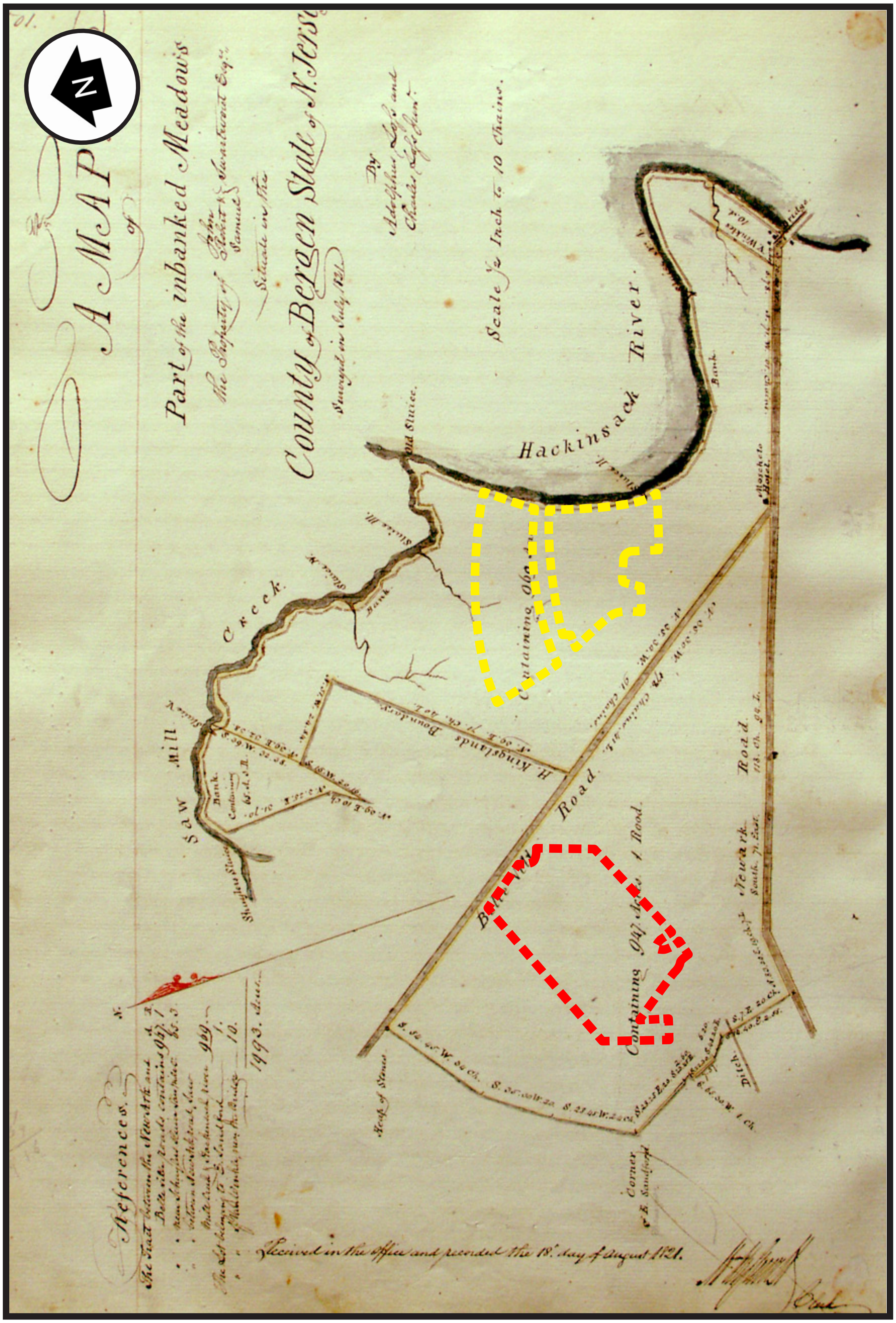

Figure 5.15. A Map of Part of the Inbanked Meadows, the Property of John, Robert and Samuel Swartwout Esq.'s Situate in the County of Bergen, State of New Jersey. 1821. Scale: 1 inch= 2835 feet (approximately). Kearny Freshwater Marsh site (red) and Kearny Brackish Marsh site (yellow) outlined.

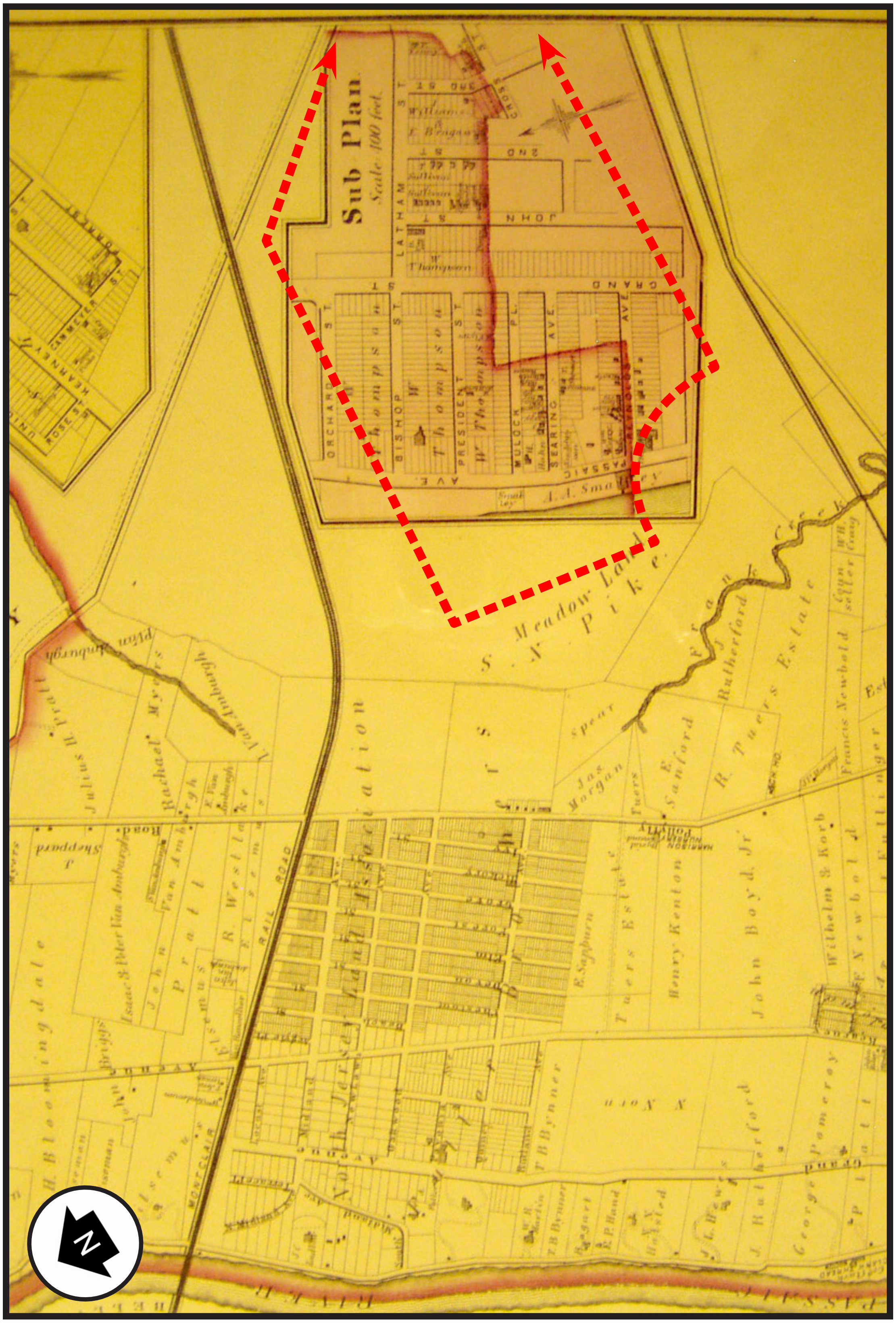

Figure 5.16. Hopkins, G.M. Map of Kearny Township in *Atlas of Hudson County, New Jersey*. 1873. Scale: 1 inch= 1620 feet (approximately). Kearny Freshwater Marsh site outlined.

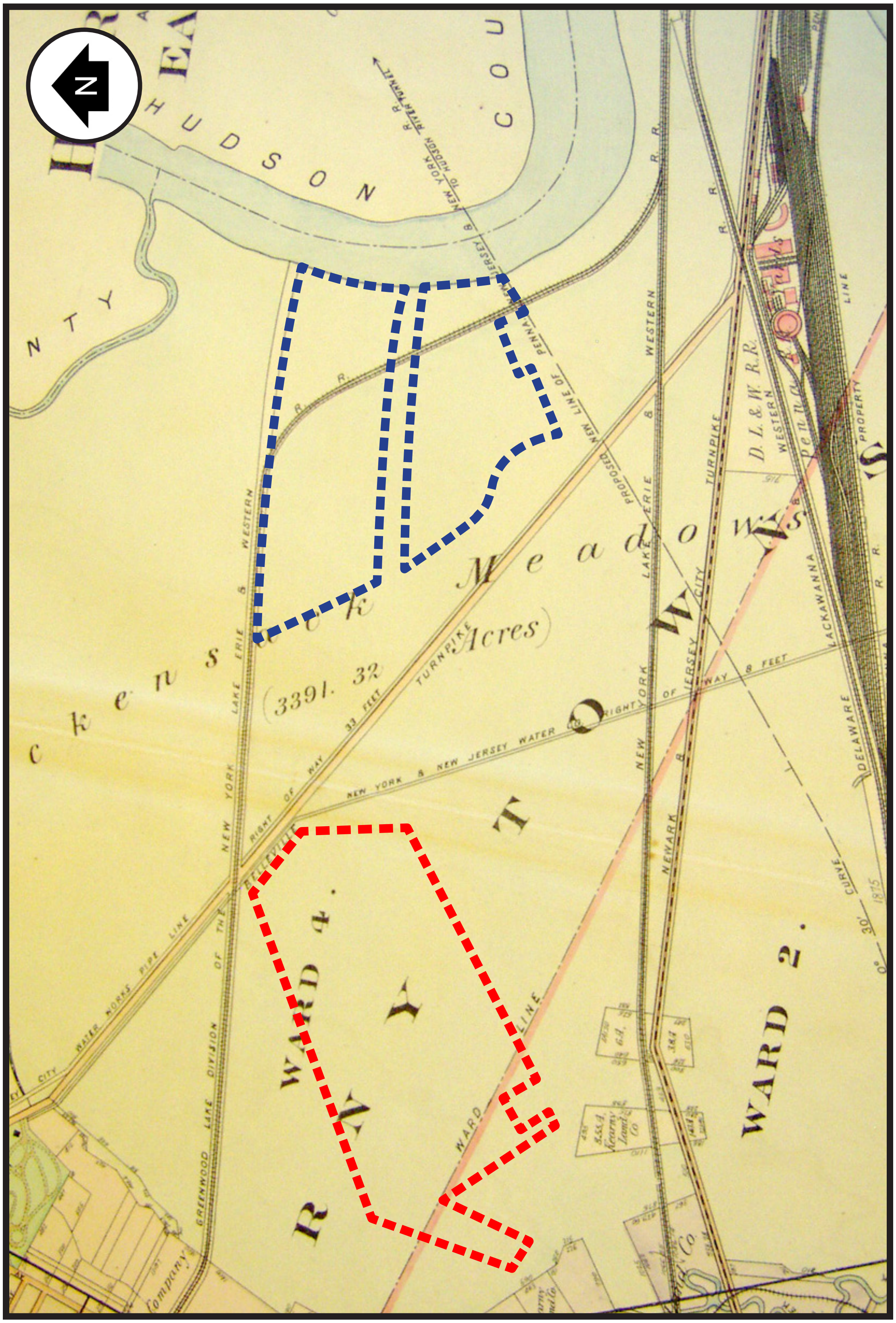

Figure 5.17. Miller, D.L. Map of Kearny in *Atlas of the Towns of Harrison and Kearny and the Borough of East Newark.* 1903. Scale: 1 inch= 1590 feet (approximately). Kearny Freshwater Marsh site (red) and Kearny Brackish Marsh site (blue) outlined.

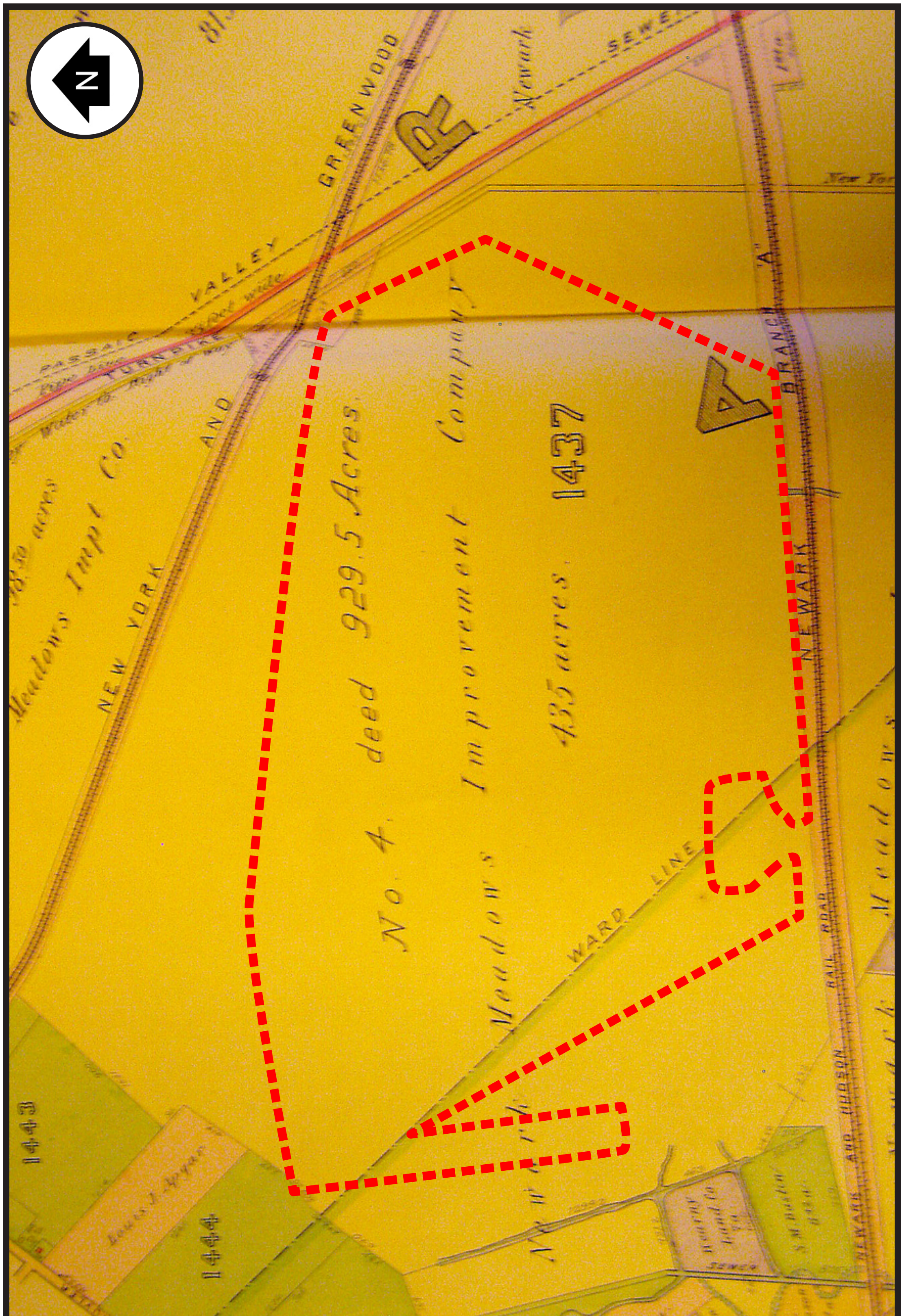

Figure 5.18. Hopkins, G.M. Map of Kearny in *Atlas of Hudson County, New Jersey*. 1909. Scale :1 inch= 990 feet (approximately). Kearny Freshwater Marsh site outlined.

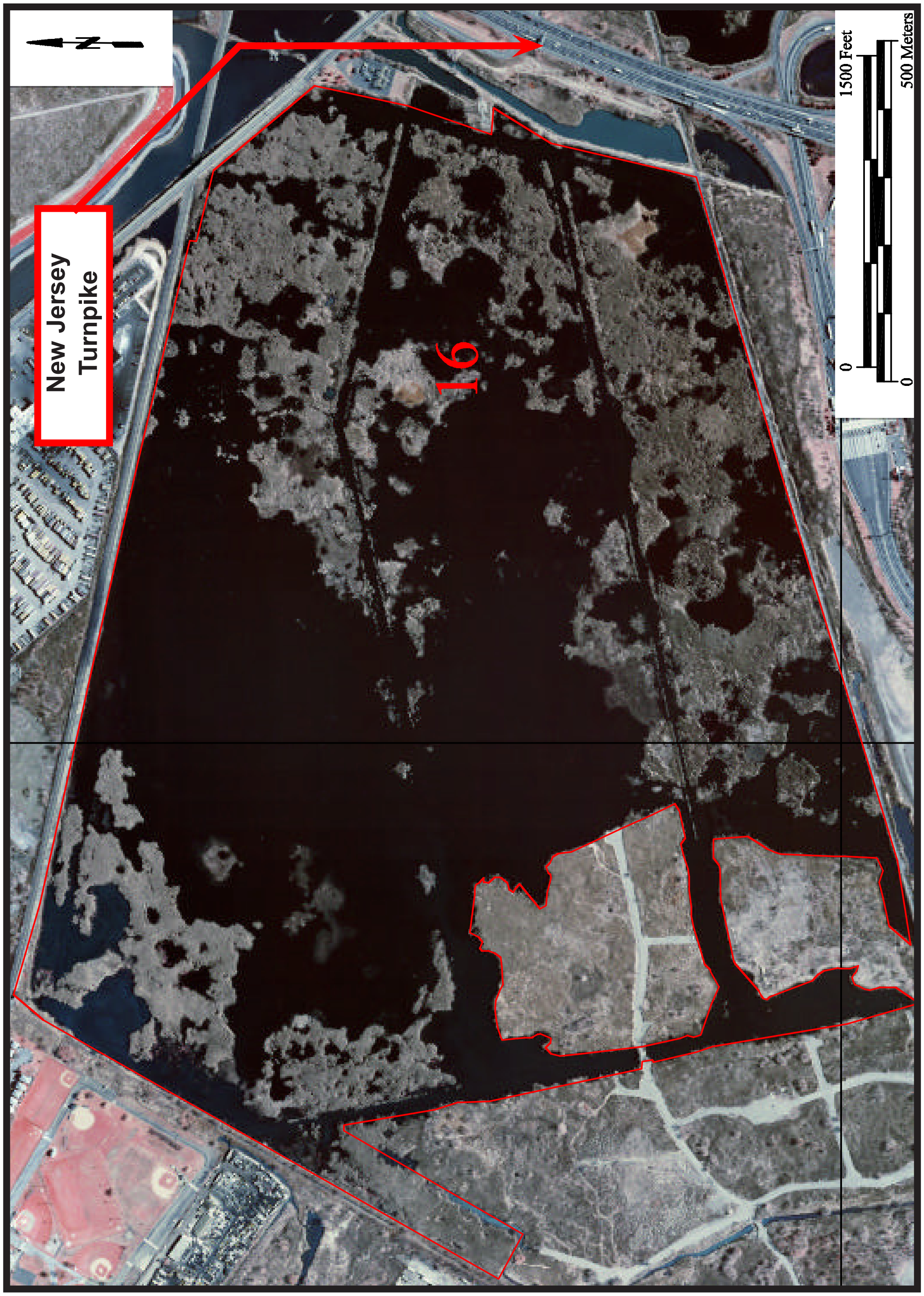

Figure 5.19. Annotated 2002 Aerial Photograph of the Kearny Freshwater Marsh. Source: New Jersey Department of Environmental Protection 2002.

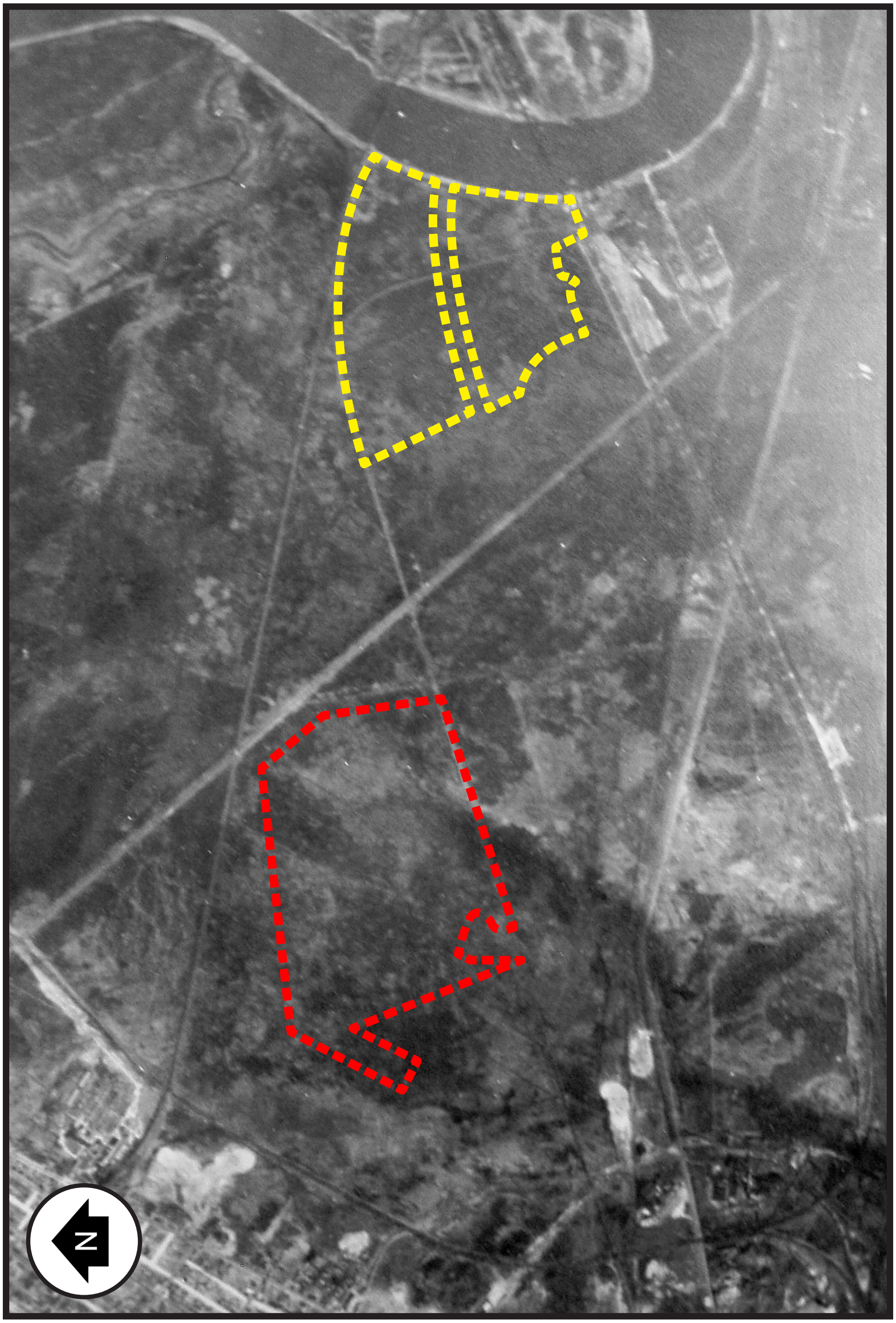

Plate 5.15. Aerial Photograph of the Kearny Freshwater #15 and Kearny Brackish Marsh #16. 1931. Source: New Jersey Meadowlands Commission. Kearny Freshwater Marsh site (red) and Kearny Brackish Marsh site (yellow) outlined.

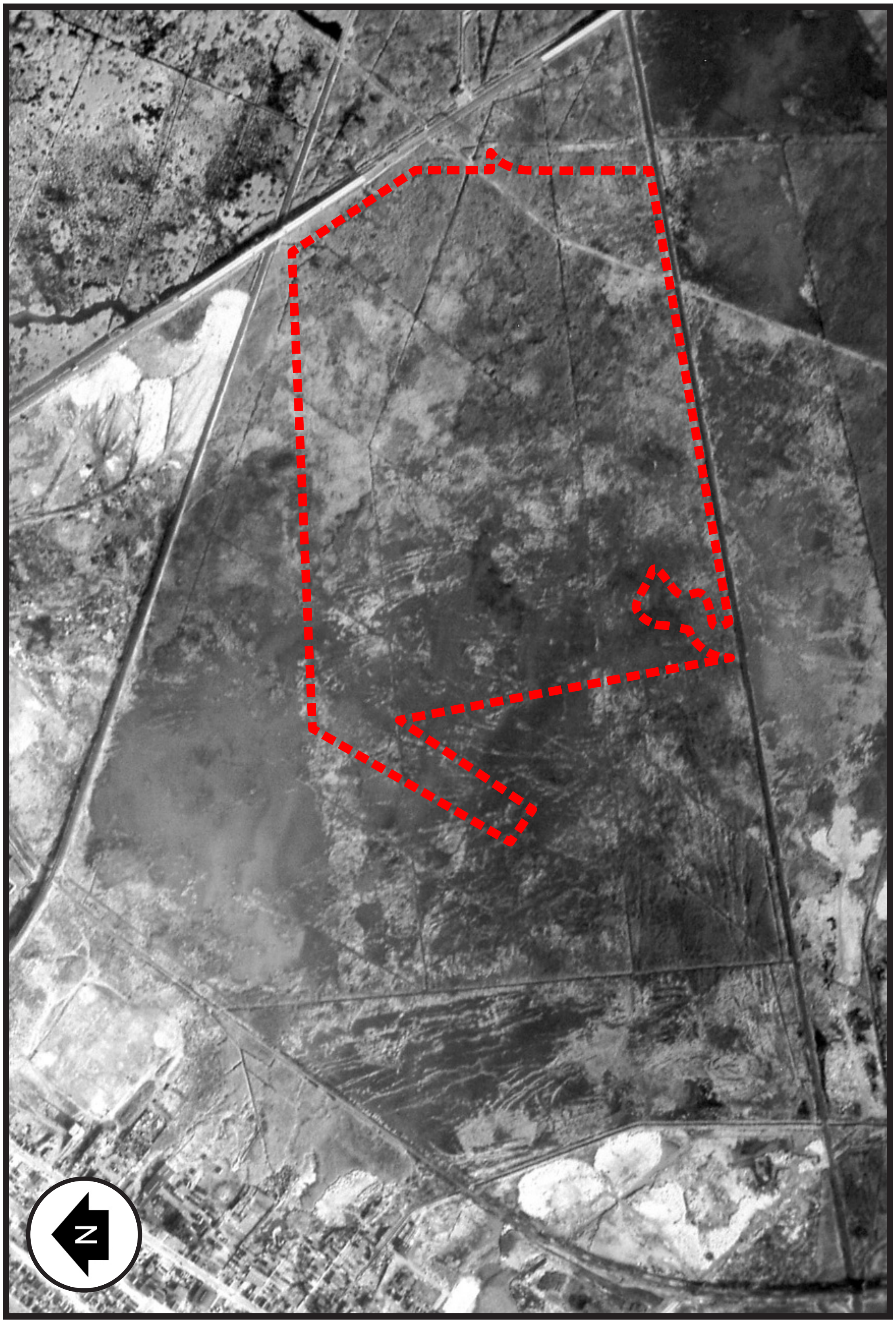

Plate 5.16. Aerial Photograph of the Kearny Freshwater Marsh. 1953. Source: New Jersey Meadowlands Commission. Site outlined.

acre tract and a 947-acre tract of meadow (Bergen County Mortgage E/500). The mortgage record included a map (Figure 5.15), which delineated the location and bounds of each "inbanked" tract. The Kearny Freshwater Marsh would have been contained within the 947-acre parcel bounded northerly by the Belleville Turnpike, southerly by the Newark Road and westerly by Ebenezer Sandford's lands. The 969-acre tract contained the present location of the Kearny Brackish Marsh and was bounded easterly by the Hackensack River, southeastwardly by the Newark Road, on the southwest by the 947-acre tract, west by H. Kingsland's property and northerly by the Sawmill Creek.

A collection of Robert Swartwout's papers is held at the New York Public Library. The manuscripts, which cover a period from the early to mid-19th century, provide insights into Swartwout's reclamation endeavors in the meadowlands. In 1813 and 1814, the Swartwouts purchased the Newark Meadows and proceeded to improve them in 1815. Although the plan seemed futile to some, the Swartwouts were tenacious and enclosed approximately 3,000 acres by creating an 11-mile long embankment, 16-feet wide and five feet high. Furthermore, the Swartwouts cut roughly 70 miles of ditch through the landholdings (P. Townsend *et al*. to New York and Bergen Dairy Company, April 23, 1833).

In 1813, John and Robert Swartwout formed a partnership and proceeded to purchase other tracts of meadow and salt marsh in Bergen County. They would attempt to ditch and drain the properties in order to convert them into fertile meadows (John and Robert Swartwout to Isaac H. Williamson, October 1821). The brothers observed that they purchased two undivided third parts of marsh from Samuel Swartwout in 1815, their brother and the Collector for the Port of New York (and an alleged embezzler).

In 1820, John, Robert, Samuel Swartwout and their wives conveyed (or intended to convey) approximately 3,016 acres of meadow to the New Jersey Salt Marsh Company. This venture was unsuccessful and the Swartwouts repurchased the marshes the following year. They then sought to drain the meadows, an endeavor that cost approximately $70,000 (John and Robert Swartwout to Isaac H. Williamson, October 1821). The New Jersey Salt Marsh Company was reorganized as the Hoboken Banking & Grazing Company, a partnership between Robert Swartwout and John G. Coster. In 1830, 1900 acres of the property were seized and sold to Coster as a result of foreclosure.

The Swartouts' undertaking was initially successful and large amounts of hay were cultivated and shipped to the New York markets. They also believed that the quality of the soil would enable the production of huge quantities of cheap vegetables for the growing metropolitan area (P. Townsend *et al*. to New York and Bergen Dairy Company, April 23, 1833). The Swartwouts were also certain that the meadows would economically fatten cattle and increase the value of the surrounding lands. By 1829, Robert Swartwout was involved with the Hoboken Banking & Grazing Company who operated on a 2,000-acre tract "near the Hackensack and Passaic Rivers". Swartwout explained that the property had been embanked for 13 years and approximately half of it was ditched thoroughly. In his letters, Swartwout clearly delineates the reclamation process, the planting of the grass seed and bringing young cattle to the pastures (Remarks Upon the Landed Estate…January 21, 1829).

Four years later, Swartwout provides similar information regarding the estate of the New York and Bergen Dairy Company. Swartwout offered to sell a 969-acre estate (this tract would have encompassed the Kearny Brackish Marsh) to the dairy company (Remarks Upon the Landed Estate…June 1833). The meadow was ditched, embanked, drained and sluiced (P. Townsend *et al*. to New York and Bergen Dairy Company, April 23, 1833).

The venture proved to be extremely challenging. In 1835, Robert Swartwout informed the Council and General Assembly of the State of New Jersey that although he had expended considerable funds in order to reclaim the meadows, he never attained the profitability he sought. The lands were regularly flooded by the tide and Swartwout therefore proposed an idea of a dam that would prohibit the overflow of salt water. His proposal was countered by Judge Benjamin Wright who was concerned with the extent to which the meadows could be drained, the viability of the undertaking and the amount of money necessary to fund such a project (Petition of Robert Swartwout, 1835).

In 1837, Robert informed his brother Samuel that he intended to dam off the Hackensack River in the vicinity of the Hackensack Bridge. Samuel expressed much hostility to the scheme and deemed that his brother lacked the ability to handle his own affairs. Robert retorted that his embarrassments were caused by the inflexibility of his brother John and the "folly" of his other brother Samuel. Robert Swartwout then informed his brother not to "cross my path in this great object of my life" (R. Swartwout to S. Swartwout, December 8, 1837). Robert Swartwout became bankrupt in 1844 and died four years later.

Robert Swartwout sold the mortgaged estate to Anthony Dey *circa* 1825 (Bergen County Deed V2/371 was largely illegible). It appears that this indenture conveyed the 947-acres of meadow. Among the Swartwout papers at the New York Public Library, an undated and incomplete letter reads: "saw Anthony Dey who informed me that he was engaged in purchasing up my bond and mortgage to the government for the purpose of extricating me from embarrassment" (Robert Swartwout Papers, New York Public Library). Unfortunately, Swartwout does not provide further information regarding this arrangement.

Anthony Dey, born just a couple of years after the onset of the American Revolution, was a descendant of Derrick Dey who arrived in New York City from Holland in 1640. Anthony Dey became a prominent lawyer and acquired large parcels of meadow located between the Passaic and Hackensack Rivers. Dey additionally served as director of the New Jersey Railroad (Winfield 1874:286-287).

Shortly after Anthony Dey acquired the property, he deeded the 947-acre meadow in what was then New Barbadoes Township to John G. Coster, a merchant from New York (Bergen County Deed W2/18). John G. Coster, one of New York City's wealthiest, founded the firm of Coster Brothers & Company with his brother Henry A. Coster in the late 18th century. The brothers, who were born in Holland, established their business after they arrived in New York City. John G. Coster had initially studied to become a physician. The firm, which traded in their own vessels, imported and sold Dutch goods, particularly oil cloths and a special tape made of flax (krollenvogel) (Barrett 1863).

John G. Coster also purchased the 969-acre tract the same year at a public sale for $1,000 (Bergen County Deed W2/19). Coster consolidated the tracts and the two modern study areas follow one sequence of ownership after he acquired these meadows. John G. Coster died in 1846 and the property was retained by his executor, George W. Coster, until 1867. Spencer B. Driggs purchased consolidated parcels of meadow for $100,000 from John G. Coster's executor in 1867 (Hudson County Deed 154/255).

Spencer B. Driggs was an engineer who partnered with Samuel N. Pike, (a distiller, real estate speculator and the builder of the opera houses in New York and

Cincinatti), in a renewed effort to reclaim meadowlands *via* the implementation of tidal gates, dikes and water pumps. Driggs held a patent for some of these devices. Driggs and Pike introduced a construction method for earthen dikes that constricted them around great overlapping iron plates designed to thwart muskrats from digging through the dikes. The two men formed the Iron Dike Land Reclamation Company and anticipated the draining of 6,000 acres of marsh at Kearny. As described in *Leslie's Illustrated Magazine* and retold by Cunningham (February 22, 1959), Driggs covertly purchased approximately 5,000 acres of marsh.

The same year that he purchased the property, Driggs deeded the meadows (all but 600 acres), containing approximately 2,200 acres, to Pike (Hudson County Deed 154/262). The sale was subject to a mortgage of $75,000 made by Driggs to John G. Coster's executor several months prior. The Hopkins map of 1873 (Figure 5.16) largely obscures the parcel by superimposing a detailed street plan of another area atop the undeveloped area. The map does, however, indicate that the meadows were held by "S.N. Pike."

Spencer Driggs proceeded to construct approximately $300,000 worth of iron levees and a series of ditches. Exclusion of tidal water enabled corn to be grown on a meadow near the Passaic River. Although the corn grew to a height of 10 feet, the plants did not produce a single ear of corn.

In 1868, the *Bergen County Democrat* reported that the reclamation efforts in the meadows were progressing: "a dyke miles in length having been constructed along the banks of the Hackensack as far up as opposite Snake Hill and around through creeks and inlets." Additionally the company constructed a ditch measuring four or five feet in width. At the time, the newspaper noted the reclamation company's use of iron plates and concluded that the significant endeavor would be "completely successful" (*Bergen County Democrat* June 12, 1868).

According to the *Scientific American*, drainage of meadows was not a novel idea. The meadows, "are not only unproductive of anything which can subserve any important purpose, but they are productive of numerous evils." The article points to mosquito infestation, the meadows being home to "mischievous and annoying insects" and recorded that Driggs' iron dikes provided an effective solution to the common problems of the marshes (*Scientific American* 1868).

Despite these promising accounts, the scheme was never economically viable. The removal of water from the meadows caused shrinkage and sinking of the peat, exposure of the embankments and rendered the sluices and drains inoperable. The partnership's plans to drain the meadows were permanently halted with the death of Samuel N. Pike in 1872.

After Samuel N. Pike's death the property passed to Pike's widow, Ellen. However, in 1876, George W. Kidd and others, the executors and trustees of Samuel N. Pike's will and his business partners sued Ellen Pike and other Pike family members. To explain the matter without delving into intricacy, after Pike's death, trusteeship over Pike's estate descended to Samuel N. Pike's oldest son, Lawrence (title to lands that Samuel N. Pike held in trust for the partnership). Pike's widow retained right of dower. Samuel N. Pike had retained certain meadows in trust of his business enterprise, land that were to "be drained, reclaimed and improved and then sold and converted into money" with the monetary gains to be divided amongst the partners. George W. Kidd, Samuel Craighead and others asserted their legal right to meadows in order to settle their affairs (Hudson County Deed 298/327).

The court ruled that Lawrence Pike would sell the residue of the undisposed meadows to his father's business partners and that the associates would receive the right to receive compensation. Ellen M. Pike was required to release her right of dower to the meadows. In 1867, she quitclaimed numerous tracts of meadow to Samuel Craighead, Joseph Tilney and George W. Kidd (Hudson County Deed 298/327). Some of the embankments were later rehabilitated and reconstructed by the Bergen County Mosquito Commission (Cunningham February 22, 1959).

John R. Ferrier acquired the meadows in 1901 (Hudson County Deed 795/180). Ferrier deeded 11 tracts of meadow to Henry L. Sprague the same year, and he subsequently sold the parcels to the Hackensack Meadows Company (Hudson County Deeds 795/205 and 798/212). The 1903 Miller *Atlas of the Towns of Harrison and Kearny and the Borough of East Newark* indicates that the area (3391.32 acres) was owned by the Newark Meadows Company (Figure 5.17). The meadows were located near the Greenwood Lake branch of the Erie Railroad, the Belleville Turnpike and a right of way of the New York & New Jersey Water Company. In 1908, The Standard Trust Company of New York initiated litigation against The Hackensack Meadows Company, the Knickerbocker Trust Company, The New Jersey Terminal Dock and Improvement Company and others regarding certain mortgaged premises. The properties were subsequently sold by one of the Masters in Chancery Court to Niel A. Weathers and Phillips A. Moore for $500,000 (Hudson County Deed 1014/1).

In 1908, Niel A. Weathers and Phillips A. Moore conveyed 10 tracts to the Newark Meadows Improvement Company for $1,000 (Hudson County Deed 1003/601). The Hopkins atlas of 1909 (Figure 5.18) indicates that the property encompassing the site of the Kearny Freshwater Marsh, labeled "No. 4…929.5 acres," may have been reduced down to 435 acres and was owned by the Newark Meadows Improvement Company. The modern site of the Kearny Brackish Marsh was contained within various tracts held by the same firm. By 1914, the mortgaged properties were once again the subject of a legal dispute and were sold at auction to Harry M. Durning for one million dollars (Hudson County Deed 1189/368). The 11 parcels included a 929-acre tract situated between the Belleville Turnpike and the Newark Turnpike containing the modern study area. Durning deeded the 11 tracts to a firm called Newark Factory Sites (Hudson County Deed 1200/300; Kestenbaum 2005). The extensive tract can be observed on aerial photographs of 1931 and 1953 (Plates 5.15 and 5.16). A series of ditches can be seen on the latter view traversing the study area. The date of these features is uncertain and they could be from the Swartwout or the Griggs/Pike reclamation episodes.

By 1960, the parcel containing the modern study area had been acquired by the Town of Kearny with the exception of a right of way maintained by the New Jersey Turnpike Authority. The Hackensack Meadowlands Commission purchased this tract and several others from Hartz Mountain Industries in 1999 (Hudson County Deed 5531/4).

2. Site Description

The Kearny Freshwater Marsh site consists of 327 acres and is bounded on the north by the Conrail line, on the northeast by the Belleville Turnpike, on the south by the Conrail line, on the east by the New Jersey Turnpike, on the northwest by athletic fields and the southwest by Keegan Landfill. This site is freshwater impoundment with islands dominated by common reed (*Phragmites australis*). A small dirt access road is located in the southwestern portion of the site. The eastern extent of the road has been terminated by rising water levels within the marsh.

3. Evaluation of Cultural Resource Potential

a. Surface and Shallow Sediments

The greater part of the site is a freshwater impoundment. It holds virtually no potential for archaeological resources in the upper levels.

b. Deep Sediments

Peats are predicted to extend to 15 feet here, becoming shallower towards the higher ground to the west. In tests to the north, Schuldenrein (1996) encountered sedges in the lowest levels of the peat, with no indications of a preceding wooded phase. No pre-peat deposits were observed above the varved clay. He suggested that shallow peats close to the uplands could cover later prehistoric sites. The vicinity of the site was mapped as a cedar swamp in 1781 (Figure 4.1).

H. KEARNY BRACKISH MARSH - AREA 15 (FIGURES 5.17, 5.19-5.21; PLATES 5.15, 5.17, 5.18)

1. Site-Specific Background Research and History

For property ownership of this marsh during the 19th century, refer to the preceding section (the Kearny Freshwater Marsh). In 1876, this tract was crossed by the Erie Railroad, the embankment of which still remains (Figure 5.21). The Kearny Brackish Marsh was subdivided in the early 20th century. In 1908, when Niel A. Weathers and Phillips A. Moore conveyed 10 tracts to the Newark Meadows Improvement Company for $1,000, the modern site of the Kearny Brackish Marsh encompassed various smaller tracts (Hudson County Deed 1003/601). The Hopkins atlas of 1909 (Figure 5.20) confirms that the tracts were held by the Newark Meadows Improvement Company. The firm Newark Factory Sites later acquired the various parcels (Hudson County Deed 1200/300). The extensive tract can be observed on an aerial photograph of 1931 (Plate 5.15) and on a later aerial photograph of 1953 (Plate 5.17). A series of ditches can be seen on the latter view traversing the study area.

By 1960, the parcel containing the modern study area had been acquired by the Town of Kearny with the exception of a right of way maintained by the New Jersey Turnpike Authority. The Hackensack Meadowlands Commission purchased this tract and several others from Hartz Mountain Industries in 1999 (Hudson County Deed 5531/4).

2. Site Description

The Kearny Brackish Marsh site consists of 116 acres and is bounded on the north by the Conrail line, on the southeast by the Conrail-Amtrak line, on the east by the Hackensack River, and on the southwest by open water. The site is divided north/south into two sections by the New Jersey Turnpike. There is an earthen causeway carrying the former Erie Railroad running northwest-southeast across the site. The Cayuga Dike runs along the Hackensack bank and is topped by an asphalt road (Plate 5.18). Access to the road has been terminated by Conrail since the September 11, 2001 terrorist attacks in New York. Vegetation at this location only exists in the form of common reed (*Phragmites australis*) present along the causeways.

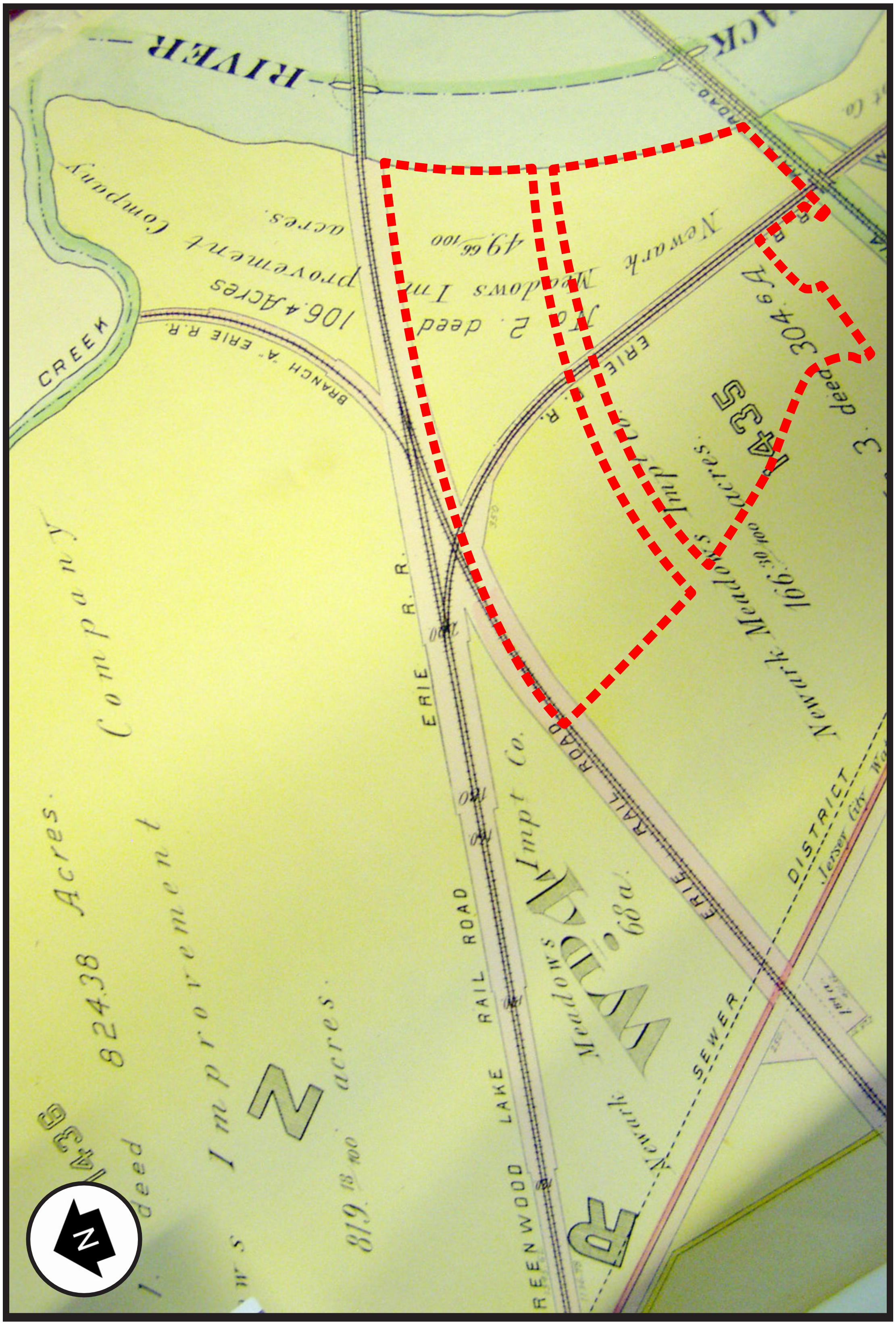

Figure 5.20. Hopkins, G.M. Map of Kearny in *Atlas of Hudson County, New Jersey*. 1909. Scale: 1 inch= 1030 feet (approximately). Kearny Brackish Marsh site outlined.

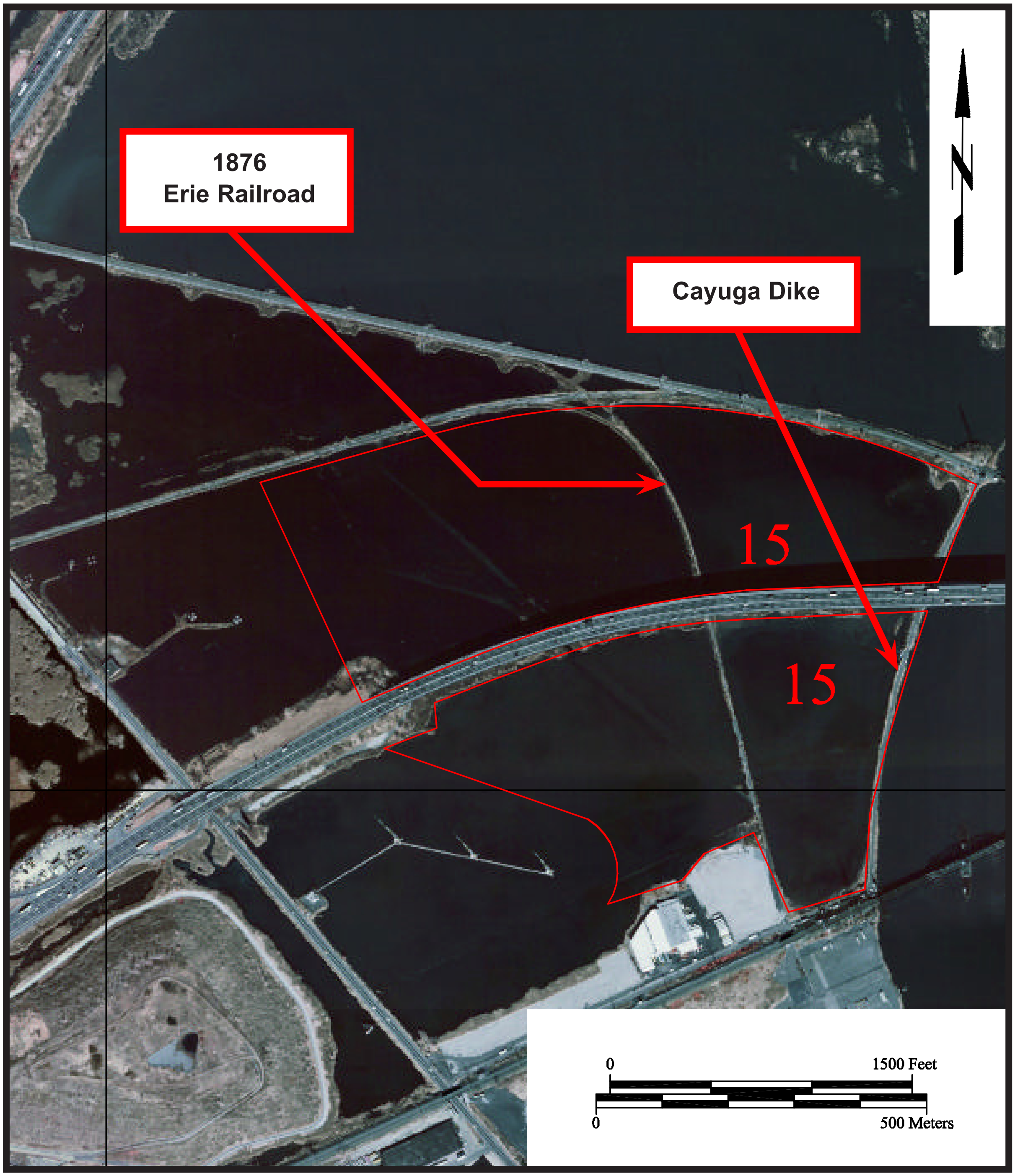

Figure 5.21. Annotated 2002 Aerial Photograph of the Kearny Brackish Marsh. Source: New Jersey Department of Environmental Protection 2002.

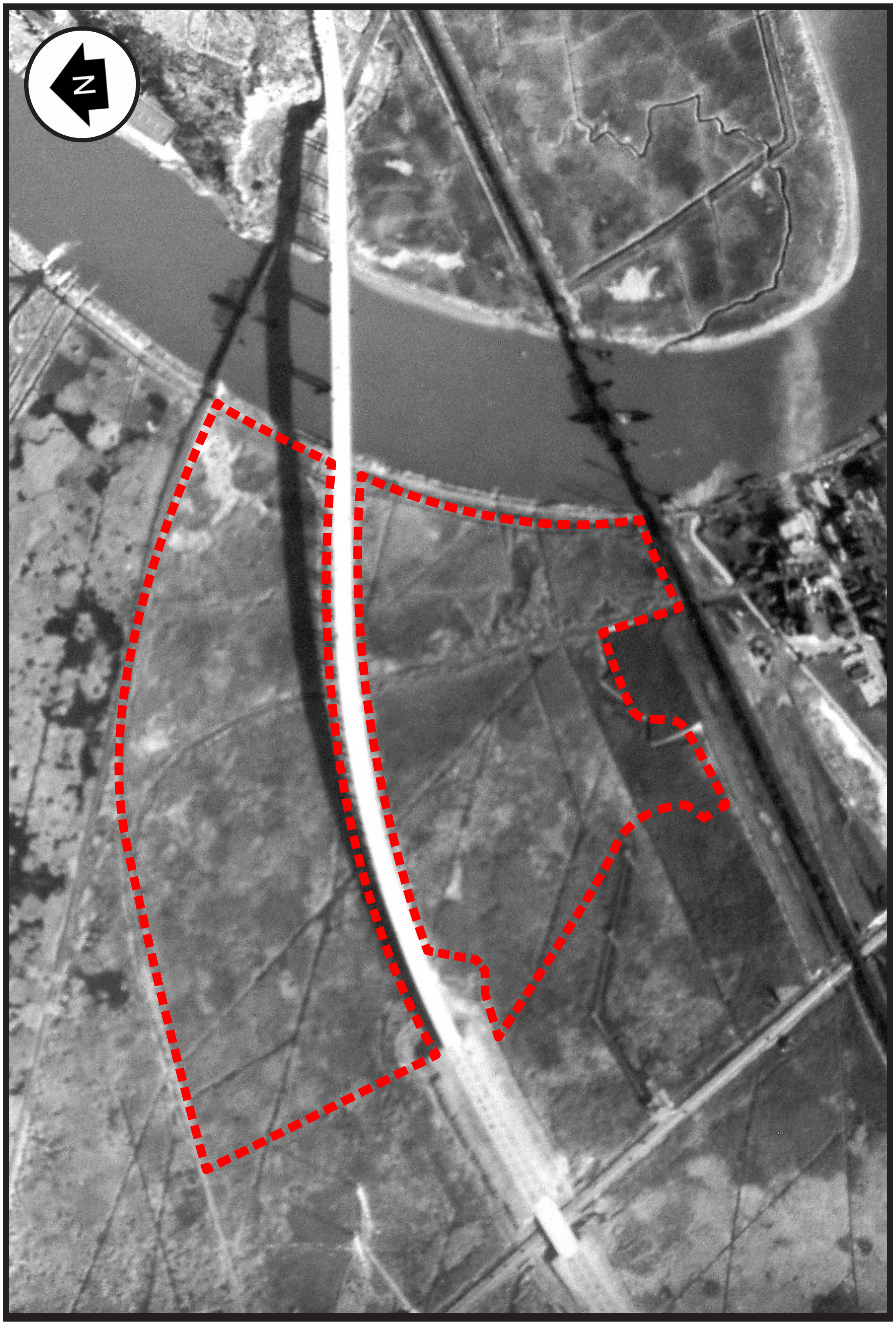

Plate 5.17. Aerial Photograph of the Kearny Brackish Marsh. 1953. Source: New Jersey Meadowlands Commission. Site outlined.

Plate 5.18. The Kearny Brackish Marsh site #15: View of the Cayuga Dike topped by an asphalt road looking west (Photographer: Ian Burrow, August 2005)[HRI Neg. #05025/D11-09].

3. Evaluation of Cultural Resource Potential

a. Surface and Shallow Sediments

The greater part of the site is a brackish impoundment. It holds virtually no potential for archaeological resources in the upper levels.

b. Deep Sediments

Peats are expected to be in excess of 25 feet deep here, and to be similar in character to those at Kearny Brackish Marsh. No pre-peat/post varve deposits are predicted and there is no nearby confluence.

I. LAUREL HILL PARK WETLAND - AREA 17 (FIGURES 5.22-5.24; PLATES 5.19-5.20)

1. Site-Specific Background Research and History

The ownership of this property follows relatively the same early sequence detailed in Section J (Riverbend Wetland Preserve). In the late 18th century, the lands encompassed within the modern Laurel Hill Park Wetland were acquired by Samuel Swartwout who acquired numerous properties on both sides of the Hackensack River in the vicinity (see Section G above). Swartwout consequently sold a portion of these salt meadows to Abel I. Smith, Deborah Smith and Jane Smith (this indenture could not be located but was referenced in Hudson County Deed 8/576). The 130-acre property was bounded on the north by Snake Hill (discussed in further detail in Chapter IV Section E), east by Fish Creek and south and west by the Hackensack River.

During the 18th and early 19th centuries, a number of deeds concerning lands near Snake Hill were recorded amongst Smith family members. Tracing the precise ownership during this time period is complex, since several of the indentures merely note that the tract(s) were located in the vicinity of Snake Hill and do not provide clear descriptions. For instance, in 1754, Abel, Job and Daniel Smith, the sons of Abel Smith, conveyed land near Snake Hill that had been devised to them by their father to Abel Smith for 1,000 pounds. The deed does not specify the acreage of the property nor does it indicate if this land was situated south or east of Snake Hill (Bergen County Deed C/215). In 1799, Daniel Smith sold 80 acres "at Secaucus" to John and Daniel Smith. This tract likely contained the study area (Bergen County Deed O/68).

By 1803, a review of land records suggests that the site had passed to Daniel Smith, possibly Abel Smith's son. In 1803, after Daniel Smith died, his 137-acre estate was sold by his executors to Cornelia Smith for $1,078.87 (Bergen County Deed S/19). The matter subsequently becomes complex in 1813 when Cornelia Smith sold the estate back to Samuel Swartwout for $3,425 (Bergen County Deed I2/427). However, a subsequent land transfer of 1846 indicates that Cornelia Smith may have repurchased the property by that time. In 1846, Cornelia (Smith) Ackerman conveyed one-eighth part of several parcels to Abel I. Smith and Job Smith (Hudson County Deed 8/576). The sale included a 130-acre parcel that would have encompassed the study area.

After Job Smith died, a partition of the property was made. The study area south of the modern Conrail alignment (previously the Greenwood Lake branch of the Erie Railroad) was devised to the heirs of Abel Smith as shown on the Hopkins atlas of 1873 (Figure 5.22). By 1909, the 29.62-acre tract (parcel 7) north of the modern Amtrak right of way and south of the modern Conrail railroad was held by Abel I. Smith as depicted on the Hopkins atlas of 1909 (Figure

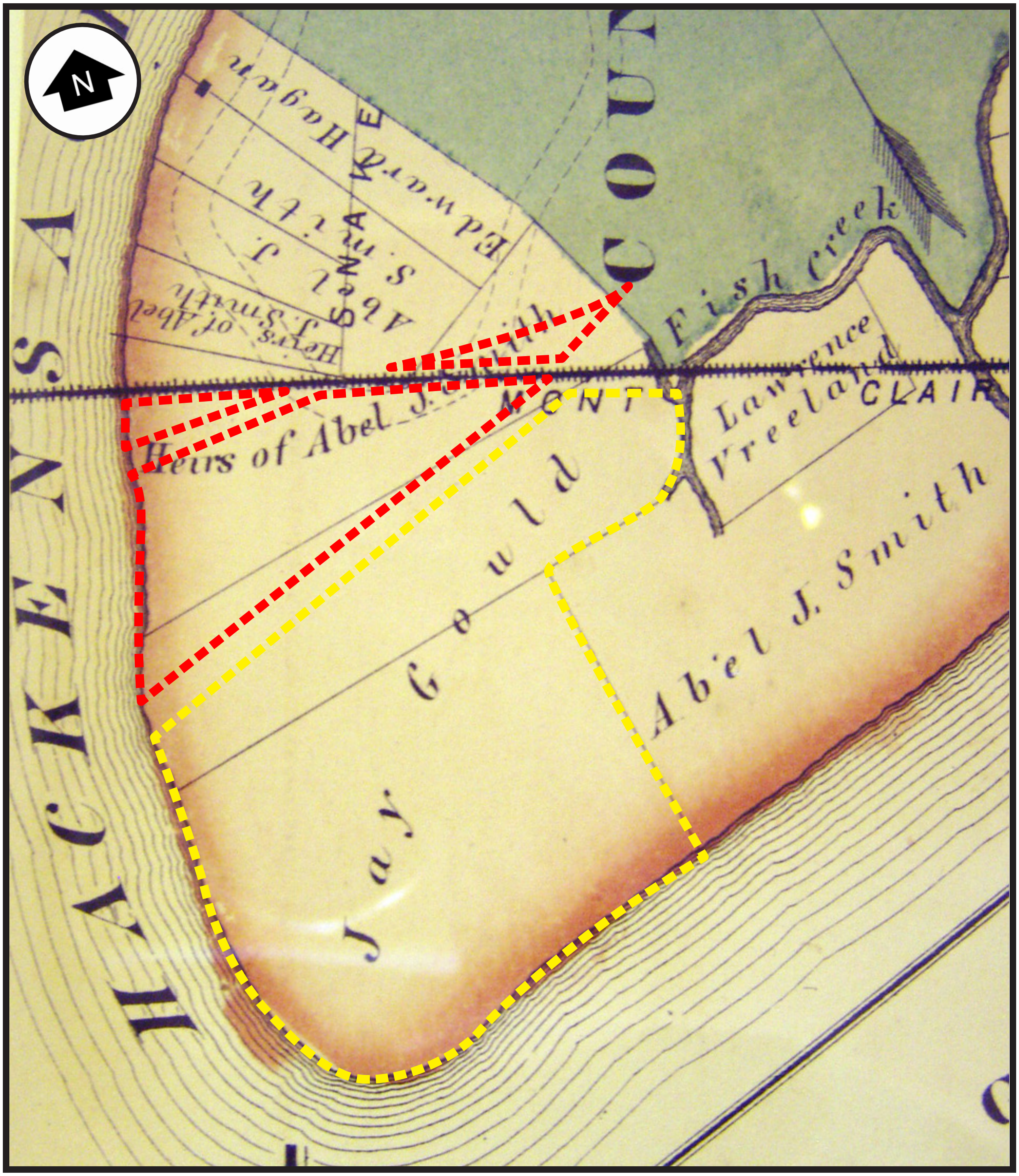

Figure 5.22. Hopkins, G.M. Map of Secaucus in *Atlas of Hudson County, New Jersey*. 1873. Scale: 1 inch= 555 feet (approximately). Laurel Hill Park Wetland (red) and Riverbend Wetland Preserve (yellow) outlined.

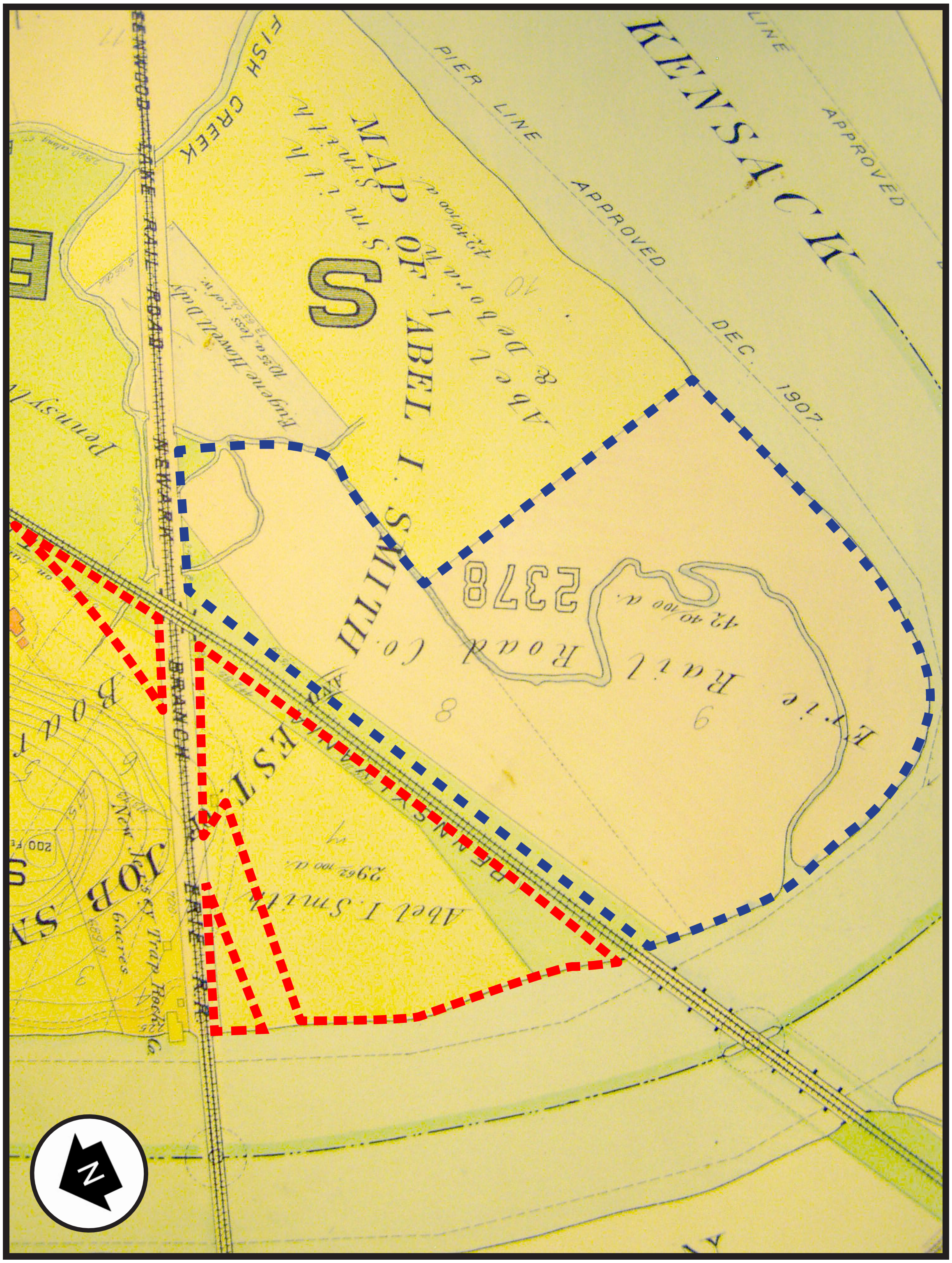

Figure 5.23. Hopkins, G.M. Map of Secaucus in *Atlas of Hudson County, New Jersey*. 1909. Scale: 1 inch= 565 feet (approximately). Laurel Hill Park Wetland site (red) and Riverbend Wetland Preserve (blue) outlined.

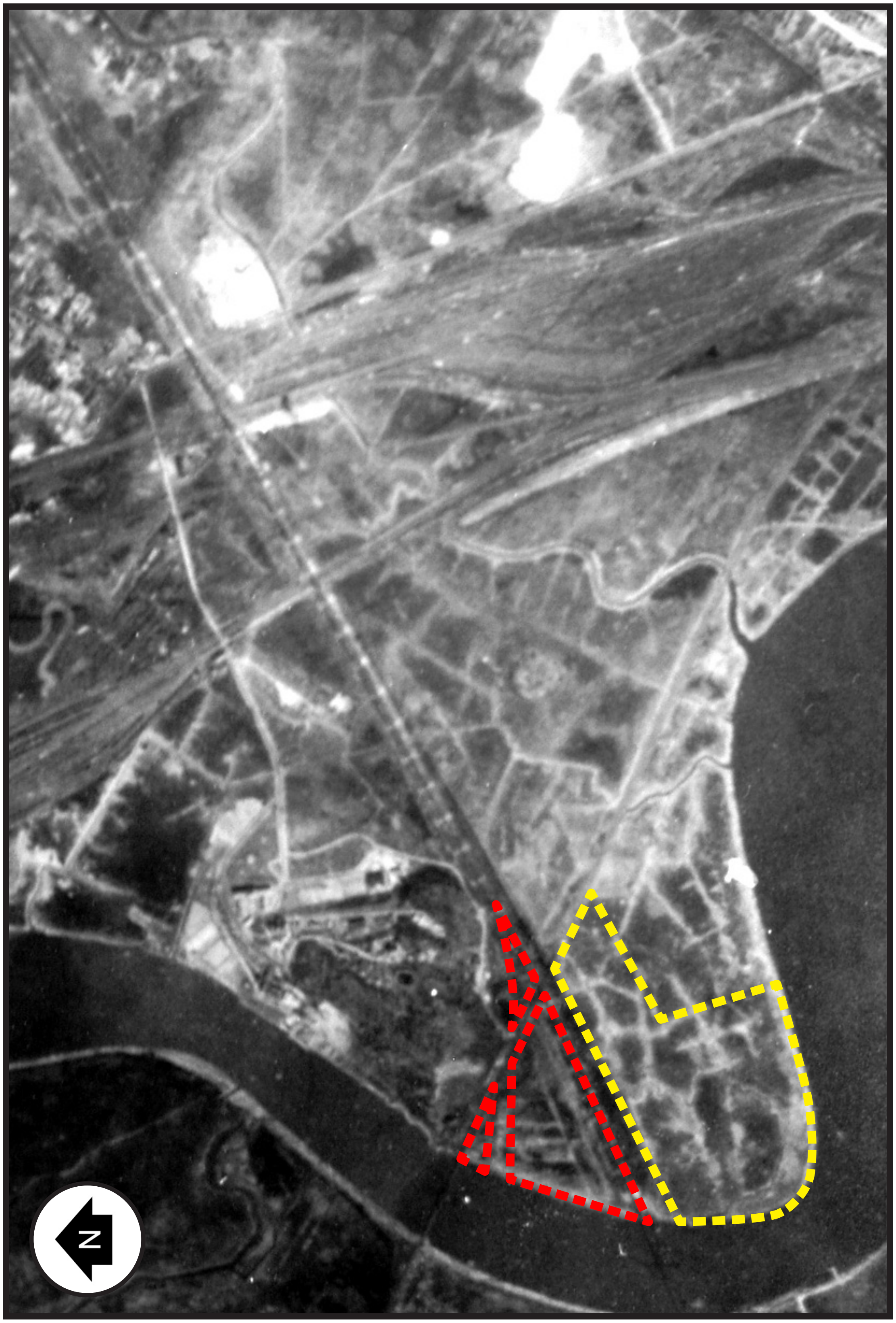

Plate 5.19. Aerial Photograph of the Laurel Hill Park Wetland #21 and the Riverbend Wetland Preserve Site #26. 1 931. Source: New Jersey Meadowlands Commission. Laurel Hill Park Wetland (red) and the Riverbend Wetland Preserve site (yellow) outlined.

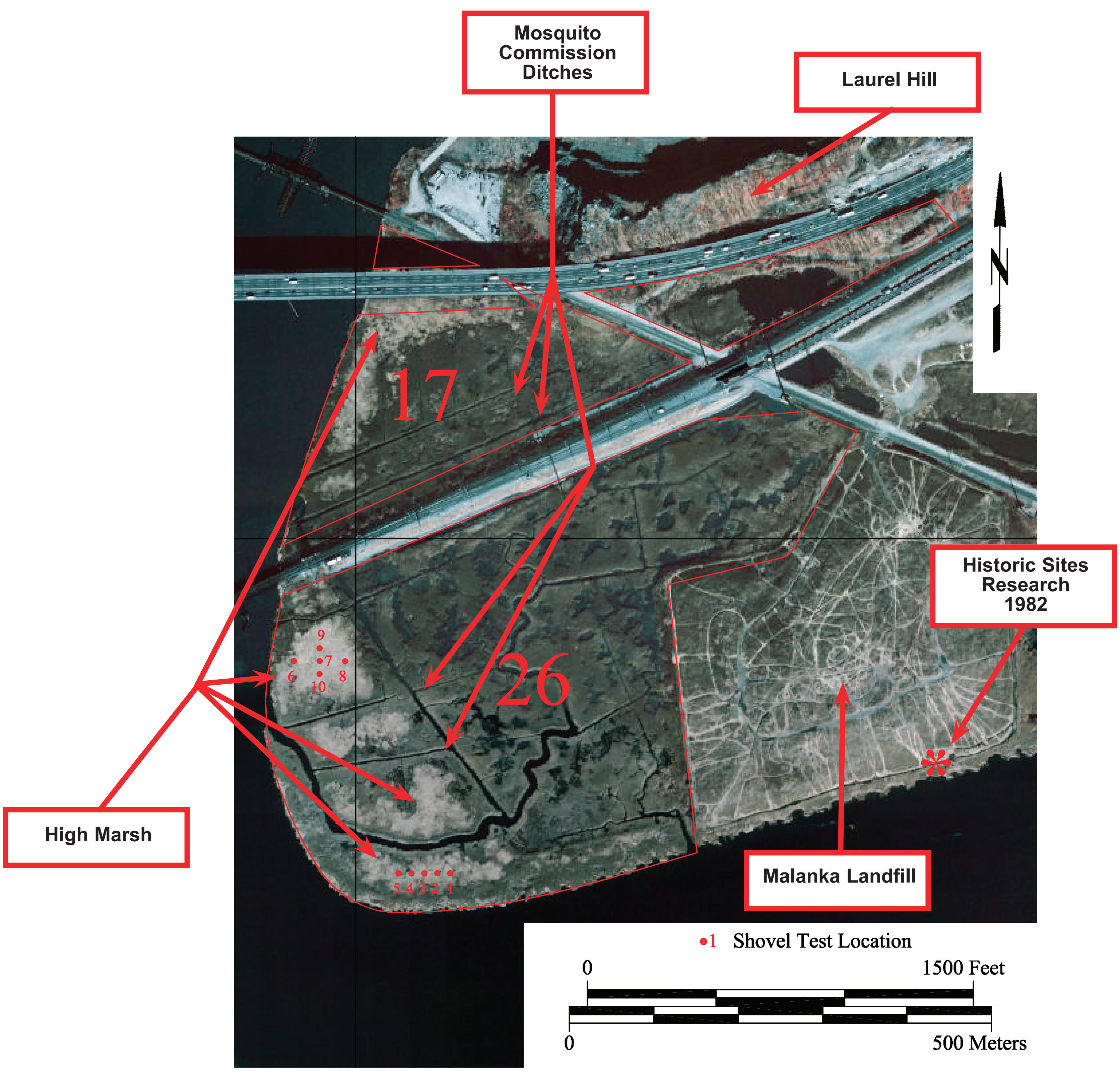

Figure 5.24. Annotated 2002 Aerial Photograph of the Laurel Hill Park and Riverbend Wetland Preserve sites. Source: New Jersey Department of Environmental Protection 2002.

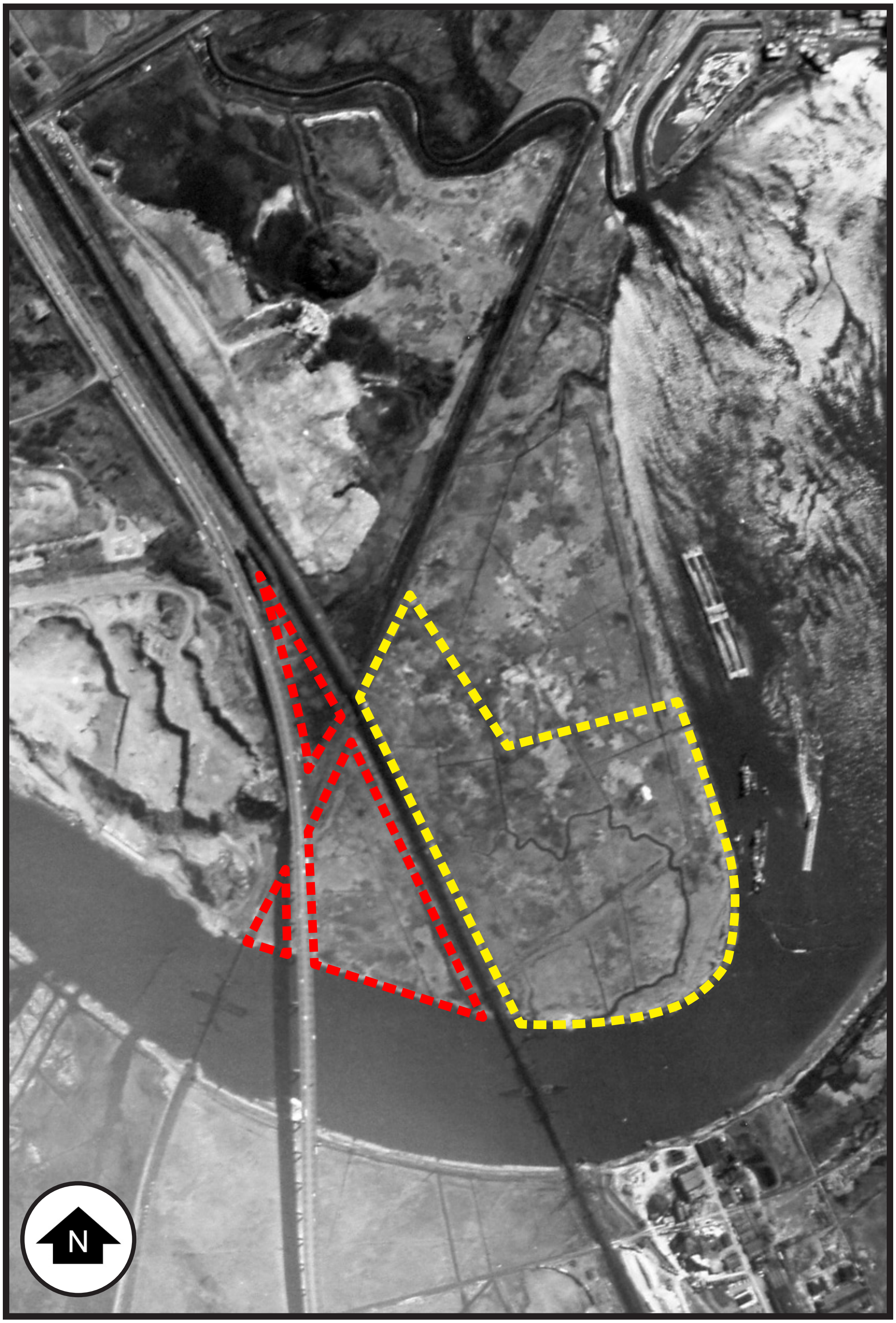

Plate 5.20. Aerial Photograph of the Laurel Hill Park Wetland #17 and the Riverbend Wetland Preserve site #26. 1968. Source: New Jersey Meadowlands Commission. Laurel Hill Park Wetland and the Riverbend Wetland Preserve site outlined.

5.23). Abel I. Smith retained the property until 1949 when he sold several lots (tracts # 4, 6, 7 and 10) to the Secaucus Holding Corporation (Hudson County Deed 3274/212). Two years later, the New Jersey Turnpike Authority acquired a right of way on the northern portion of the property (Hudson County Deed 2451/304). Presently, a portion of this tract (Block 1, lot 3) is owned by the Jersey City Water Department. Air photographs of 1931 and 1968 appear to show drainage ditches on the earlier photograph becoming obscured by the latter date.

2. Site Description

The triangular Laurel Hill Park Wetland site covers 20 acres and is bounded on the north by the eastern spur of the New Jersey Turnpike, on the south by the Conrail-Amtrak line, and on the west by the Hackensack River. The site is undeveloped and is dominated by common reed (*Phragmites australis*) with pockets of saltmarsh hay (*Spartina patens*). Linear man-made ditches running northeast/southwest have been cut into the meadow the Mosquito Control Commission. This area also exhibits a few small freshwater ponds.

3. Evaluation of Cultural Resource Potential

a. Surface and Shallow Sediments

The proximity of the site to the higher ground of the Secaucus "island" is considered to elevate the possibility that anthropogenic changes may be identified in the upper portions of the palynological record at this site. Although the property was owned by the Swartwouts there is little of sign of major drainage activity on the site in the 19th century.

b. Deep Sediments

Nearby work by Historic Sites Research (1982) suggests that organic deposits in this part of the valley south of Snake Hill are very deep (30+ feet) and comprise organic clays with peat. It is possible that the clays are derived from erosion off the Secaucus "Island." The depth of the deposits suggests they began to accumulate earlier than those further upstream. The pollen record appears to show that grasses predominated through time, although some tree pollen was present at the lower levels. Regional and local pollens were not distinguished, so the local environment is difficult to reconstruct from these data. A fine gravel was identified below the organic levels. There is no confluence at this location.

J. RIVERBEND WETLAND PRESERVE - AREA 26 (FIGURES 5.22-5.24; PLATES 5.19-5.24)

1. Site-Specific Background Research and History

In the late 18th century, lands contained within the present-day Riverbend Wetland Preserve were acquired by Samuel Swartwout taking up poorly documented properties owned by the Smith family and others (see above under Laurel Hill Park).

By 1865, Job Smith had died and there was an attempt made to partition the lands formerly owned by Abel I. Smith and Job Smith. The division could not be made and the matter was heard by the chancery court wherein Sarah Newkirk and others were complainants and Abel I. Smith was the defendant. The property was consequently partitioned as suggested in the transfer. The property containing the study area was sold to Edward Evans in 1865. The indenture included tracts 8 and 9 that were sold to Evans for $740.50 and $720.80 (Hudson County Deed 127/17). Three years

Plate 5.21. The Riverbend Wetland Preserve site #26: General view showing vegetation and the Malanka landfill in the background looking northeast (Photographer: James Lee, October 2005)[HRI Neg. #05025/D10-12].

Plate 5.22. The Riverbend Wetland Preserve site #26: View showing auger testing and vegetation with the Conrail-Amtrak line in the background looking northwest (Photographer: James Lee, October 2005)[HRI Neg. #05025/D10-1].

Plate 5.23. The Riverbend Wetland Preserve site #26: View showing auger testing looking south (Photographer: James Lee, October 2005)[HRI Neg. #05025/D10-10].

Plate 5.24. The Riverbend Wetland Preserve site #26: View showing tested area looking southwest from drainage channel just east of Hackensack River (Photographer: Joel Grossman, November 2005) [HRI Neg. #05025/D12-18].

Plate 5.25. The Riverbend Wetland Preserve site #26: Grasses/sedges (*Spartina alternaflora)* on the foreshore and phragmites are in the marsh behind (dredge spoil?). View facing south (Photographer: Joel Grossman, November 2005)[HRI Neg. 05025/D12-21].

later, in 1868, Edward and Jane Evans and John S. Howell deeded the two tracts to Jay Gould for $21,600 (Hudson County Deed 175/379). The Hopkins atlas of 1873 (Figure 5.24) indicates that two adjacent tracts south of the modern Conrail route were held by Jay Gould. A property to the north and to the southeast continued to be owned by the heirs of Abel Smith.

Jay Gould (1836-1892) was an entrepreneur who showed particular interest in railroads. Early in his career, Gould became a manager of the Rensselaer & Saratoga Railroad, which he later purchased and reorganized. Similarly, Gould also acquired and rearranged the Rutland & Washington Railroad. In 1868, Gould and James Fisk wrestled to gain control of the Erie Railroad from Cornelius Vanderbilt. They ultimately succeeded and Gould was elected president of the Erie Railroad in 1869. At that time, Jay Gould proceeded to sell stocks that were soon discovered to be fraudulent. This consequently resulted in legal action—Gould was ousted from the company and was required to pay back millions of dollars. Gould subsequently became involved with Tammany Hall and helped elect Marcy "Boss" Tweed to the directorship of the Erie Railroad. Gould later acquired control of the Union Pacific Railroad and the Missouri Pacific Railroad, routes that were crucial toward the formation of his railroad infrastructure. Gould continued to pursue various endeavors and to accrue millions until his death in 1892 (Wikipedia 2005).

Gould transferred the parcels to the Erie Railway Company in a declaration of trust the following year (Hudson County Deed 207/141). The Hopkins atlas of 1909 (Figure 5.23) attaches the corresponding numbers of partitioned tracts that formerly were owned by the Smith family. In the study location, the mapmaker notes that parcels 8 and 9 were owned by the Erie Railroad Company and that a stream flowed through the two lots. The waterway is slightly obscured on an aerial photograph of 1931 (Plate 5.19).

The Erie Lackawanna Company and the Delaware Lackawanna and Western Company merged in 1959 to form the Erie-Lackawanna Railroad Company. The 1968 aerial photograph (Plate 5.20) shows the study location with greater clarity and indicates that ditches had been constructed on portions of the property, although these may also be present in 1931. Areas of lighter vegetation on this and the 2002 air photograph (Figure 5.24) may represent high marsh settings. The Erie Land and Improvement Company was the successor of the railroad corporation following a merger of 1968. In 1983, the Erie Land and Improvement Company sold the property to Hartz Mountain Industries who then sold the land to the Hackensack Meadowlands Development Commission in 1996 (Hudson County Deeds 3385/92 and 5080/243).

2. SITE DESCRIPTION AND ARCHAEOLOGICAL FIELDWORK

The Riverbend Wetland Preserve site has been the subject of 18 biological and restoration studies (see Appendix B). The site covers 57 acres and is bounded on the north by the Conrail-Amtrak line, and on the south and west by the Hackensack River and on the east by wetlands and a Conrail line adjacent to the Malanka landfill (Plate 5.21). The site is undeveloped and supports a mixture of native high saltmarsh grasses dominated by spike grass (*Disticulus spicata*). The high marshes are surrounded by dense stands of common reed (*Phragmites australis*) (USACOE 2004: Site Information Fact Sheet 26). The site exhibits several linear man-made ditches running northeast/southwest and northwest/southeast cut into the meadow by the Mosquito Control Commission. This area also exhibits a few interior freshwater ponds.

Because of the presence of accessible and relatively dry areas not dominated by *phragmites*, this site was selected for a shovel-testing program to provide baseline data for the utility of this technique on the remediation sites (Plates 5.22-5.24). Archaeological testing in this area consisted of ten auger tests along two transects across the high marsh. Auger tests in the first transect were spaced 50 feet apart in a single line. The second transect was located 300 feet south of the first transect and employed 100-foot spacing. Two tests were excavated 50 feet north and south of the middle of the second transect. The results were consistent across the testing area. The first context consisted of one-foot of root-mat followed by the second context extending the length of the auger (five feet) and consisted of saturated black decayed vegetal matter with a little clay. Both contexts are considered to be of recent historic origin. No cultural materials or evidence of cultural horizons were observed during the subsurface testing.

The archaeological testing was accompanied by a geoarchaeological study by Enviroscan, Inc., included here as Appendix E. This study concluded that there is little potential for buried surfaces or soils at depth of less than six feet, but that deeper intact cultural feature might be present in Early Holocene deposits if present. These conclusions broadly support those from earlier studies, although as has been discussed previously, Early Holocene deposits are not considered likely even at this location in the valley. Peat initiation here may begin about 5000 B.P or little earlier, suggesting occupation potential from the Late Archaic onwards.

3. Evaluation of Cultural Resource Potential

a. Surface and Shallow Sediments

Based on an examination of the site during a survey by boat, pedestrian survey, and subsurface archaeological testing, the site has little to no potential to yield prehistoric or historic cultural resources within the *phragmites* root mass down to one foot. The decayed vegetal matter examined down to five feet has little coherence, but can probably be sampled with appropriate coring techniques, and can therefore be expected to yield data on anthropogenic changes in the last 350 years or so. These results can probably be extrapolated to the other candidate locations.

b. Deep Sediments

As the site furthest down the Hackensack drainage, the Riverbend site has an important potential role in providing baseline data on the earliest date of Holocene peat accumulation in the Meadowlands, and its implications for sea level rise. The character of the "brown organic clays" (Historic Sites Research 1982) is unclear, but they are clearly not peat deposits since these were identified as strata within the clays. It appears that a somewhat different depositional regime prevailed in this part of the valley. Depths of over 30 feet are anticipated for the organic sediments, which may lie on gravels above the lake clays. There is no significant confluence at this location, although a small drainage does emerge from the site.

K. OVERALL ASSESSMENT AND RANKING (TABLE 5.2)

Table 5.2 assembles some key variables identified during the course of research and analysis. It presents a scoring system from which the sites are ranked in the right column for cultural resource sensitivity. It will at this point be clear that predicting the location and character of archaeological sites, particularly prehistoric ones, is a difficult task at the current stage of knowledge. Table 5.2 identifies three variables (confluence locations, the likelihood of pre-peat and post-lake deposits, and proximity to "fast" or drier land) that may influence prehistoric site location, and two (the probability of 17th- and 18th-century palynological and cultural data surviving, and the degree and date of reclamation and drainage) of importance for historic archaeological site data. The construction priority ranking of 1 and 2 is of course an entirely independent variable reflecting current planning priorities. If this factor is excluded there are only minor changes to the overall rankings in the middle of the range.

Research for this study has drawn renewed attention to the various drainage and reclamation activities, particularly those by the Swartwouts and their successors in the Kearny Marshes but also the more piecemeal and largely undocumented activities further north. The dated railroads at Meadowlark, Oritani and Berry's Creek Marshes provide *termini ante quos* (dates before which) for the ditches at those locations. At Oritani and Berry's Creek Marshes these extensive ditch systems must date to before the 1830s. While it is likely that these historic reclamation programs had an adverse impact on any earlier historic cultural data, and may have degraded the upper portions of the palynological record, they are the physical imprint of past cultural attitudes to the Meadowlands environment, of the considerable resources of finance and labor placed into them, and the developing technology deployed in efforts to control the hydrology. Recommendations on ways of addressing this resource type are presented in Chapter 6.

Table 5.2 is not intended as a sophisticated predictive tool, but the ranking does help to formalize somewhat more subjective conclusions developed in the discussion of the individual sites. It is clear that Meadowlark Marsh holds considerable promise to yield good quality archaeological and palynological data, reflected in its score of 10. At the other end of the ranking scale, the Kearny Brackish and Freshwater Marshes have scores of 3 and 5, reflecting their degraded and inundated character, remoteness, absence of confluences, and probable lack of pre-peat/post varve deposits. Kearny Freshwater Marsh is, however, close to the higher ground to the west. Areas of shallow peat here may have some potential, as suggested by the North Arlington study (Schuldenrein 1996).

The Anderson Creek and Riverbend sites both receive high rankings because of their locations on the east bank of the Hackensack near the Secaucus "Island", the site of much 17th-century activity. Anderson Creek additionally has the slight possibility that a pre-1836 structure may be present on the site. Both can be expected to provide good stratigraphic sequences. Sites in the middle rankings (5= and 6=) show varying combinations of factors that suggest they should probably be grouped together.

This assessment and ranking will be used in Chapter 6 as a basis for developing recommendations for systematic data collection from the sites.

Chapter 6

ASSESSMENTS AND RECOMMENDATIONS

A. PRELIMINARY EVALUATION OF SIGNIFICANCE

The data and analysis in Chapter 5 has shown that the presence of conventional archaeological "sites" or properties cannot be demonstrated at the 10 remediation sites given the present level of information. Exceptions to this generalization are the historic dikes and ditches present on the majority of the areas, and the potentially informative fill material at Meadowlark Marsh.

As has been discussed, the dike and ditch systems fall into four categories: 1). Those constructed by the Swartwout operations of the second and third decades of the 19th century, chiefly in the southern portions of the Meadowlands; 2). The New Jersey Land Reclamation Company enterprise of the late 1860s, with its use of iron plates at the core of the dikes, located again chiefly south of Sawmill Creek on the west side of the Hackensack; 3). Mosquito Control Commission operations at many locations throughout the Meadowlands in the first half of the 20th century; 4). Other private drainage schemes carried out a various times. These latter are mostly poorly documented and may be mentioned only incidentally in land records (Wright 1988). As has been demonstrated, some of the schemes can be placed into a relative sequence by their relationship to dated features, particularly railroads.

Views of these attempts to modify the Meadowlands have been colored by their lack of success, by the adverse effects they have had on the environment (*e.g.* inundation and *phragmites* infestation), and perhaps by the difficulty of disentangling the palimpsest of schemes in any given area. There has apparently been no modern attempt made to place these Meadowlands efforts within the broader context of land reclamation and drainage in Europe, particularly the Netherlands, and in colonial America and the United States. Without such a context it is not possible to fairly assess the significance of these cultural landscapes, but it cannot at this point be assumed that no examples may meet National Register significance criteria. The issue of eligibility will be returned to in Section C of this chapter.

The industrial fill deposit at Meadowlark has been shown to date to before 1931, and probably to after 1917. It appears to be a single source deposit containing materials relating to industrial brick making. It may therefore retain technological information of importance in industrial history.

The potentially most significant resources in the remediation areas are, however, the submerged environmental context and cultural indices of human activity from the colonial period back to the Late Archaic and beyond. These will range in character from anthropogenic vegetation changes discernible in plant macrofossil and pollen assemblages, to more conventional concentrations of portable artifacts and features at particular locations. They are set in a matrix of organic material and sediments that preserve a wide range of paleoenvironmental data. The advent of high-resolution procedures and dating methods, and recent successes at regional reconstruction, indicate that these data can now be analyzed to a high level of accuracy and detail, and this greatly enhances both the potential for discovery and the significance of any cultural resources located in such settings.

B. ASSESSMENT OF EFFECT

The Corps of Engineers' responsibilities under Section 106 of the National Historic Preservation Act of 1966 mandate assessment of the effect of the undertaking before recommendations for treatment or for further investigation can be made. At this point, detailed recommendations have been prepared only for the Anderson Creek Marsh - Area 11 (Source: *Anderson Creek Marsh Restoration**, Hackensack Meadowlands Ecosystem Restoration Study),*** and these are considered as representative of the types of restoration undertaking to be carried out at the other sites.

Alternative 1 – No action

There would be no effect on archaeological resources under this alternative.

Alternative 2 - Tidal Pond

Actions:

- Create berm along river blocking hydrological connections (prevent recontamination from sediments; hold water onsite)

- Install 2 major and 2 minor controllable hydrological connections in berm

- Flood site by retaining spring high water on site, resulting in decreased *Phragmites* and decreased exposure to (risk from) contaminants in sediments. Hydroperiod could be manipulated to facilitate native salt marsh vegetation (this may assume that flooding would facilitate marsh subsidence that would achieve elevations supportive of low marsh)

Effects:

-The construction of the berm could impact historic properties, depending on the source of the berm material. Materials from the Hackensack channel would have low potential to contain cultural resources, but any excavation from the marsh would be undesirable, impacting sediments up to 4000 years old.

Alternative 3 – Low marsh, minor remediation

Actions:

- Cut up to approximately 2 feet and fill as needed to achieve desired elevations

- Fill to high-marsh elevation the 2 major hydrological connections to river (reducing risk)

- Create high marsh on filled creek

- Create 15-foot-wide tidal creek (moat) along landward side of site (isolate site from re-invasion of *Phragmites*; provide new hydrology); connect some existing secondary creeks to new creek

- No action along landward side of new creek

Effects:

- Cutting to approximately 2 feet may reach below root mat and potentially effect cultural strata
- Creation of 15 foot-wide tidal creek has potential to affect cultural strata to depth of excavation

Alternative 4 – Low marsh, major remediation

Actions:

- Cut approximately 3 feet across entire site
- Fill 2 feet as cap

- Additional fill to achieve desired elevations

- Balance of actions identical to Alternative 3

Effects:

- Cutting to approximately 3 feet will reach below root mat and potentially effect cultural strata

- Creation of 15 foot-wide tidal creek has potential to affect cultural strata to depth of excavation

Alternative 5a – Mixed marsh, passive solution

Actions:

- Remove *Phragmites* (most likely through application of herbicide followed by mowing)

- (optional) Cut up to approximately 1 foot where necessary (high spots) to limit re-invasion of *Phragmites*

- (optional) Plant native species as necessary

- Deepen some channels as necessary up to approximately 2 feet (to improve hydrology)

Effects:

- Channel deepening may affect cultural strata to depth of excavation

Alternative 5b – Mixed marsh, new tidal creek, passive solution

Actions:

- Same as Alternative 5a with the addition of the tidal creek (moat) detailed in Alternative 3

Effects:

- Channel deepening may affect cultural strata to depth of excavation
- Creation of 15 foot-wide tidal creek has potential to affect cultural strata to depth of excavation

While it may be assumed that the upper 1-1.5 feet will comprise root mat of *phragmites* for the most part, it is apparent from the recent Piermont Marsh study that just below this depth coherent palynological data can be obtained (Pederson *et al.* 2005). Depths of three feet at Piermont were dated to about AD 1600, and the colonial and modern periods therefore lie between one and three foot deep there. Given the potential for early colonial activity at Anderson Creek, and the possible presence of a pre-1839 building, these sediments must be considered potentially archaeologically sensitive and significant. The excavation of new tidal channel at this location will entail significant lateral and vertical removal of material, although depth information is not available. Overall, it appears that deeper sediments will not be directly impacted by proposals of this type, but near-surface actions may affect the integrity, accessibility and research content of the environmental and human ecological sequence.

C. RECOMMENDATIONS

1. Overall Approach

To date, all the most effective cultural resource investigations in the Meadowlands have been multidisciplinary, with the identification of specific archaeological sites taking second place to the development of topographic models and the establishment of stratigraphic and vegetational sequences. While Table 5.2 provides a ranking for the restoration sites that includes some factors considered to be broad predictors of archaeological site location, it is clear that examination of these areas must be undertaken within a broader geoarchaeological and palynological framework. In the following sections this assumption is used to develop a research design and sampling strategy for the collection and analysis of paleoenvironmental data from the restoration sites. This will ensure that areas of high probability for buried archaeological sites are examined concurrently with an efficient and proven program of paleoenvironmental investigation.

Separate recommendations are presented for the historic ditch and dike systems and for the fill materials at Meadowlark Marsh.

2. Research Design for Hackensack Meadowlands Paleoenvironments (By Dorothy M. Peteet with contributions by Joel Grossman)

While key localities in the Hackensack Meadowlands have been investigated to characterize the general environmental history of the area (*i.e.* Heusser, l949; Carmichael, l980; Rue and Traverse, l997; Schuldenrein, l995, etc.) more recent regional Hudson Valley questions have emerged that help us to define leading questions regarding the anthropogenic and natural history of this large wetland. A focus on the Hudson River marshes and their environmental history may also be helpful in understanding the Meadowlands history. Sites such as recently studied locations on Staten Island that record the last 11,000 years of change (Peteet, unpublished) are also useful for comparing Meadowlands history.

In the light of these recent developments, the following research issues are now defined. They can be addressed through a north-south transect of cores across the Meadowlands linked specifically to the cultural resource sensitivity assessment of the restoration areas. The issues start with the chronologically most recent, and therefore most likely to be impacted by remediation-related undertakings.

a) European Impact. In Piermont Marsh, Pederson *et al.* (2005) in their high-resolution study (samples every 20 years) were able to discern the impact of Europeans on the uplands through pollen stratigraphy (less tree pollen, more herb pollen, especially ragweed, pigfoot, and dock) and on the lowlands through the increase in inorganic supply due to farming and other landscape disturbance. A detailed study of the Meadowlands would be informative as to the pattern, timing and scale of change to the uplands and to the Hackensack marshes. This would require fine sampling of the upper sediments for pollen and spores, macrofossils, charcoal and loss-on-ignition (LOI). Critical to this endeavor are the use of dating methods such as Cs-137 and AMS C-14 on identified plant macrofossils.

b) Holocene Marine Transgression and Implications for Human Settlement. In Piermont Marsh, Pederson *et al.* (2005) documented paradigm-altering, new insights indicating order of magnitude fluctuations in the rates of sedimentation and, by extension, rates of sea level rise for the past 1500 years, (500 to 2000 AD). The absolute versus relative correlation between rates and sedimentation is yet to be universally established. It may vary significantly between interior versus tidal marshes, as well as from variations in subsidence and/or other uncontrolled factors. Nevertheless, the high resolution Piedmont Marsh sequence raises some intriguing issues that flag some long held assumptions for Late Holocene patterns. If correlated correctly, this new data contradicts the commonly cited "best estimate" mean rates of *circa* 11 -18 cm per century for the historic period used by EPA and other international agencies (IPCC) to plan for future coastal hazard and erosion threats (Gornitz 1993, 1995,2000a, 200b, 2001; Gornitz and Lebedeff 1987; Gornitz and Solow 1991; Houghton *et. al.* 2001). The new high-resolution Piedmont Marsh chronology (Pederson *et al*. 2005) documented fluctuating rates from as little as 3 cm per century between *circa* AD 800 and AD 1250, to an upper range of between *circa* 30 to 60 cm between AD 1250 and AD 1300, with a documented rate of *circa* 30 cm for the Colonial period - all reflecting order of magnitude variances in contrast to the "straight-line" mean regression plots of the commonly referenced post-1850 tide gage data.

Given the projected physical and chronological time depth of the Meadowlands core columns, the use of comparable high-resolution, 20-50 year (4 cm) sampling fractions and radiocarbon determinations holds the promise of pushing the currently available sequence for the region back in time by nearly 1500 years, or to at least the third millennium B.P.

Given the relevance of these new patterns of fluctuating rates to the reconstruction of former, pre-inundation topography, levels of exposure, and projected econiches during the prehistoric and historic periods, it is important that the analysis of the calibrated sequences of shifting deposition rates be correlated with, or tied, "pegged", to the sub-marsh topography to provide geospatially-based 3D GIS planning and targeting tools (tied to current Army Corps, New Jersey Department of Environmental Protection (NJDEP) and Meadowlands Commission baseline GIS and cartographic data sets) for the geospatial evaluation of potential archaeological sensitivity (Grossman 2003).

c) Medieval Warm Period. Pederson *et al.* (2005) analyzed the estuarine sediments of Piermont Marsh, in the lower NY estuary and found a large climate signal during the Medieval Warm Period, approximately AD 800-1350. During this interval, higher pine and hickory pollen along with very large amounts of charcoal and increased inorganic content in the marsh implied a major drought in this region. Similar records of drought for the Chesapeake estuary at this time (Cronin *et al.* 2003, Willard *et al.* 2003) as well as for the Jamestown Colony (Stahle *et al.* 1988) suggest that the entire northeastern US region may have experienced this major drought. The drought has major implications for the New York region as it is part of natural climate variability, and the Hackensack Meadowlands should be investigated for charcoal as well as for indications of higher salinity indicators (salinity sensitive plants and foraminifera) during this interval.

d) What stratigraphy can we find that might shed light on the time interval from about 13,000 (glacial varves) to 3000 –5000 (peat initiation) years ago? The geoarchaeological or geomorphological evaluation of the deeper core fractions from a transect of cores would be useful in assessing whether or not this time interval is missing throughout the marsh, or whether we might find clues to the environment prior to 3000 years B.P. and reasons for the missing time interval.

e) How does the varve sequence in the Meadowlands relate to recent varve chronologies that help us to understand the timing of deglaciation (*i.e.* Ridge 2004)? Recent maps have been published (Stone *et al.* 2002; Stone *et al.* 2005) that document the timing of the Laurentide deglaciation with respect to sea level rise and map the glacial deposits that characterize the region. The Meadowlands should be re-examined with respect to the chronological sequences that are outlined. Recent data on loess deposits on Long Island that might be tied in to possible loess deposits in the Meadowlands (Rue and Traverse 1997). Stratigraphic sequences should be taken in a north-south transect in the Meadowlands, and re-examined to better interpret the regional shifts as a whole.

3. Archaeological and Paleoenvironmental Testing Proposal

On the basis of the above, it is recommended that a program of coring and probing therefore take place on the three highest-ranked remediation areas (see Table 5.2): Meadowlark Marsh (20), Anderson Creek Marsh (11) and Riverbend Wetland Preserve (26). These have the advantage of being located in the north, center and southern parts of the study area, thus providing desirable transect data. Anderson Creek and Meadowlark are confluence or near-confluence locations, and this is considered likely to increase the probability of identifying higher-intensity archaeological site signatures. All three sites are likely to contain undisturbed, high integrity sediments above the basal varves and predating the peat. Meadowlark and Riverbend are close to "fast" land, while Anderson Creek is slightly more distant. Anderson Creek may be the site of a pre-1836 structure. It is also opposite Lyndhurst Marsh, recommended for testing in 1994 (Grossman 1994:6).

Using either boat-mounted or land-based coring equipment, depending on accessibility, it is recommended that two probes and one high-resolution column be taken at each remediation site, for a total of nine cores and probes. The probes will be completed first and will provide basic stratigraphic information on the sites. Specific locations in the remediation areas will be selected chiefly on the basis of proximity to the confluence or tributary stream (in the case of Meadowlark and Anderson Creek) or closest portion to fast land (Riverbend) in order to maximize the possibility of encountering archaeological artifacts. All tests and probes will be located using a global positioning system and mapped on the Meadowlands Commission GIS and used in the proposed revision to the sub-marsh 3D terrain model (see below). This modern update of the sub-marsh topography would utilize the most recent high-resolution geospatial controls and 6-inch-air-photo-derived digital base maps in conformity with the standards and methods of current GIS-based frameworks in use by the Army Corps, NJDEP and Meadowlands Commission.

After examination of the probes, one high-resolution column will then be collected from each location, using Hiller, Livingston, VibraCore or other instruments that minimally compress the column. In view of the labor-intensive nature (and therefore high cost) of pollen, spore and foraminifera data collection, consideration may be given to analysis of this data from only one of the high-resolution cores, although it would be more effective to perform this for all three high-resolution cores. Assessment of the desirability of analyzing the second and third cores should be made on completion of work on the first.

All three cores will, however, be subjected to the following analyses: Macrofossils; loss-on-ignition; carbon content; radiocarbon dating (AMS); possibly Cesium dating for upper portions of column; foraminifera; sediments: particle size/energy assessment, geological origin; archaeological artifacts (lithic and organic).

Sampling intervals on the columns will be designed to track century or sub-century changes. At Piermont Marsh 4 cm (1.5 inch) intervals were used to obtain sub-century dates. If this approach is used on these sites approximately 300 samples will be taken, roughly 100 from each column, assuming peat depths averaging 4 meters and 25 samples per meter being taken. These numbers are higher than those recommended for Lyndhurst Marsh in 1994, reflecting advances in dating and other analyses.

The results of the analyses will be presented in a peer-reviewed article for publication, and will also be incorporated into compliance and planning documents prepared by the U.S. Army Corps of Engineers and the New Jersey Meadowlands Commission. The implications of the findings for the future identification, evaluation, and treatment of buried archaeological resources will be addressed.

Once these results are fully analyzed it will be possible to refine a treatment strategy for the remaining seven environmental restoration locations in relation to restoration-related undertakings such as ditching or peat removal. It is anticipated that the data from the three sites selected for coring will permit the development of a powerful archaeological/paleoenvironmental sensitivity model. Such a model will greatly reduce the need for additional investigation by permitting extrapolation of the data from the three sites to other portions of the Meadowlands. In this way the unnecessary duplication of results will be avoided. Additional investigations at the other seven locations will therefore only be warranted if there are site-specific issues to be addressed. The model will therefore be an efficient tool for all future land-use planning in the Meadowlands as a whole, and could be incorporated into a Memorandum of Agreement and into New Jersey Meadowlands Commission Master Planning documents.

4. Proposal to Revise 1994 Sub-Marsh 3-D Terrain Model

It is recommended that the 1994 Grossman 3D pre-inundation, sub-marsh 3D terrain model SAMP map (see Figure 1.6) be updated. Greatly improved geo-referencing, using 2005 6-inch-resolution base maps and digital imagery is now possible compared to 1994. New more accurate marine transgression data is also now available. The revised georeferenced historic mud depth data will be used to refine the topographic model of pre-peat Meadowlands. This will then be correlated with the new marine transgression chronology to graphically define former landscapes and shifting exposures through time. This refined model will enable former and now buried topographic settings and habitats that could support prehistoric sites (such as confluence settings, terraces, hummocks) to be identified in far more detail than previously.

5. Proposed Historic Context Development for Meadowlands Drainage Features

Following National Park Service Guidelines for the analysis of cultural landscapes (Preservation Brief 36: *Protecting Cultural Landscapes*) and for historic context development, it is recommended that the property types associated with the various phases of drainage and reclamation in the Meadowlands be defined and placed in context. This study will entail analysis of cartographic and air photographic data combined with documentary research, and will establish criteria for evaluating the National Register significance of specific features.

6. Evaluation of Early 20th-Century Industrial Fill at Meadowlark Marsh

Historical research into local industrial brick operations, such as those a Little Ferry, and on the records of the New York Acreage Estates Company, should be undertaken to identify the source of the materials forming the fill at Meadowlark. Concurrently, a representative sample of the materials will be recovered and their function determined through comparative and literature search. These data will be used to determine whether the material is of historic significance, for example in the history of brick-making technology.

REFERENCES

Aerial Photograph of the Hackensack Meadowlands.
1953 On file, New Jersey Meadowlands Development Commission, Lyndhurst, New Jersey.

Aerial Photograph of the Hackensack Meadowlands.
1968 On file, Hackensack Meadowlands Development Commission, Lyndhurst, New Jersey.

Agron, S. L.
1980 Environmental Geology: Hackensack Meadowlands. In *Field Studies of New Jersey Geology and Guide to Field Trips: 52nd Annual Meeting of the New York State Geological Association*, pp. 216-243. Geology Department, Rutgers University, Newark, New Jersey.

Airmap Corporation of America
1931 Airmap of Hackensack River Valley Made for the Hackensack Valley Sewerage Commission. On file, Hackensack Meadowlands Development Commission, Lyndhurst, New Jersey.

Americans.net
2005 Governeur Morris. Available online at http://www.americanrevolution.com/GouverneurMorris.htm [September 9, 2005].

Atkinson, R. B., R. T. Belcher, D. Brown, and J. E. Perry (editors)
2000 Atlantic White Cedar Restoration Ecology and Management. Proceedings of a symposium held at Christopher Newport University, Newport News, Virginia, May 31-June 2.

Averill, S. P.
1980 Late Wisconsin-Holocene History of the Lower Hudson Region: New Evidence from the Hackensack and Hudson River Valleys. In *Field Studies of New Jersey Geology and Guide to Field Trips: 52nd Annual Meeting of the New York State Geological Association*, pp. 159-187. Geology Department, Rutgers University, Newark, New Jersey.

Barrett, W.
1863 *The Olde Merchants of New York City*. Carleton, New York, New York.

Bergen County Deeds
On file, Bergen County Courthouse, Hackensack, New Jersey.

Bergen County Mortgages
On file, Bergen County Courthouse, Hackensack, New Jersey.

Bogert, F. W.

1983 The Colonial Days 1630-1775. *Bergen County, New Jersey History and Heritage*. The Bergen County Board of Chosen Freeholders, Hackensack, New Jersey.

Bowser, E. A.

1870 Report on the Tide Marsh on Newark Bay and the Passaic and Hackensack Rivers. In *Annual Report of the State Geologist of New Jersey for 1869*. New Jersey Geological Survey, Trenton, New Jersey.

Bromley, G. W.

1912 *Atlas of Bergen County*. Volume 1. G.W. Bromley and Co., Philadelphia, Pennsylvania.

1913 *Atlas of Bergen County*. Volume 2. G.W. Bromley and Co., Philadelphia, Pennsylvania.

Carmichael, D. P.

1980 A Record of Environmental Change During Recent Millennia in the Hackensack Tidal Marsh, New Jersey. *Torrey Botanical Club Bulletin* 107(4 October-December):514-524.

Clayton, W. W., and W. Nelson

1882 *History of Bergen and Passaic Counties*. Everts and Peck, Philadelphia, Pennsylvania.

Cook, G. H.

1868 *Geology of New Jersey*. Published by the Board of Managers. Printed at the Daily Advertiser Office. Geological Survey of New Jersey, Newark, New Jersey.

1879 On the Southern Limits of the Last Glacial Drift Across New Jersey and Adjacent Parts of New York and Pennsylvania. In *Transactions of the American Institute of Mining Engineers*. 6th ed., pp. 467-470.

Cultural Resource Management Services, and

1979 A Stage IA Cultural Resources Survey of the Proposed Bergen County Utilities Authority Composting and Incineration Facilities. On file, New Jersey Historic Preservation Office (NJDEP), Trenton, New Jersey.

Cultural Resources Consulting Group

The Secaucus Potter's Field Cemetery. Available online: http://www.culturalresourcegroup.com/projects/secaucus1.htm [February 2, 2006].

Cunningham, J. T.

1959a Meadows. *Newark Sunday News*, February 3.

1959b Reclaiming the Meadows. *Newark Sunday News*, February 22.

De Leuw Cather and Parsons

1979 *Historic and Archaeological Resources of the Northeast Corridor -- New Jersey*. On file, New Jersey Historic Preservation Office (NJDEP), Trenton, New Jersey.

Drainage and Reclamation of Marsh Lands

1868 *Bergen County Democrat*, July 10.

East Jersey Deeds

On file, New Jersey State Archives (NJDS), Trenton, New Jersey.

Geoarchaeology Research Associates

2006 Developing a Framework for a Geomorphological/Archaeological Model of the Submerged Paleoenvironment in the New York/New Jersey Harbor and Bight in Connection with the New York and New Jersey Harbor Navigation Project, Port of New York and New Jersey. Draft Report. Prepared for: Barry A. Vittor & Associates, Inc., Mobile, Alabama.

Goldman, C. A.

1975 The Hackensack Meadowlands: The Politics of Regional Planning and Development in the Metropolis. PhD Dissertation. On file, Princeton University, Princeton, New Jersey.

Gornitz, V.

1993 Mean Sea Level Changes in the Recent Past. In *Climate and Sea Level Change: Observations, Projections and Implications*, edited by R.A. Warrick. Cambridge University Press, New York, New York.

1995 A Comparison of Differences Between Recent and Late Holocene Sea Level Trends from Eastern North America and Other Selected Regions. *Journal of Coastal Research* Special Issue 17, Holocene Cycles: Cycles, Climate, Sea Levels and Sedimentation:287-297, edited by C.W. Finkl Jr.

2000a Impoundment, Groundwater Mining, and Other Hydrologic Transformations: Impacts on Global Sea Level Rise. In *Sea Level Rise: History and Consequences*, edited by M. K. a. S. L. B.C. Douglas, pp. 97-119. Academic Press, San Diego, California.

2000b Rising Seas: A View from New York City. Goddard Institute for Space Studies, Http://www.giss.nasa.gov/research/briefs/gornitz_05/.

2001 Impacts of the Sea Level Rise in the New York Metropolitan Area. *Global Planet Change* 32:61-88.

Gornitz, V., and A. and Solow

1991 Observation of Long-Term Tide-Gauge Records for Indications of Accelerated Sea Level Rise. In *Greenhouse-Gas-Induced Climatic Change: A Critical Appraisal of Simulations and Observations*, edited by M.E. Schlesinger, pp. 347-367. Elsevier, Amsterdam.

Gornitz, V., and S. Lebedeff

1987 Global Sea Level Changes During the Past Century. In *Sea Level Fluctuation and Coastal Evolution*. SEPM Special Publication No. 41, edited by O. P. a. J. H. D Nummedal, pp. 3-16. Society for Economic Paleontologists and Mineralogists.

Grossman and Associates, Inc.

1992a Draft Alternative Actions Screening Report for Cultural Resources, Part II: A Cartographic Impact Evaluation of HMDC Development Alternatives on Known and Potential Prehistoric and Historic Resources Within the Hackensack Meadowlands, New Jersey. On file, U.S. Army Corps of Engineers (New York District), New York, New York.

1992b Stage 1A Archaeological and Historical Sensitivity Evaluation of the Hackensack Meadowlands, New Jersey. On file, New Jersey Historic Preservation Office (NJDEP), Trenton, New Jersey.

1994 Hackensack Meadowlands Archaeological and Historical Sensitivity and Impact Evaluation. On file, Hackensack Meadowlands Development Commission, Lyndhurst, New Jersey.

Grossman, J. W.

1991 A Cartographic Analysis of Environmental Change, Prehistoric Archaeological Sensitivity and Historical Settlement Patterns for the Hackensack Meadowlands, New Jersey. On file, U.S. Army Corps of Engineers (New York District), New York, New York.

1992 Draft Alternative Actions Screening Report for Cultural Resources, Part II: A Cartographic Impact Evaluation of HMDC Development Alternatives on Known and Potential Prehistoric and Historic Resources Within the Hackensack Meadowlands, New Jersey. On file, U.S. Army Corps of Engineers (New York District), New York, New York.

2003 Revisiting the SAMP: The Use of Historic GIS & 3D Terrain Modeling to Reconstruct the New Jersey Meadowlands. Abstract prepared for the Meadowlands Symposium, Lyndhurst, New Jersey, Ocotber 9-10.

Hackensack Meadowlands Development Commission

1976 The Kearny Meadows: A Land Use Study. On file, New Jersey Meadowlands Commission, Lyndhurst, New Jersey.

Hackensack Meadowlands Development Commission (Mattson, C. e. a.

1973 *An Historical Consideration of Tidal Flow in the Hackensack Meadowlands*. Hackensack Meadowlands Development Commission, Lyndhurst, New Jersey.

Hartz Mountain Industries, Inc.

1978 Environmental Impact Statement of a Multipurpose Development Proposed on a Tract of Land in North Bergen and Secaucus, Hackensack Meadowlands District, Hudson County, New Jersey. On file, New Jersey Historic Preservation Office (NJDEP), Trenton, New Jersey.

Harvey, C.

1900 *The Genealogical History of Hudson and Bergen Counties*. New Jersey Genealogical Publishing, New York, New York.

Heusser, C. J.

1949a A Note on Buried Cedar Logs at Secaucus, N.J. *Bulletin of the Torrey Botanical Club* 76(4):305-306.

1949b History of an Estuarine Bog at Secaucus, New Jersey. *Bulletin of the Torrey Botanical Club* 76(6 November):385-406.

1963 Pollen Diagrams from Three Former Cedar Bogs in the Hackensack Tiday Marsh, Northeastern New Jersey. *Torrey Botanical Club Bulletin* 90(1 January-February):16-28.

Hills, J.

1781 A Sketch of the Northern Parts of New Jersey. In *A Collection of Plans, Etc. Etc. Etc. in the Province of New Jersey*. Compiled by Peter J. Guthorn, Portolan Press, Brielle, New Jersey.

Historic Sites Research

1982 Cultural Resource Reconnaissance of Hackensack River Tidal Barrier Hudson County, New Jersey. On file, New Jersey Historic Preservation Office (NJDEP), Trenton, New Jersey.

Hopkins, G. M.

1861 *Map of the Counties of Bergen and Passaic, New Jersey*. Corey, G.H., Philadelphia, Pennsylvania.

1873 *Combined Atlas of the State of New Jersey and the County of Hudson*. G.M. Hopkins & Company, Philadelphia, Pennsylvania.

1908 *Atlas of Hudson County, Jersey City*. G.M. Hopkins & Company, Philadelphia, Pennsylvania.

Houghton, J., Y. Ding, D. Griggs, M. Noguer, P. Van der Linden, X. Dai, K. Maskell, and C. Johnson (editors)

2001 *Climate Change 2001: The Scientific Basis*. Contribution of Working Group 1 to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, New York, New York.

Hudson County Deeds
Hudson County Courthouse, Jersey City, New Jersey.

Hunter Research, Inc.
1992 An Archaeological Survey of the Intersection Paterson Plank Road and U.S. Routes 1 and 9 (21), North Bergen Township and the Town of Secaucus, Hudson County, New Jersey. On file, New Jersey Historic Preservation Office (NJDEP), Trenton, New Jersey.

J. and R. Swartwout to Isaac H. Williamson [October].
1821 In *Robert Swartwout Papers*. New York Public Library, Rare Books and Manuscripts Division, New York, New York.

Jumikis, A.
1978 Engineering Aspects of Glacial Soils of the Newark Metropolitan Area of New Jersey. *Engineering Research Bulletin* [New Brunswick, New Jersey] Number 42. Rutgers University, College of Engineering.

Kestenbaum, L.
2005 Harry M. Durning. Available online at http://politicalgraveyard.com/bio/durkee-duval.html [October 3, 2005].

Kummel, H. B.
1908 *Geologic Atlas of New Jersey, Passaic Folio*. Geological Survey of New Jersey, Trenton, New Jersey.

Lane, W. J.
1939 *From Indian Trail to Iron Horse: Travel and Transportation in New Jersey, 1620-1860*. Princeton University Press, Princeton, New Jersey.

Leslie, J.
1916 Report of Chief Inspector, April 22d to May 25, 1916. Bergen County Mosquito Extermination Commission. On file, New Jersey Meadowlands Commission, Lyndhurst, New Jersey.

Lovegreen, J. R.
1974 Paleodrainage History of the Hudson Estuary. M.S. thesis, Columbia University, New York, New York.

Manganaro Martin and Lincoln
1970 Bergen County, NJ Southwest Area Drainage Study. On file, Hackensack Meadowlands Development Commission, Lyndhurst, New Jersey.

Marshall, S.
2004 The Meadowlands Before the Commission: Three Centuries of Human Use and Alteration of the Newark and Hackensack Meadows. Published Online in 2004. *Urban Habitats* 2(1).

Microsoft Encarta Online Encyclopedia
1997-2005 Peatland. Available online: http://encarta.msn.com [January 22, 2006].

Miller, D.L.
1903 *Atlas of the Towns of Harrison and Kearny and the Borough of East Newark*. D.L. Miller & Company, Philadelphia, Pennsylvania.

Miller, R. M.
1968 Hackensack Meadowlands Reclamation and Structural Development. On file, New Jersey State Library, Trenton, New Jersey.

Munn, D. C.
1976 *Battles and Skirmishes of the American Revolution in New Jersey*. Bureau of Geology and Topography, Department of Environmental Protection.

New Jersey Department of Transportation (BEA)
1987 Investigation of the Outwater Family Cemetery, Washington Avenue, Borough of Carlstadt, Bergen County. On file, New Jersey Historic Preservation Office (NJDEP), Trenton, New Jersey.

New Jersey Meadowlands Commission
NJMC Master Plan. Draft. New Jersey Meadowlands Commission, Lyndhurst, New Jersey.

Ogden Family Papers
On file, New Jersey Historical Society, Newark, New Jersey.

P. Townsend et al. to New York and Bergen Dairy Company [April 23]
1833 In *Robert Swartwout Papers*. New York Public Library, Rare Books and Manuscripts Division, New York, New York.

Partition Map of the Grafflin Estate Known as the Little Ferry Farm In Ridgefield Township, Bergen County, New Jersey.
1898 On file, Bergen County Clerk's Office, Hackensack, New Jersey.

Passaic Valley Citizens Planning Association
1958 Hackensack Meadows, Bergen County, New Jersey. Master Plan Series. Report Number 1: Survey Phase. On file, New Jersey Meadowlands Commission, Lyndhurst, New Jersey.

Pederson, D., D. Peteet, D. Kurdyla, and T. Guilderson
2005 Medieval Warming, Little Ice Age, and European Impact on the Environment During the Last Millenium in the Lower Hudson Valley, New York, USA. *Scirnce Direct Quaternary Research* 63:238-249.

Petition of Robert Swartwout to the Honorable Council and General Assembly of the State of New-Jersey
1835 In *Robert Swartwout Papers*. New York Public Library, Rare Books and Manuscripts Division, New York, New York.

PMK Group
2003 Preliminary Assessment, Meadowlands Site, Block 4006, Lot 1, Ridgefield, New Jersey, PMK Group #0503188. On file, New Jersey Meadowlands Commission, Lyndhurst, New Jersey.

Proceedings of the Second Annual Meeting of the New Jersey Mosquito Extermination Association of the State of New Jersey.
1915 MacCrellish & Quigley, Trenton, New Jersey.

Quinn, J. R.
1997 *Fields of Sun and Grass*. Rutgers University Press, New Brunswick, New Jersey.

R. Swartwout to S. Swartwout [December 8]
1837 In *Robert Swartwout Papers*. New York Public Library, Rare Books and Manuscripts Division, New York, New York.

Reeds, C. A.
1933 The Varved Clays & Other Glacial Features in the Vicinity of New York City. In *Guidebook 9: New York Excursions, International Geological Congress, XVI Session*. United States Government Printing Office, Washington, D.C.

Remarks Upon the Landed Estate of the Hoboken Banking & Grazing Company [January 21]
1829 In *Robert Swartwout Papers*. New York Public Library, Rare Books and Manuscripts Division, New York, New York.

Research & Archaeological Management, Inc.
1989 Cultural Resource Reconnaissance: Hackensack Meadowlands District, Hudson and Bergen Counties, New Jersey. On file, Hackensack Meadowlands Development Commission, Lyndhurst, New Jersey.

Richard Grubb & Associates, Inc.
1998 Stage IB Cultural Resource Investigation/Paleoenvironmental Analysis Combined Sewer Overflow Planning Study, Planning Areas IA and III, North Bergen Township, Hudson County, New Jersey. On file, New Jersey Historic Preservation Office (NJDEP), Trenton, New Jersey.

Ridge, J.
2004 The Quaternary Glaciation of Western New England with Correlations to Surrounding Areas. In *Quaternary Glaciations--Extent and Chronology*. Part II, edited by J. Ehlers and P.L. Gibbard, pp. 169-1999.

Robert Swartwout Papers
New York Public Library, Rare Books and Manuscripts Division, New York, New York.

Rue, D. J., and A. Traverse
1997 Pollen Analysis of the Hackensack, New Jersey Meadowlands Tidal Marsh. *Northeastern Geology and Environmental Sciences* 19(3):211-215.

Salisbury, R. D. et al.
1902 The Glacial Geology of New Jersey. *Final Report of the State Geologist* [Trenton, New Jersey] Vol. 5. Geological Survey of New Jersey.

Schuberth, C. J.
1968 *The Geology of New York City and Environs*. Natural History Press, Garden City, New York.

Schuldenrein, J.
1995 Geoarcheological Overview of Bellman's Creek, Hackensack Meadowlands, New Jersey. On file, Geoarcheology Research Associates, Riverdale, New York.

Sidar, J. W.
1981 New Jersey Geological Surveys in the Nineteenth Century. *Northeastern Geology* 3:52-55.

Sidney, J. C.
1849 *Map of Twelve Miles Around New York*. Map on file, Johnson Public Library, Hackensack, New Jersey.

Snyder, J. P.
1969 *The Story of New Jersey's Civil Boundaries, 1606-1968*. Bureau of Geology and Topography, Trenton, New Jersey.

Stahle, D., M. Cleveland, and J. Hehr
1988 North Carolina Climate Change Reconstructed from Tree Rings: AD 372 to 1985. *Science* 240:1517-1519.

State Mosquito Control Commission of the State of New Jersey
1961 *Fifth Annual Report of the State Mosquito Control Commission of the State of New Jersey*. On file, Rutgers University, Alexander Library, Trenton, New Jersey.

1962 *Sixth Annual Report of the State Mosquito Control Commission of the State of New Jersey*. On file, Rutgers University, Alexander Library, Trenton, New Jersey.

1963 *Seventh Annual Report of the State Mosquito Control Commission of the State of New Jersey*. On file, Rutgers University, Alexander Library, Trenton, New Jersey.

1965 *Ninth Annual Report of the State Mosquito Control Commission of the State of New Jersey*. On file, Rutgers University, Alexander Library, Trenton, New Jersey.

Stone, B., S. Stanford, and R. Witte
2002 *Surficial Geologic Map of Northern New Jersey*. Miscellaneous Inv. Series Map I-2540-C.

Stone, J., J. Schafer, E. London, M. DiGiacomo-Cohen, R. Lewis, and W. Thompson
2005 Quaternary Geologic Map of Connecticut and Long Island Sound Basin. Scientific Investigations Map 2784.

TAMS Consultants, Inc.
2001 Riverbend Wetland Preserve: Sampling and Analysis of Sediment. On file, Hackensack Meadowlands Development Commission, Lyndhurst, New Jersey.

The Andrews School
2005 History of the Andrews School. Available online: www.andrews-school.org/school-history.html [October 2, 2005].

Thieme, D., and J. Schuldenrein
1996 Quaternary Paleoenvironments in the Hackensack Meadowlands: A Geological and Palynological Study of Borings for the Proposed North Arlington Force Main and Pumping Station, North Arlington, New Jersey. On file, New Jersey Meadowlands Commission, Lyndhurst, New Jersey.

U.S. Army Corps of Engineers (New York District)
2004 Meadowlands Environmental Site Investigation Compilation (MESIC), Hudson-Raritan Estuary, Hackensack Meadowlands, New Jersey. Final. On file, U.S. Army Corps of Engineers (New York District), New York, New York.

United States Coast Survey
1837 *Map of the State of New Jersey Between Hackensack and Bergen*. On file, National Archives, College Park, Maryland.

1839 *Map From Hackensack to Newark and Elizabethtown*. On file, National Archives, College Park, Maryland.

Van Valen, J. M.
1900 *History of Bergen County N.J.* N.J. Publishing & Engraving Co., New York, New York.

Van Winkle, D. (editor)
1924 *History of the Municipalities of Hudson County*. Lewis Historical Publishing Company, New York, New York.

Veit, R., and K. Walezak
1997 Phase IA Cultural Resource Investigation, The Wood-Ridge Site, Wood-Ridge and Carlstadt Boroughs, Bergen County, New Jersey. On file, New Jersey Historic Preservation Office (NJDEP), Trenton, New Jersey.

Vermeule, C. C.
1896 *Map of Hackensack Meadows to Illustrate Report on Drainage*. On file, New Jersey State Archives (NJDS), Trenton, New Jersey.

1897 Drainage of the Hackensack and Newark Tide-Marshes. *New Jersey Geological Survey Annual Report* 1896:287-317.

Vertical Files
On file, Bergen County Cultural and Heritage Commission, Hackensack, New Jersey.

Vertical Files
New Jersey Historical Society, Newark, New Jersey.

Wacker, P. O.
1975 *Land and People: A Cultural Geography of Preindustrial New Jersey*. Rutgers University Press, New Brunswick, New Jersey.

Walker, A. H.
1876 *Atlas of Bergen County, New Jersey*. Pease, C.C., Reading, Pennsylvania.

Westervelt, F. A.
1923 *History of Bergen County, New Jersey, 1630-1923*. Lewis Historical Publishing Company, New York, New York.

Wikipedia
2005 Jay Gould. Available online at http://en.wikipedia.org/wiki/Jay_Gould [September 9, 2005].

Winfield, C. H.
1872 *History of the Land Titles in Hudson County*. Wynkoop & Hallenbeck, New York, New York.

1874 *History of the County of Hudson*. Kennard & Hay Stationary M'fg. and Printing Company, New York, New York.

Wolfe, P. E.
1977 *The Geology and Landscapes of New Jersey*. Crane Russak, New York, New York.

Wright, K. W.
1988 The Hackensack Meadowlands: Prehistory and History. On file, Hackensack Meadowlands Development Commission, Lyndhurst, New Jersey.

Zimmerman, G. L., and K. A. Mylecraine
2000 Reconstruction of an Old Growth Atlantic White Cedar Stand in the Hackensack Meadowlands of New Jersey: Preliminary Results. Atlantic White Cedar Restoration Ecology and Management. Proceedings of a symposium held May 31-June 2, 2000 at Christopher Newport University, Newport News, Virginia.

APPENDICIES
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