EAST RIVER WATERFRONT ESPLANADE AND PIERS- INBOARD RESOURCES WHITEHALL STREET TO NORTH OF THE BROOKLYN BRIDGE PHASE 1A ARCHAEOLOGICAL ASSESSMENT

EAST RIVER WATERFRONT ESPLANADE AND PIERS- INBOARD RESOURCES WHITEHALL STREET TO NORTH OF THE BROOKLYN BRIDGE PHASE 1A ARCHAEOLOGICAL ASSESSMENT

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I. INTRODUCTION

The Lower Manhattan Development Corp. (LMDC) is the lead agency for the development of the proposed East River Waterfront Esplanade and Piers Project. The East River Waterfront Esplanade and Piers project is intended to revitalize the East River waterfront by improving a two-mile-long, City-owned public open space connecting the Whitehall Ferry Terminal and Peter Minuit Plaza to the south with East River Park to the north. The existing esplanade would be enhanced, some new sections of esplanade would be created, and several piers would be renovated and redeveloped. For the purposes of this study, the Project Site or Area of Potential Effect (APE) runs along present South and Marginal Streets roughly from Whitehall Street adjacent to Battery Park, north and east to Jackson Street, along the East River shoreline of the Borough of Manhattan. The APE has been broken down into ten segments corresponding to discrete project elements, and the rough boundaries of the segments are described below:

1. Whitehall Street to the south side of Broad Street
2. Broad Street to Vietnam Veterans Plaza, on South and Marginal Streets
3. Broad Street through Old Slip, on Marginal Street and Outboard of Bulkhead
4. Old Slip to the North Side of Pier 15 between Fletcher and John Streets
5. Pier 15 and Adjacent Channels
6. Marginal Street between Beekman Street and Peck Slip, Pier 18, New Market Building, and the Proposed Marina
7. North of Pier 15 (between Fletcher and John Streets) to Montgomery Street
8. Pier 35
9. Part of Pier 36, between Montgomery Street and Gouverneur Slip West
10. Pier 42

A more detailed depiction of the APE is found on Figures 1-4, which use the current Sanborn insurance atlas as the base map. According to current plans, projected subsurface disturbance in the APE will generally be no greater than five feet below the current surface, with certain exceptions. The roadway area north of the Battery Maritime Building (BMB) to the Vietnam Veterans Plaza would require more substantial excavation to move the entrance to the Battery Park Underpass approximately 350 feet to the northeast, as well as for the potential relocation of a sewer outfall. The proposed pavilions to be constructed beneath the elevated FDR Drive would typically be constructed on concrete slab footings to a depth of not more than three feet, including utilities. Specific outboard locations—those on the river side of the existing bulkhead—such as Piers 15, 35, and 42, for example, would be affected by pile driving and/or dredging.

Due to the length of the project corridor, as well as the multi-phased components of the proposed improvements, a Programmatic Agreement (PA) is being established between LMDC, the Advisory Council on Historic Preservation, and the New York State Historic Preservation Office (SHPO). The PA outlines the appropriate procedures for assessing the archaeological sensitivity of the APE. As described in the Final Environmental Impact Statement (FEIS), LMDC and the City will cooperate in the preparation of a Phase 1A study that will examine the potential for archaeological resources to be present in the Archaeological APE. The Phase 1A study will consider the entire Archaeological APE, with the exception of two areas that would experience

minimal disturbance (less than two feet in depth) for the Esplanade Project. These two areas are: the esplanade area that is outside the pavilions and South Street north of the Brooklyn Bridge. The Phase 1A study will be submitted to LPC and SHPO for review and approval. It is anticipated that the following phased approach to the required Documentary Study will conform to the PA so that the project can move forward and, at the same time, treat potential resources appropriately. Such studies may or may not indicate that further work, in the form of testing and/or monitoring during construction, will be required.

Historical Perspectives, Inc. has completed this Phase 1A study in compliance with the PA. The following documentary study of the proposed APE: 1) identifies categories of potential archaeological resources in the APE; 2) examines the construction history of the project site in order to determine the probability that any potential archaeological resources have survived post-depositional disturbances and remain in situ; and 3) determines whether additional study or testing regarding potentially-surviving archaeological resources is necessary.

This report, the second Phase 1A task, covers the inboard portion of the APE that is south (technically west) of the Brooklyn Bridge (the majority of Segment 7) (Figures 1-3). Separate Phase 1As cover the sections of the APE outboard of the bulkhead wall (Figures 1, 2, 4) and the portion of the APE that is north (technically east) of the Brooklyn Bridge (Figures 3, 4).

Methodology

To build a picture of environment, land use, and disturbance to the APE through time, various public and private offices and institutions were contacted and collections researched. This includes not only published and unpublished archaeological and historical literature, but also newspaper articles, pamphlets, correspondence, maps, soil boring logs, photographs, and drawings. These contacts and their offices and institutions are given below.

Contacts

Vasanth Battu, Outside Projects Department, Metropolitan Transit Authority
Melanie Bower, Manager of Collections Access, Museum of the City of New York
Norman J. Brouwer, Librarian Emeritus, South Street Seaport Museum
Kenneth Cobb, Assistant Commissioner, Department of Records, City of New York
Brian Cook, Topographic Bureau, Manhattan Borough President's Office
Diane Dallal, Technical Director for Archaeology, AKRF
Meghan A. Douris, Assistant General Counsel, New York City Department of Design and Construction (DDC)
Simon Gelin, New York City Department of Environmental Protection (DEP)
Jeffrey Katz, Section Chief, New York City Department of Design and Construction
Joshua Kraus, Project Manager, Lower Manhattan Borough Commissioner's Office, New York City Department of Transportation (NYCDOT)
Bill Lemke, URS
Matthew Monahan, Assistant Commissioner, Public Affairs, New York City Department of Design and Construction
Daniel Pagano, Archaeologist, New York City Landmarks Preservation Commission
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Suchi Sanagavarapu, New York City Department of Transportation
Vincent Soriano, Chief, BW&SO Mapping/Records, New York City Department of Environmental Protection
Rajen Udeshi, Principal Engineer, Outside Projects, CPM
Deborah Waters, Collections Information, Museum of the City of New York

Repositories
City Hall Library
Manhattan Community Board 1
Manhattan Borough President's Office, Topographic Division
Municipal Archives, Photographs–Department of Docks and Department of Ports and Trade; Manhattan Borough Presidents' Collection; New York City Mayors' Collection
New York City Department of City Planning
New-York Historical Society
New York Public Library (Humanities and Social Sciences Library)
New York Public Library (Science, Industry, and Business Library)

Online Resources
3dparks.wr.usgs.gov/nyc/index.html—"Geology of the New York Region," USGS
historicals.ncd.noaa.gov/historicals/histmap.asp—Office of the Coast Survey, Historical map and chart collection
rs6.loc.gov/ammem/browse—Library of Congress-American Memory
www.davidrumsey.com—David Rumsey Historical Map Collection
www.cooper.edu—"History Group EID101-D"
www.greenway.org—"East Coast Greenway-New York"
www.nycgovparks.org—"FDR Drive"
www.nycroads.com—"Franklin D. Roosevelt (East River) Drive
www.nylcv.org—"New York Waterfront Blueprint: Manhattan"
www.nottingham.ac.uk—"The 3Cities Project: JB Axelrod Essay"
www.oasisnyc.net/oasismap.htm—New York City Oasis (aerial photographs)

II. TOPOGRAPHY, PALEO-ENVIRONMENT, AND EXISTING CONDITIONS

A knowledge of Manhattan's geological history is essential for understanding the development and land-use history of both the project site and New York City. The island lies within the Hudson Valley region and is considered to be part of the New England Upland Physiographic Province (Schuberth 1968:10). The underlying geology is made up of "gneiss and mica schist with heavy, intercalated beds of coarse grained, dolomitic marble and thinner layers of serpentine" (Scharf 1886:6-7). The land surface in the metropolitan area was carved, scraped, and eroded by advancing and retreating glaciers during three known glacial periods. Before the final glacial retreat from the New York City area at the close of the Pleistocene (ca. 12,500 Before Present [BP]), melting ice formed a number of lakes in the valleys of the East, Hudson, and Hackensack Rivers, dammed by ice and glacially deposited moraines. Much of Manhattan Island, including the APE, was submerged beneath glacial Lake Flushing (USGS 2003).

When Lake Flushing drained as erosion ate through the moraine dams—probably through one or more massive flood events by 12,000 BP—Manhattan Island and the present channel of the East River, including the APE, were exposed as dry land. The release of meltwater during this same glacial retreat, however, also resulted in the rise of sea levels from about 400 feet below current levels 12,500 years ago, to about 10 feet below current levels between 4,000 and 2,600 years ago (Raber et al. 1984:10), flooding the APE. In short, the APE was exposed as dry land in ca. 12,000 BP, and then reflooded by ca. 2,600 BP as sea levels rose. For much of this period, the APE was not a shoreline location, and the channel of the East River was several miles distant.

Present Manhattan Island is marked by low hills and is surrounded by estuaries and tidal straits. These bodies of water, part of an embayed section of the Coastal Plain, are the remains of the channels of the Hudson, East, and Harlem Rivers, inundated by rising sea levels. Historical development has altered many of the topographic features which once characterized precontact Manhattan, and the current East River shoreline bears little resemblance to its condition during the early 17th century, when European colonization commenced. An examination of the Viele "Water Map," which charts the original shoreline of Manhattan, shows the APE submerged beneath the waters of the East River, lying between approximately 54 feet (Segment 7 between Frankfort Street and Catharine Slip) and more than 550 feet offshore (Segments 4 and 7 from Wall Street to Fulton Street) from the pre-fill/pre-bulkheading shoreline (Viele 1865) (Figure 5).

Intentional bulkheading and filling begun during the 17th century extended the shoreline to approximately its present location by the early 20th century (Sanborn 1928). According to the mid-19th century profiles of South Street, one covering Whitehall to Moore Streets (Smith 1846 – now part of Segment 1 of the APE) and the other between Roosevelt and Catharine Streets (Profile ca. 1851 – now part of Segment 7 of the APE), the then-existing street surface was between 2.1 and 8 feet above the high water mark. According to the current United States Geological Service (USGS) topographic map, the tidal rise from mean low to mean high water in Upper New York Bay is 4.5 feet (USGS 1981), indicating that modern, human-deposited fill extends at least 6.6 feet or more below 19th-century street levels.

Furthermore, regrading and the continuous paving and resurfacing of South and Marginal Streets in the APE raised the surface of the project site an additional number of feet by the 1950s. During the construction of the South Street Viaduct in 1952, the 1836 cobblestone street surface was encountered on South Street at Clinton Street (APE Segment 7), within 4 feet of the modern street level (*New York Times* 1952:25; Borough 1954).

III. PRECONTACT PERIOD

The precontact period on Manhattan Island and in the surrounding area can be divided into three time periods, based on the precontact population's adaptations to changing environmental conditions. These periods are generally known as the Paleo-Indian (ca. 12,000 to ca. 10,000 BP), the Archaic (ca. 10,000 to ca. 2,700 BP), and the Woodland (ca. 2,700 to ca. 500 BP). These precontact periods are followed by the proto-historic and historical European Contact period, (beginning ca. 500 BP), which is distinguished from the precontact by the first Native American interactions with European trade goods, traders, trappers, fishermen, explorers, and settlers.

Although the earliest evidence of humans in the New York City area appears during the Paleo-Indian period, approximately 12,500 years ago, and human occupation has continued into the present, there is no existing evidence of direct precontact occupation or exploitation of the APE. This is understandable, since before landfilling the APE was under water for approximately the last 2,600 years. As noted in the previous section, however, with the melting of the glacier at the end of the Wisconsin age and the draining of Lake Flushing, the APE would have been dry land available for exploitation by humans during the period from approximately 12,500 BP, when sea levels were 400 feet below current levels, until sometime between 4,000 and 2,600 BP, when glacial meltwater brought sea levels to 10 feet below current levels (Raber et al. 1984:10), flooding the APE. This time period corresponds roughly to the Paleo-Indian and Archaic culture periods.

The potential presence of submerged precontact sites far out on the continental shelf has been hypothesized for decades, and studies of near shore submerged sites were being published by the early 1960s (Emery and Edwards 1966). Unfortunately, the time, difficulty, and expense required to locate these sites, much less recover data, have resulted in the investigation of few submerged sites in this region. Ironically, our knowledge of precontact "coastal" adaptations, both in the New York City area and in other parts of the United States, is not generally based on sites that were coastal when they were formed, since the contemporary coast was many miles distant (Lewis 2000:528; Merwin, et al. 2003:46). Based only on terrestrial archaeology, we have an incomplete view of Archaic coastal adaptation, since few sites that were actually coastal have been investigated. Submerged archaeological sites from these periods would be extremely valuable because of the expected preservation of organic materials such as wood, plant fibers, and leather, which would survive in an underwater environment (Merwin et al. 2003:42, 51-52).

A review of available underwater archaeological literature regarding submerged site formation and the potential survival of submerged remains has proven somewhat inconclusive. There is no doubt that submerged archaeological sites do survive to a certain extent, and that certain data are preserved. This has been noted by archaeologists at submerged and partially-submerged sites around the world, including England, Denmark, Greece, Israel, South Africa, and Australia (Wilkinson and Murphy 1986; Stewart 1999:572-574; Merwin et al. 2003), as well as along the Gulf Coast of the United States (King 1981; Lewis 2000).

There is general agreement that rapid inundation increases the potential for a site's survival and integrity. Archaeologist George Bass noted in 1980 that gradual submergence "allows time for waves and currents to tear the site apart," while rapid submergence with a subsequent sediment

cover "protects both the artifacts themselves and their spatial patterning from destruction by water and marine organisms. Archaeologist David J. Stewart observed that the "pounding surf, [and] alternate periods of dryness and wetness" expected under conditions of slow inundation "can damage or destroy material, [and] even if artifacts are preserved, spatial context will be destroyed" (Stewart 1999:565).

Research along the Mississippi Gulf Coast conducted by Archaeologist R. Barry Lewis suggests that the submergence of low gradient and low energy (i.e., minimal wave and current action) shorelines, somewhat similar to those formerly in the APE, would have "tended to submerge rather than rework archaeological deposits." On the other hand, he also concludes that storm surges and storm tides are probably the most destructive agents on the Atlantic and Gulf Coasts (Lewis 2000:531, 536).

Based on data from a number of sites in the Eastern Mediterranean, Stewart agrees with Lewis' conclusions that archaeological sites on steep slopes tend to suffer more from inundation, since steep slopes become submerged more gradually than shallow ones,[1] and thus are exposed to direct tidal action for a longer period of time. Also, he observes that on steeply-sloping sites, artifacts erode out of their positions more easily and move farther downslope – away from their original positions. This migration is also affected by artifact size, shape, and weight. Israeli archaeologists have investigated a number of submerged coastal sites which exhibit some disturbance, but some artifacts are preserved in situ. One site, Athlit-Yam, a pre-pottery Neolithic (PPN) village (occupied ca. 8,100 to ca. 7,500 BP), was found 300 to 400 m (984 to 1,312 feet) offshore in 8 to 12 m (26.2 to 39.4 feet) of water, on a shallow slope of approximately 2° to 3°. Numerous stone structures, hearths, at least one well, and a wealth of artifacts, including organic remains, were recovered. Spatial patterning was preserved to the extent that activity areas (lithics work area, animal butchering area, etc.) could be identified. It is not clear, however, whether spatial patterning *within* the activity areas was preserved (Stewart 1999:572, 583-584).

Of course, Paleo-Indian and Archaic period sites in the New York City region are somewhat less substantial than PPN villages. New York Harbor, the drowned estuary of the Hudson River, has long been hypothesized as an attractive place for precontact human activity, based in particular on the resources of the surrounding land, the number of precontact archaeological sites found on its present banks, and the small number of known sites dating to between 10,000 and 6,000 BP. The largest cache of stone artifacts from a precontact submerged site (more than 200), was recovered in 1994-1995 by beachcomber Helene Corcione, who combed through sand that had been dredged for a beach replenishment project and deposited on the Central New Jersey shore. The sand and the artifacts, which included 24 Archaic period points, some of which dated to the Early Archaic, came from a modern "borrow" area 3 km (1.86 miles) east of Sandy Hook. The artifacts were believed to have been in the upper 2 m (6.6 feet) of the sand stratum, buried beneath river sediment and muck. A survey of the area around the borrow location was conducted by the Stony Brook University Department of Anthropology in July/August 2003, and found water depths in the vicinity ranging from 14 to 20 m (45.9 to 65.6 feet) (Merwin et al. 2003:46-47).

[1] Lewis' examples refer to slopes of 14° (steep) versus 2-3° (shallow).

Sea level curves constructed for New York Harbor by Paolo Pirazzoli in his 1991 *World Atlas of Holocene Sea Level Changes* indicate that offshore archaeological sites dating to 10,000 BP will be in water depths no greater than approximately 26 m (85.3 feet) below mean low water, and those from 6,000 BP will not be deeper than 14 m (45.9 feet) (cited in Merwin et al. 2003:46-47). These figures correspond roughly to the water depths from which Corcione's artifact cache originally dredged.

Several studies have hypothesized potential survival of submerged precontact and historical resources in and around New York harbor. In 2004, the Cross Harbor Freight Movement DEIS assessed the precontact potential in a location quite similar to that of the APE—in and adjacent to the 65th Street Yard in the Bay Ridge section of Brooklyn—an area of drowned land, partially under water, and partially filled and developed with piers and bulkheading. The report concluded that:

> the channels along the Brooklyn waterfront have been subject to repeated dredging and maintenance during the 19th and 20th centuries, and construction of the piers and bulkheads along the waterfront also frequently involved dredging and deposition of large quantities of landfill. Due to the expected extent of disturbance associated with these actions, it is unlikely that any undisturbed prehistoric archaeological resources are present under the bulkheads or immediate off-shore areas of 65th Street Yard (NYCEDC 2004:7-14, 7-15, 7-16)

On a site north of the harbor, an attempt was made in 2002 to locate potential submerged precontact and historical resources prior to a dredging program planned for the upper Hudson River. This involved the collection of a series of 967 sediment cores. The preliminary analysis by the archaeologists reviewing the cores found that 122 of the cores contained historical archaeological deposits. No precontact period artifacts were recovered in any of the 967 Hudson River cores reviewed (URS 2003).

Potential Precontact Archaeological Resource Types

Since they would pre-date the inundation of the APE, potential precontact archaeological resources would be expected beneath river-deposited stratum, which are generally identified in soil borings as "mud" or "river mud," or "silt," but could also contain sand and clay. Mud and clay are expected as the predominant deposits in relatively still water, such as is found between piers and in slips. Sandy strata beneath the mud and clay would represent river deposits found in flowing river channels, i.e., predating pier construction. Beneath these deposits, a sandy, glacial till stratum would be expected, representing the former land surface of ca. 12,500 to 2,600 BP. This would be glacial till left behind by the Wisconsin glaciation. If this former land surface is undisturbed by river currents, tidal action, and historical dredging and construction, it would be expected in this stratum. The preinundation land surface would be buried more deeply the closer a location is to the present river channel. Soil boring logs show deposits of river mud in many parts of the APE, but this mud stratum varies in thickness and in depth depending on location and historical dredging.

Physical evidence of dredging or current/tidal activity that may have destroyed or severely impacted strata with precontact archaeological potential would include thin or missing glacial till strata, such as locations where fill or river mud sits directly atop rock or hard pan.

In Lower Manhattan, there have been no documented archaeological investigations of the preinundation land surface. The nearest contender is the 7 Hanover Square Site (south side of Old Slip, between Water and Pearl Streets, 2 blocks west of the APE), at which a layer of red sand was encountered beneath later river deposits. This was originally identified as the intertidal zone of Manhattan's early-17th-century beach. Examination and testing of the red sand under the direction of Steven Selwyn, Ph.D., however, concluded that it was not a "'beach' horizon" deposit, but sand redeposited *underwater* by river or stream currents. Furthermore, the red sand did not come from the most recent Wisconsin ice sheet of ca. 12,500 BP, the sands from which would have been of a yellowish cast, but represented the deposits of an earlier glaciation from ca. 40,000 BP (Rothschild and Pickman 1990:Appendix C).

A second consideration in determining precontact archaeological potential is an assessment of a location's attractiveness to precontact hunter foragers. The normal criteria for evaluation include a dry, sheltered, well-drained location, near a fresh water source, and near an area rich in game and useful plant resources. Given the extreme changes which have occurred to the environment since the period between 12,500 and 2,600 BP, it is nearly impossible to reconstruct the ancient environment of the APE. It is worthwhile to note that for most of this time period, the channel of the East River was as much as several miles distant from the APE, until rising sea levels flooded the estuary and eventually inundated the APE.

IV. HISTORICAL PERIOD

Historical Period Overview

Before being superseded by the Hudson River during the mid-19th century, the East River was the main port of entry into New York City. Its advantages included a gently sloping shoreline sheltered from strong winds, and a channel with an average depth of 50 feet, deep enough for 17th- to 18th-century ocean-going ships (Gratacap 1909:112). As ships gradually got larger during the 19th century, commerce shifted to the Hudson, until the vast majority of Manhattan's shipbourne trade entered the City via the Hudson River by the 20th century.

The importance of the East River shoreline is reflected by the placement of the New Amsterdam settlement there in the 1600s. Ships moored in the deep water off shore, and would be unloaded into smaller boats which would ferry the cargo to shore. The first wooden dock was built in 1647 at what is now Pearl and Broad Streets, and the shoreline was ordered stabilized with wooden sheetpile seawalls during the 1650s (Bone 1997:92-93).

The East River was the center of activity, and continued as such after the British conquest in 1664, and following the American Revolution. As trade and other ship-related industries expanded, and ships became larger, there was an ever greater need for facilities and storage space. As a result, piers, warehouses, and other facilities were constructed along the shoreline, and in order to keep pace with other ports, they were continuously expanded and modernized (Buttenwieser 1999:11-13). They also became more permanent, as the construction techniques of the 1600s and early 1700s—piles, plank platforms, timber sheet piling, and stone embankments—gave way to solid-based cribworks. The calm waters of the new basins and slips created by the new docks accumulated silt and debris, requiring the institution of regular dredging (Bone 1997:94-97).

Waterfront development also included the expansion of the Island of Manhattan into the East River. With the Dongan Charter of 1686, the City of New York received title to, among other things, all lands and water bodies on Manhattan extending to the low-water mark, and allowing the City to "fill, make up, lay out, use and build on" lands then under water. The city began selling water lots to private citizens, provided that the new owner fill and build the street and wharf along the low-water line. The Dongan Charter effectively extended Manhattan 200 feet into the East River, and the Montgomerie Charter of 1730 extended City boundaries from Whitehall to Corlears Hook, another 400 feet beyond the old low water mark. As commerce recovered from the British Occupation during the Revolution, the Outer Streets and Wharves Act of 1789 provided for the creation of South Street beyond the 1730 400-foot line. The Act also provided for greater regulation by the City of new development, including surveying straight streets (South Street) to facilitate commerce, and allowing the City to take action to fill in gaps at the private owners' expense, if necessary (Buttenwieser 1999:28-29, 39-40).

A comparison of maps from this period, namely a 1793 map by Goerck and Van Sheecburgh (South Street Seaport Museum Library) and the Taylor-Roberts Plan of 1797 (Cohen and Augustyn 1997:94-95) illustrates this problem, showing the jagged East River shoreline with crooked, irregular Front Street interrupted by numerous slips and watery areas between piers.

The 1797 map does show the earliest section of the new South Street, however, extending a grand total of three city blocks, from Whitehall Street to Broad Street, and Broad Street to Coenties Slip. North of Coenties Slip, the location of the future South Street is punctuated by numerous wharves jutting out into the East River as far north as Beekman Street.

The opening of the Erie Canal in 1825 provided further impetus to New York's commercial and physical expansion. By 1827, the Goodrich Map shows South Street open from Whitehall Street north to Roosevelt Street, broken only by Coenties Slip, Old Slip, Coffee House Slip (Wall Street), Burling Slip, and Peck Slip. After a seven-block break of East River wharves, South Street is again shown on the map, from Rutgers Street east to present Jackson Street, but this appears to be a projection, with the existing shoreline drawn in to the landward side of South Street (Cohen and Augustyn 1997:115).

By 1849, with the exception of Coenties Slip, South Street ran uninterrupted from Whitehall to Jackson Street (then Jackson Slip). The shoreline was punctuated with piers, beginning with Pier 2 at the foot of Whitehall Street, and ending with Pier 57 at Jackson Slip. Although generally straight along the landward side, South Street's mid-19th century pier and river edge was still jagged. Although a 70-foot street width was mandated, the width varied from a low of 61 feet to as much as 108 feet wide, although it was generally between 61 and 80 feet wide. This additional area is labeled "Marginal Street" in many 20th-century atlases. "Marginal bulkhead platforms were often constructed to permit vehicle and pedestrian traffic access to the bulkhead line;" in other words, these additional filled areas facilitated the functioning of the piers and wharves, and sometimes also hosted structures (Alvord 1849; Sanborn 1975; Historical Perspectives 1987:30).

Department of Docks—East River Bulkhead

Subsequent filling and construction activities during the 19th and early 20th centuries gradually expanded South Street (including unlabelled "Marginal Street" areas) to its approximate boundaries at present. The proposed width was originally 200 feet, but this was modified to a projected 150 feet to provide an additional 50 feet for piers in the somewhat narrow East River (*New York Times* 1895). In spite of this, the modern street is generally 120 to 125 feet in width (Bromley 1921). The major innovation was the construction of the East and Hudson River bulkheads and associated structural systems begun in 1871 by the New York City Department of Docks. This initiative was partly in response to the run-down and squalid waterfront conditions that existed at the time, and New Yorkers' growing sense of, and pride in, their city as a center of world commerce. Design of the bulkhead was originally the responsibility of Civil War General George B. McClellan. The masonry-faced bulkheads and modern piers were to be the most up-to-date port facilities in existence, and were intentionally monumental to symbolize New York's international importance (Graham 1873; Bone 1997:99,102).

According to research conducted by AKRF, Inc. utilizing the archives of the South Street Seaport Museum, Department of Docks annual reports, and a structural conditions survey completed in 1989 by TAMS on behalf of the New York State Department of Transportation (NYSDOT), the bulkhead within the APE was generally completed by ca. 1890. The section between Piers 35 to 42 (east of Rutgers Street through Montgomery Street), however, was not constructed until ca. 1910. The documentary record is somewhat incomplete. In some cases, dates of original construction are suggested by recorded dates of bulkhead damage and repair.

The bulkhead north of the Brooklyn Bridge to Market Street, for example, was rebuilt in 1890 after being washed out by heavy tides.

Cartographic research indicates that the construction of new piers and the filling and expansion of Marginal Street behind the new bulkheads did not take place as soon as the new bulkheads were built, but were completed as late as the first decade of the 20th century. The 1891 Bromley real estate atlas does not record an expanded Marginal Street, and the piers are essentially the same as depicted in the 1885 Robinson atlas (Robinson 1885). More detailed maps from the collection of the South Street Seaport Museum Library (SSS 1903a; 1903b; 1907; 1911), showing bulkhead and pier facilities from 1903 to 1911, show an unwidened Marginal Street in the early 20th century.

For example, at Old Slip, the 1903 South Street Seaport Museum Library map (SSS 1903a – Figure 6) records a crib bulkhead ("CRIB B'H'D") at the foot of the filled-in slip, varying between 75 and 90 feet east of the landward side of South Street. Former Piers 11 and 13 are drawn in north and south of the slip. The bulkhead line is noted at 125 feet east of the landward side of South Street. Lest it be assumed that the 1903 map is simply out of date, two years later the 1905 Sanborn records a similar scenario, but with updated attributes. (Figure 7) There the "new" bulkhead line and proposed new piers are delineated with a dashed line, but former Pier 11 is still apparently functioning. Former Pier 12 remains as a stub, having been truncated to the new bulkhead line in preparation for the construction of new Pier 10.

The 1906 annual report of the Department of Docks notes expenditures for the construction of bulkhead walls and paving "new marginal street[s]" in all sections of the APE from Broad Street to Jackson Street. In the Old Slip section, from the upper part of Coenties Slip to just north of Wall Street (including the location discussed in the preceding paragraph), bulkhead expenditure was substantial ($248,596.07), especially in proportion to the total moneys ($371,875.54) already spent on the bulkhead there (Docks 1906:175-176), and the large volume of work corresponds to the projected bulkhead lines shown there in the 1905 Sanborn atlas (Sanborn 1905).

In other areas, such as the Broad Street to Coenties Slip section, where bulkhead wall and new pier construction had been authorized in December 1899 (Docks 1899:115, Map n.p.), the funds spent on the bulkhead wall in 1906 ($31,381.71) were a small part of the total expenditure on the bulkhead ($205,538.16), and suggest minor construction or even repairs. This is also apparent on the 1905 Sanborn Atlas, which shows no ongoing or projected construction in this area (Sanborn 1905).

As the maps also show (e.g., Sanborn 1905), even with completion of the new bulkhead, both old and new piers existed side by side. Old piers continued to earn revenue (Docks 1906:81) while the "old work" was gradually removed and new piers built (Docks 1899:82; 1906:175-181; 1914:172-175).

In summary, the monumental task of constructing new port facilities for the island of Manhattan did not end with the completion of the bulkhead wall. Filling and pier and street construction continued for many years after sections of the bulkhead were finished.

East River Drive
Despite the major improvement to the East River facilities, commerce still shifted to the better-endowed Hudson River. The East River piers became obsolete, and the adjoining area quickly declined to slum-like conditions. As its importance in shipping and related trades declined, the East River shoreline entered a new phase of existence, as the site of a new arterial highway—East River Drive—planned to relieve ever-increasing traffic congestion that followed the advent of the automobile. Under the direction of engineer Walter Binger, the Commissioner of Borough Works, and with the support of Borough President Stanley Isaacs, the grand opening of the Montgomery Street to Grand Street section of the East River Drive (now the FDR Drive), (adjacent to Segments 7, 9, and 10 north of the Brooklyn Bridge), took place on May 17, 1940 (Isaacs 1940: Box 5, Opening Ceremonies Program).

In a 1940 letter to Mayor LaGuardia, Borough President Isaacs noted, "There will still be required at some future date, the construction of an elevated express highway from Montgomery Street to South Ferry. I believe this will be needed when the Brooklyn-Battery tunnel is opened four years [1944] from now" (Isaacs 1940: Box 5, Letter 9/11/1940). With the interruption of World War II, construction of the planned elevated South Street Viaduct linking the FDR Drive with the Brooklyn Battery Tunnel and the West Side Highway had to wait until June 1951, when construction work began on the support foundations (*New York Times* 10/13/1951:14), under the direction of the contractor, the Fehlhaber Corporation of New York. The viaduct was designed to accommodate express traffic, while attempting to keep the number of supporting columns to a minimum so that local traffic on South and Marginal Streets would not be interfered with. The highway was completed in 1954, and opened on May 28 (Borough 1954).

By 1979, the steel and concrete structure had begun to deteriorate. In June of that year, a "small part" of the highway collapsed, "showering a parking lot with chunks of cement." This resulted in the banning of buses and trucks from the viaduct, and an engineering study "of the whole viaduct area" was initiated (*New York Times* 1979). Corrosion of the highway's supports was attributed to salt from de-icing operations (Bird 1980), and work began in 1980 on a new concrete deck, replacement of some structural supports, new drainage, and new lighting (*New York Times* 1980). The rebuilding was carried out by NYSDOT (www.nycroads.com/roads/fdr).

Potential Historical Archaeological Resource Types

Riverbottom Remains
These resources include discarded and lost cargo, and discarded material from shoreline activities. Prior to filling, the APE was part of the original harbor of Nieuw Amsterdam/New York, and potential for resources from this category would be expected within the strata of accumulated river muds, silts, and sands. For example, at 64 Pearl Street (between Broad Street and Coenties Slip, 3 blocks north of the APE), Archaeologists Rothschild and Pickman noted substantial numbers of late 17th-century artifacts in the stratum believed to have been the 17th-century East River bottom adjacent to an existing dock, and interpreted these as ship and shore discards and losses (Pickman and Rothschild 1981).

The nature of discarded remains is somewhat problematic, however, since they generally cannot be linked to any specific episode, person, household or business. Artifacts might be purposely

dumped, or accidentally lost from either ship or shore activities, from businesses and households adjacent to the underwater location, or dumped clandestinely, and/or with collected refuse from other locations.

This is not to say that under certain circumstances the data provided by riverbottom remains cannot be valuable as a dating tool or for other avenues of research. In his archaeological study of excavated Cruger's Wharf (Old Slip and Water Street, 2 blocks west of the APE), Archaeologist Paul Huey noted a red sand stratum more than 25 feet below modern street level, which was identified as the original river bottom, and two strata of river bottom deposits representing the period between ca. 1650 and the construction of the wharf in ca. 1740. Huey not only used the artifacts to date the strata, but he was able to interpret the pieces of ships rigging, numerous whole bottles, ceramic vessels, shoes, and other complete objects as items lost or discarded overboard during normal shipping activities. From this data he attempted to reconstruct the changing trading patterns of New Amsterdam/New York during the 17th and 18th centuries (Huey 1984).

Sunken Vessels

Sunken vessels are perhaps the most complex and sensational of the artifact classes that have been recovered in the landfilled areas of Manhattan. Sometimes decrepit vessels simply sank at their moorings, or in another case, ships even caught fire and burned (Historic Sites Research 1977:45). A systematic examination of the New York City Common Council minutes from 1675 to 1776 and 1784 to 1831[2] (MCC 1905, 1917) provides references to approximately 28[3] "Hulks" or sunken vessels in slips and docks. In each case, the Common Council took action to have the hulk removed. Only two cases are mentioned prior to the Revolution, when the Dockmaster was ordered to "Remove several Boats & Wrecks that have lien Sometime as Nusances in several of the Slips and Dock of this City" in 1729, and in 1769, when Lambert Losie and others were paid £7 5s to remove a wreck from "Elises Slip" (MCC 1905:III 477, VII 157). In comparison to the approximately 24 hulks recorded between 1784 and 1831, the paucity of references dating to the century before the American Revolution naturally reflects a smaller volume of trade. The increase in hulk removal during the 1780s, with five removals during 1784 and 1785 alone (MCC 1917:I 6, 27, 52, 80, 152, 170)—more than in the entire century before 1776—also documents the decrepit state of the Manhattan waterfront after the British occupation ended in 1783 (Bone 1997:96; Buttenwieser 1999:38).

The necessity for rebuilding war-ravaged and neglected harbor facilities, and the need to revive the city's trade after the seven-year occupation, were probably the original motivating factors behind the Common Council's more proactive role in slip and wharf maintenance, beginning in the 1784 with an order to the aldermen to investigate the presence of "Old Hulks and other Incumbrances" in the slips in their wards (MCC 1917:I 60-61). In December 1805, the involvement of the Council with and its scrutiny of these issues was underlined by the creation of the Standing Committee on Wharves, Piers and Slips (MCC 1917: IV 106-107), whose three aldermen recommended action to the full Council (Ibid.:VII 645-646).

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[2]The intervening period represents the British occupation of the city, 1776-1783.

[3]In one case, more than one hulk is noted but not the exact number (MCC 1905:III 477; 1917: I 152, 170). In other cases, based on the date and location, it is unclear whether the same vessel is being referenced (e.g., MCC 1917:I 223, 230-231).

Two general courses of action taken were by the Common Council when a hulk was blocking the channel of a slip or wharf. The Council either ordered the owner of the vessel to remove it (MCC 1917: I 52), or directed a municipal employee or official to have the hulk removed and to bill the owner (Ibid.:VI 171, VII 601). In cases in which the owner could not be found, the Council ordered the work done at Council expense (Ibid.:VII 264). The title of the official varied, depending on the circumstances. The "Corporation Wharfinger" was ordered to take charge in the case of Whitehall Slip in 1790 (MCC 1917: I 612), in 1799 and 1818 hulk removal was referred to the Street Commissioner (MCC 1917:II 543, IX 739), and in 1810 and 1812 the "Superintendent of Repairs" (MCC 1917:VI 171, VII 264, 601).

Council action regarding hulks often began with complaints from "Sundry Inhabitants" (MCC 1917:I 52, VII 601), ships' captains (Ibid.:XVI 607), underscoring the fact that the offence was a very public one, affecting not only City revenue, but private revenue as well. Private wharves and piers were generally controlled by multiple proprietors, who were required to build and repair the piers, and keep the slips open for passage (e.g. MCC 1917:II 144, III 284-285, V 105). At Burling Slip, for example, a petition was filed in 1803 by John Riker, Simeon and Rem Remson, Jordan Wright, Thomas Pearsall, and other merchants that owned land near the slip in order to elongate it eastward. They further requested that the owner of the water lot adjoining the wharf (George Codwise) be directed to take out his grant and complete the construction of a 25-foot-wide wharf alongside the slip by December (MCC 1917:III 294). Responding to the petition, in 1807 Peter Schermerhorn and George Codwise filed a petition for the construction of a pier or wharf at Burling Slip and requesting compensation by the City of New York (Ibid.:IV 471). The Common Council concluded that Schermerhorn and Codwise should be permitted to contract with someone to build a pier and that the City would pay one-third of the expense. In return, they would be entitled to receive the wharfage on the east side of the pier for two berths of ships, or for the use of the water within 60 feet of the pier (Ibid.). The pier was to extend from the south side of South Street out into the East River. In 1811 inhabitants near the slip complained to the Common Council that sea vessels were in the habit of lying in the slip to the exclusion of the coasters, which was impeding trade in this part of the city (Ibid.:VI 698). The citation of Burling Slip being a "public slip" in 1810 indicates no private ownership (Ibid.:VI 73).

Furthermore, proposals from private citizens offering to remove hulks suggest that a hulk was somewhat valuable for its constituent parts. As with any contract, a cash payment for the removal was specified (MCC 1917:I 152, 170, 301, II 543, VII 275), but agreements often specified that the remover receive the hulk *and* a cash payment, as in 1812 (Ibid.:VII 237), and in 1788 at Albany pier (west side of Coenties Slip) (Ibid.:I 402). In 1804, the Council had a hulk sold for its own profit (Ibid.: III 475). Even the old wood was useful. In 1784 there were two recorded instances in which payments were assigned to third parties for breaking up hulks to provide "fewel [sic] for the Poor" (Ibid.:I 27; there are others, e.g. in 1824: XIII 790-791). The seriousness with which obstructions to commerce were viewed is perhaps evidenced by the fines assessed for "incumbering" public slips, when those who bought the hulks did not remove them quickly enough, as was the case in 1824 (Ibid.:XIII 790-791).

Orders for removal regularly demanded immediate compliance, "without delay" (MCC 1917:III 325, XVII 413), or threatening fines (Ibid.:VII 645-646), or legal action (Ibid.:I 52, 60-61; VII 232). Removal was not always immediate, but eventually it did occur. When legal action was necessary, it was not always the swiftest course. A privateer sunk in Beekmans Slip was ordered removed in June 1784, a judgment against the owners appears to have been made in September 1784, a bid for removal made in July 1785, and the matter settled in July 1786 (Ibid.:I:52, 152, 223, 230-231).

Research on sunken ships completed in 1992 for the Route 9A Project followed the fate of three ships which sank on Manhattan's Hudson River shore during the 19th century: at Warren Street (1829), Chambers Street (ca.1827), and Canal Street (ca.1812). The ship at Canal Street, the *Sally*, was ordered removed by the Council, which paid Joseph Brundidge $15 for the completed task in 1812 (MCC 1917:VII 275). The ship at Chambers Street was subsequently raised at the order of the Council (Ibid.:XVI 607, XVII 413). With the Warren Street wreck, there was no evidence from Council records that the ship had been raised. During the 20th century, teak timbers had been unearthed in the vicinity of Warren Street, which with the 19th-century report of the ship's sinking led to the designation of Warren Street as potentially sensitive for ship remains. Research on Warren Street noted, however, that the street had probably been filled by the time the vessel sank and was supposedly buried there, and that the ship may actually have sunk in the channel beyond the bulkhead. Furthermore, the teak timbers recovered were unmilled, and therefore probably not from a ship. As a result, the site was deemed not to be sensitive. (Hartgen and HPI 1992:11,12,14).

Archaeologists Kardas and Larrabee investigated the well-documented sinkings of the *Great Republic,* the *Joseph Walker,* and the *White Squall,* which occurred when a fire swept through the docking area around Dover Street in December 1853. Despite the "considerable litigation" which followed the burnings, the wrecks were eventually removed, which Kardas and Larrabee attribute to the pressure for usable dock space along a busy waterfront (Historic Sites 1977:45).

Considering the importance of the slips and wharfage to the commerce of the City, it is highly unlikely that a hulk would have entered the archaeological record in a functioning slip or dock via "accidental" sinking or simple abandonment, given the continuously increasing need for dock space and the inherent value of the hulk itself. This is especially true given the active interest in preventing obstructions to commerce displayed by the Council. Furthermore, as ships became larger with deeper drafts during the 19th century, pier slips were made wider and deeper through dredging to accommodate them (Harbor Commissioner 1857; USC&GS 1906; Buttenwieser 1999:40-41), making it a virtual impossibility that a sunken vessel would escape removal. This phenomenon has also been noted by archaeologist J. Lee Cox, Jr. in his predictive model for shipwreck sites in the Philadelphia region (Cotter et al. 1992:464).

A second method of disposing of hulks, however, was to incorporate them into landfill by filling them with earth and sinking them. This does not seem to be the preferred method, at least by 1786, although to modern sensibilities it would seem to be the simplest. In the case of the privateer described earlier, the hulk was "partly on the Ground where the street is to be made," and attempts were made to remove it, but it was concluded that it "Cannot be raised." The Council's committee recommended "that the Hulk or wreck, lying in the slip be fill'd level with

the street—That the petitioner be permitted to extend the street to the width of twenty feet at his own expence [sic]"[4] (MCC 1917: I 52, 230-231). A second incident, in 1815, involved a "dismantled sloop" in the head of New Albany Basin (Hudson River), which "prevents filling," and legal action had to be taken to have it removed so work could proceed (Ibid.:VIII 232).

Along the former East and Hudson River shorelines, several examples of such vessels have been found by construction workers, and fewer excavated and/or recorded by archaeologists. Most notable among these was the hull of an early-18th century vessel found in the basement of 209 Water Street, later part of the South Street Seaport Museum, and the ca. 1720 ship excavated at 175 Water Street.

The ship excavated at the 175 Water Street site, unofficially dubbed the *Ronson* after the site developer, is of great historical significance, since it is not only an example of 18th-century landfill techniques, but also the only surviving example of a cargo vessel built during that period (Brouwer 1980; Hartgen 1992) and "a rare example of the eighteenth-century shipwrights' art" which is poorly documented (Rosloff 1986). Once it had outlived its usefulness, the 92-foot long, 25-foot wide vessel had been purposely sunk parallel to the shoreline and covered with fill. The bottom of the hull was found at 18 feet below grade (Bergoffen 2002). Analyses could not determine its country of origin, but based on the warm water shipworms embedded in the *Ronson's* pitch-and-horsehair sheathing, it may have plied the waters of the Caribbean (Rosloff 1986; Cantwell and Wall 2001) or possibly served in the tobacco trade along the coast of North Carolina.

For the purposes of this discussion, the locations and time periods of these vessels are notable, since they were, without exception, further inland than the APE where the 18th century shoreline terminated, and therefore represent the filling practice of an earlier period. The *Ronson,* found in building lots on the north side of Front Street—a block northeast of the APE—dated to ca. 1720. Sections of another early 18th-century ship were recorded at 209 Water Street, a site also similar in relation to the APE chronologically and physically. Portions of ships were also noted in excavations for Hanover Square in the 1960s, an area filled before 1730 (Cohen and Augustyn 1997:55). The ship originally identified as the *Tijger* was encountered near Dey and Greenwich Streets, an area filled in by ca.1760 (Cantwell and Wall 2001:234; Bergoffen 2002:3-4; Cohen and Augustyn 1997:64, 71). Archaeologist Celia Bergoffen also notes an example of this landfilling technique in England, during the 1720s (Bergoffen 2002:4).

As noted above, it is unlikely that a vessel would have entered the archaeological record via sinking or simple abandonment in a slip or other outboard location, given the importance and profitability of the slips and wharfage to the well-being of the City and its inhabitants, as well as the intrinsic value of the vessel itself. According to Common Council minutes, a much more strict and organized posture was adopted regarding sunken vessels and pier and slip maintenance during the reconstruction following the American Revolution. Documentary and archaeological research on known sunken vessels in slips identifies none that were not raised and removed subsequent to 1786, which predates the earliest documented pier and slip construction in the outboard sections of the APE by approximately 14 years. In addition, by the 1780s, the use of vessels as landfill retaining devices—at least in water lots which were to become municipal

[4]The location is presently Beekman Street between Water and Front Streets, outside the current APE.

streets—was avoided by the Common Council, which appears to have monitored this practice also. The hulk noted on Beekman Street in 1786 was only permitted to remain because it could not be raised, and others noted were removed. Although archaeological evidence records vessels incorporated into landfill as late as the 1760s, this practice had fallen from favor by the 1780s, and certainly by ca. 1800, by which time the New York waterfront had been renovated and rebuilding was proceeding. As noted in the Route 9A Corridor report, early 19th-century landfill "dates from a time in the city's history when a conscious effort was made to standardize fill retaining devices and keep the harbor free of hulks and the potential for sunken ships to be incorporated into the landfill is limited" (Hartgen and HPI 1992:10).

Therefore, based on the preceding discussion, only sections of the APE that were bulkheaded and filled prior to 1800 will be considered potentially sensitive for this category of archaeological remains.

Landfill Retaining Structures, Wharves, and Piers

Historic cribbing and bulkheads—devices for retaining fill—have been a subject of archaeological investigation for many decades (See e.g., Historic Sites Research 1978), and docks and wharves, some of which eventually functioned as landfill retainers, are known to have existed throughout the APE prior to the construction of present South and Marginal Streets.[5] All utilized similar construction techniques, which evolved from an almost vernacular tradition in the 17th and 18th centuries, to the recorded, standardized construction practices of the late 19th century.

According to Architect Kevin Bone (1997), a bulkhead wall is "a retaining wall along a waterfront, which shores up the embankment in order to stabilize it for the construction of wharves and piers." The term is believed to have originated with New York City engineers (Bone 1997:272). A wharf refers generally to a structure at which vessels unload cargo (Ibid. 277), although some sources distinguish between a marginal wharf, or quay, which is a parallel extension of the shoreline, and wharves which extend more or less perpendicular to the shoreline, usually called piers (Joseph et al. 2004:178-179).

Prior to the late 18th century, the chief method of land extension and wharf construction in the New York City area was by the creation of sheet-pile seawalls. Debarked logs of American white oak, sharpened to a point at one end and shaped at the head to accommodate a pile cap, would be driven side by side into the mud of the river floor with a log or stone drop hammer. They would then be anchored together with heavy horizontal wood planking secured to the outboard face of the piles. The planking would retain the fill which would be deposited on the landward side. Sheet piling was also employed in the construction of docks and wharves (Bone 1997:92-96), and according to a description written by Freeman Hunt in the April 3, 1840 edition of the *Merchants' Magazine and Commercial Review*, the practice continued well into the 19th century (Small 1941).

Other methods were developed for specific circumstances, such as shallowly-inundated building lots. At 7 Hanover Square, stone house foundations are believed to have been laid directly on the river bottom in ca. 1687-1697, in what was interpreted as the intertidal zone on the outboard side

[5] Sunken ships, also used in this capacity, are discussed separately in the previous section.

of present Pearl Street. The stone foundations not only supported the new houses, but also seem to have been employed to retain landfill (Cantwell and Wall 2001:236-237; Rothschild and Pickman 1990).

Sheet piling was also employed to surround riprap embankments, and combinations of piles, planks, stone embankments, and sheet piling were the dominant construction method to the time of the American Revolution. By the late 18th century, during the post-Revolutionary War rebuilding of Manhattan waterfront facilities, cribworks—wood-frame, "boxlike receptacles" with solid bottoms and open sides, filled with loose stone and sunk to river bottom—provided larger, sturdier supports for retaining walls and wharves, where pile-supported structures could not be built or proved unstable in the face of strong river currents and ice. The larger number of laborers available after ca. 1800 to man the required derricks and rigs made this type of construction more feasible. The river floor would be dredged, clearing mud and loose debris down to the bedrock or hardpan substratum. The crib bottom was fitted to the river floor's contours, and the cribwork was carefully filled with stone, mud, sand, and sometimes even concrete, and pinned to bottom. If the crib facing were constructed so tightly that earth alone could be used as the fill, it was called a "solid-filled crib" (Bone 1997:96-99; Joseph et al. 2004:178-179).

The more primitive construction form, using notched, unhewn logs, and larger fill cells, was known as a cobb[6] wharf, and the fill supposedly consisted entirely of stone (Joseph et al. 2004:179). Often the fill included other materials, such as ballast rock and coral, brush, and tree stumps (Louis Berger 1990:V-3). Cobb construction, with its less accurate joints, was less durable and stable than cribwork (Bone 1997:96-99). The 1690s cobb structure excavated at the Barclays Bank Site (75 Wall Street, corner of Wall and Water Streets) was built with rough logs joined to form a series of 5-foot-square compartments. The structure was secured in place by pilings, and filled with rock and coral (Louis Berger 1983).

Data illuminating 18th- and 19th-century wharf construction practices in Lower Manhattan has been accumulating since the 1960s, as examples of cobb-type construction have been uncovered at a number of archaeological sites. Archaeological excavations conducted in 1969 on the site of Cruger's Wharf, at present Old Slip and Water Street (west of the APE), also uncovered part of a wharf of cobb construction, built in ca. 1740 (Huey 1984). The cobb components were encountered approximately 5 feet below the 1969 street surface, and extended an additional 17 feet down to what had been the ca. 1740 riverbottom. As the shoreline was extended from Water Street to Front Street by ca. 1765, fill placed on the landward side of the L-shaped wharf had "transformed" it into a retaining wall/bulkhead.

During the excavations for the Telco Block (site bounded by Water, Fulton, Front and John Streets, west of the APE) the tops of the wooden members of a mid-18th-century cobb wharf complex were consistently encountered at or below mean sea level, which was at approximately 5.5 feet below the curb, and an exposed section extended to 9.5 feet below mean sea level, to what was interpreted as the riverbottom. Deposits within the cobb wharf were stones, as would

[6] Cobb, or cob, may refer to a beating or spanking administered with a flat piece of wood, such as would make up the cribbing, or more likely, to the cobbles used in the fill.

be expected. Lines of plank bulkheading were added as the wharves were incorporated into the shoreline system (Rockman, Harris, and Levin 1982:60, 64-68, Figures 3.10, 3.12).

The most complete study of such structures in Lower Manhattan took place at the Assay Office Site, on the block between Front and South Streets, and Wall Street and Gouverneur Lane, a block west of the APE. Plank bulkheads, as well as a cobb wharf complex dating to the 1790s, were unearthed beneath the basement floor levels of modern buildings. These represented multiple fill episodes, and were encountered in a fill stratum beginning approximately 8 to 13 feet below street level. Large logs of approximately 1 foot in diameter were used in the cobb frame, which from its base was 15 feet high. The 4-foot by 8-foot cells had well-built, split timber floors. The various wooden elements were attached to each other through carefully-prepared wooden joinery, and even some metal fasteners (Greenhouse 1984: 2, 3, 4, 10, 13-14; Louis Berger 1990:Fig. 4.2, IV 3,14-17; 1991; Cantwell and Wall 2001:230-233).

Predating the cobb wharves, a wharf type known as "block and bridge," was also uncovered at the Assay Office Site. In this case a series of wooden "blocks" 20 feet square and 40 feet apart (the blocks could also be masonry), and spanned by plank "bridges," had been constructed before the 1780s. This design allowed the river currents to pass through the pier, avoiding some of the buildup of mud and debris which occurred with solid wharves. As with many other piers, when the adjacent river was filled, the underwater spaces between the blocks was closed with planking, and like the adjacent cobb wharves, became part of a landfill retention system (Cantwell and Wall 2001:232-233). Cantwell and Wall note, in retrospect, that the sections of Cruger's Wharf and the wharf on Beekman Slip at the Telco Block were actually parts of block and bridge piers (Ibid.:325).

Only one excavation along the Hudson River has revealed the presence of wharves, in this case, a cobb-type construction. The wooden members were encountered during monitoring at Site 1 of the Washington Street Urban Renewal Area, and were dated to the late-18th and early-19th centuries. Although somewhat distant geographically from the APE, the remains are notable for providing valuable information on the joinery and fastenings employed on such constructions (Louis Berger 1987).

A grillage/raft type wharf employed construction techniques similar to that of a cobb wharf. As the name implies, it was a solid raft-like structure built of timbers laid as headers and stretchers, incorporating layers of stone. Additional "rafts" were built and stacked until the required height was reached. It would then be floated out to the intended location, filled with stones, and sunk (Joseph et al. 2004:179). Although more famous for the excavation of the *Ronson*, the 175 Water Street site (on the block surrounded by John, Fletcher, Water, and Front Streets, west of the APE) also uncovered wharf construction of this type, dating to ca. 1750 (Geismar 1983:117,203; Louis Berger 1990).

As was the case at the Assay Office Site, the remains of wharves and landfill devices may still survive beneath modern building foundations. Soil borings and test pits performed during a preliminary archaeological assessment of Block 97 (lots along the east and west sides of Front Street between Beekman Street and Peck Slip, west of the APE), in 2002, encountered wooden beams apparently belonging to cribbing or other landfill devices beneath building foundations on

and extending below the current water table, which was encountered between 3 feet 8 inches and 5.5 feet below grade (Test Pit 1, 214 Front Street Block 97 Lot 37), and in fragments in all the soil borings (Bergoffen 2002:11-12). Monitoring was recommended in this case, but unlike the APE, these were building lots, not streetbeds.

During the 1870s, with the establishment of the New York City Department of Docks and the advent of the modern bulkhead system, East River bulkheads, piers and wharves were constructed following "modern" techniques (Figures 8, 9, 10). Rather than cribbing, piers were built with a deck of wood or concrete atop wooden piles driven into the hard bottom in various combinations, often given greater stability by being driven through riprap or broken stone placed for that purpose (Greene 1917:28-33). A description of, and the impact of this construction on potential archaeological resources is provided later in this report.

Landfill Deposits

As described in the previous section, the APE was gradually filled in incorporating structures built using a variety of bulkhead- and wharf-building techniques. Given South Street's distance from the historical shoreline of Manhattan, landfill activities only impacted the APE during the 18th century, and continued through the 20th century. As wharves and bulkheads were built, rebuilt, and replaced, the slips and channels between piers were filled, eventually creating the land for South and Marginal Streets. Landfill is especially likely to contain artifactual material (e.g., Historic Sites Research 1978:14-15; Huey 1984), particularly in the strata closest to the surface (Historic Sites Research 1991:277-278, 282) (Figures 11, 12, 13). Such archaeological evidence is useful for documenting past lifeways, as well as for dating when and how fill was deposited.

Questions have been raised regarding the interpretation of artifacts from landfill deposits. As noted in the Louis Berger Assay Office report (1990:VI-14,-15), earlier interpretations of the artifact content of landfill soils (Greenhouse 1984; Rothschild and Dallal 1983:10) were based on the supposition that the artifacts were representative of the material culture of New York City during the time period concerned, and could be used to examine social and economic processes taking place in the City. This is problematic, since the origin of the fill is generally unknown, and the artifacts cannot be tied in to specific households or businesses, or even general classes of these entities. This was already acknowledged in the 1982 Telco Block (bounded by Water, Fulton, Front and John Streets) report, which reviewed the interpretation of the large amounts of leather and shoe fragments recovered in the excavations of six Lower Manhattan landfill deposits. Earlier analyses such as the 64 Pearl Street study (Pickman and Rothschild 1981) had attempted to connect these artifacts with nearby tanners and shoemakers, but the data from Telco suggests that the fill, a combination of domestic and commercial refuse, had been brought in from an unrelated outside source (Rockman, Harris, and Levin 1982:78).

The Berger report recommended "that landfill soils be used only to describe the specific depositional histories of the sites under investigation," that is, sampling these soils for the purposes of recording the landfill deposition history of a site (as e.g., at Telco), as opposed to in-depth artifact analysis. Of course, if "unusual" artifact deposits are found, such as a china "dump," or rare artifacts, these would be important for recovery as contributions to the study of the ranges and forms of available material culture in the City (Louis Berger 1990:VI-14, -15;

Rockman, Harris, and Levin 1982:54,56ff). To this could also be added fill that can be reliably assigned a narrow date range. This has occurred on the 7 Hanover Square site (south side of Old Slip, between Water and Pearl Streets, 2 blocks west of the APE), where documentary research determined that the landfill episode occurred between 1687 and 1697. Thus, in addition to the recovery of examples of 17th-century utilitarian earthenwares from the Dutch potting center of Bergen op Zoom, it was possible to use the faunal evidence to study foodways in late 17th-century Manhattan (Rothschild and Pickman 1990).

Primary Landfill

As described in the previous section, within the landfill support structure, archaeologists have theorized two broad categories of fill strata. The first-deposited, and largest of the strata, would be the landfill placed within the various types of support constructions. Archaeologists Kardas and Larrabee, in their report on excavations on Schermerhorn Row at South Street, refer to this as "Primary Landfill," and the process as "land-making." The landfill consisted of large- and medium-sized rocks in a matrix of "dark grey to black muck with some clay." They suggest that the presence of clay in the matrix is probably beneficial, since it could inhibit its being washed out of the cribbing (Historic Sites Research 1978:138-139; 1991:277-278). On the other hand, this would depend on the support structure, since as discussed earlier, cobb-style wharves for example, were designed only for bulky fill such as rocks.

As at Schermerhorn Row, primary landfill at the Assay Office Site (southern side of Block 35, bounded by South Street, Old Slip and Front Street) was identified from the presence of timbers and mud—the components and contents of landfill structures—discerned from soil boring log descriptions. This stratum ranged from 10 to 20 feet thick, beginning approximately 8 to 13 feet or more below street level. During subsequent excavation, several types of wooden bulkhead and landfill structures, including cob and block-and-bridge wharves, representing multiple fill episodes, were identified in this stratum (Greenhouse 1984:13-14; Louis Berger 1990:Fig. 4.2, IV 3,14-17; Cantwell and Wall 2001:230-233).

On the Telco Block, discussion of the landfill encountered also separated the strata into two main groups, namely: "Fill category 1,"—found as high as 1 foot above mean sea level, and extending into the water table—which seems to correspond to what Kardas and Larrabee would term secondary fill; and "Fill category 2," corresponding to primary landfill, which lies beneath Fill category 1 and extends to the former river bottom (Rockman, Harris, and Levin 1982:77). It was also noted that, like Schermerhorn Row, the lower landfill strata ("Fill category 2") had a much lower artifact density than the upper fill ("Fill category 1") (Rockman, Harris, and Levin 1982:77,79).

Few artifacts are to be expected in the primary landfill stratum (aside from the support structure and clean fill itself, which are technically artifacts), because decaying, artifact-rich garbage was avoided because it would compress unevenly, settle at varying rates, and cause instability (Historic Sites Research 1991:278).

Such was not the case at the end of the 17th century, when fill was deposited at 64 Pearl Street (between Broad Street and Coenties Slip, 3 blocks north of the APE). Analysis indicated that although comprising one fill episode, the landfill came from multiple loads of soil taken from

different locations. Although archaeologists found that 19th-century building construction had virtually eliminated the secondary fill layers, the primary landfill strata were still present beneath the existing building's basement floor. The 64 Pearl Street landfill had been carried out under the supervision of private owners who seem to have acquired a combination of sterile subsoil and loads of artifact-bearing topsoil/garbage deposits. The artifacts were used to date the landfill to the late 17th century. Oddly, landfill retaining devices were not encountered, although in the "gray silt clay" stratum beneath the landfill, and interpreted as the 17th-century East River bottom, there was a concentration of planks, boards, rocks, and pieces of brick—materials suggestive of such constructions. Subsequent to this landfilling episode, the Common Council issued an order in December 1691 that lot owners "Vse the Dock Mudd Twenty ffoot into the Dock before their owne houses for the filling up of their owne Lotts." Archaeologists Rothschild and Pickman observed that the landfill from water lots filled with "Dock Mudd" could be virtually indistinguishable from the river deposits beneath it (MCC 1905:I 259; Pickman and Rothschild 1981).

In analyzing landfill from the time of the 1691 "Dock Mudd" order (1687-1697) at nearby 7 Hanover Square, Rothschild and Pickman noted the use river mud—a green gray silt in ca. 1697 landfill—at a location in which documents record Teunis DeKay's agreement to fill an area with "mudd" following construction in the summer of 1697. Landfill in these locations was distinguishable from that on other parts of the site, and may have been mud dredged from the river bottom, as DeKay agreed (Rothschild and Pickman 1990).

By the 1790s, however, in response to a series of yellow-fever epidemics, the City government made mandatory the use of clean, sterile sand for fill, based on the fear that the decaying garbage often included in fill was a source of disease. Archaeologist Joan Geismar compared the contents of two landfills, one created before the epidemics (175 Water Street), and the other after the fill legislation had been passed (Washington Street on the Hudson). She found that there were still some lawbreakers, but New Yorkers did add less garbage to the later fill (Geismar 1983; 1987; Louis Berger 1987).

Although the acquisition and deposition of landfill is poorly documented, various references suggest that clean landfill material was generally obtained from regrading and construction projects in other parts of Manhattan. An 1828 observation regarding the drained "fresh water pond," in the City Hall vicinity, reports that "several large hills or mounds of earth that environed the pond ... have all been leveled, and the ground thrown into the ponds" (Stokes 1926:1,671, 1,828). As Geismar discovered, there were unscrupulous landowners who used "dirty" landfill, such as redeposited nightsoil encountered at the Assay site (Greenhouse 1984:14), but references to this behavior seem to concern organics in more surficial fill, rather than in the primary landfill (Historic Sites Research 1978:15).

Primary landfill, like the superstructure which it filled, would bring the location's elevation to about mean sea level or a few feet below, but notably not above the high tide level (Historic Sites Research 1991:279). At Schemerhorn Row, this stratum extended from five to more than 20 feet below the existing surface in 1981-82 (Historic Sites Research 1991:282) (Figures 11, 12). At the Assay Site this figure was between approximately 8 and 13 feet below the surface, with mean sea level noted at 5 feet below the surface (Louis Berger 1990:Fig. 4.2, IV 14-17). On the Telco

Block, as noted earlier, primary landfill ("Fill category 2") appeared below the water table and extended to the former riverbottom (Rockman, Harris, and Levin 1982:77).

Secondary Fill

In the same excavations at Schermerhorn Row, Kardas and Larrabee noted a layer of reddish-brown sand atop the primary landfill, which they termed "Secondary Fill," and hypothesized that it was utilized to cover the rough and rocky primary landfill, providing a working surface for construction. It contained less rock than the primary landfill, and was where most of the artifacts recovered by the excavations were found (Historic Sites Research 1991:278-279). (Figures 11, 12) Archaeologists at the Telco Block likened this upper fill stratum to "redeposited refuse" (Rockman, Harris, and Levin 1982:77).

This corresponds to recorded historical observations of the filling of water lots by their owners, using "earth and trash (whose buckles and bricks and china and bits of ships are treasures today)" (Shumway 1975, quoted in Historic Sites Research 1978:15). At a time of deadly yellow fever outbreaks, as noted above, there were objections to the prevalence of refuse in this stratum, but the worries seem to center on the unhealthiness of decaying organics in the refuse, rather than the presence of discarded artifacts. Four ordinances regarding the filling of sections of South Street at Whitehall were passed by the Common Council in 1796, indicating that the "filth" in the fill was the cause of illness. It is also significant that the artifact-rich refuse targeted by the Common Council seems to be secondary fill, since it was being added to a newly-filled location in order to bring it up to street level (Historic Sites Research 1978:15; Cantwell and Wall 2001:228-229).

Another encounter with secondary fill in the APE occurred at South Street and Clinton Street during the construction of the FDR Drive in 1952, when a section of 1836 cobble paving was uncovered. Intrigued by the survival of the early streetbed, then-Mayor Wagner's chief engineer Anthony J. Donargo dug beneath the cobbles and "brought out a veritable hoard of old clay pipes, which must have been smoked and unstemmed before the cobblestone paving was laid in 1836. There were also shards of iridescent old glass, a couple of hand-wrought nails, pieces of zinc, and some bricks probably brought here from Holland. Some of the pipes were decorated with the Masonic square and compass, with a G enclosed" (*New York Times* 1952:25).

Under normal circumstances, secondary fill was deposited on top of the primary landfill, which ended at or below mean sea level. At Schemerhorn Row, this stratum extended from two to five feet below the existing surface in 1982-1983 (Historic Sites Research 1991:282). At the Assay Office site, the secondary fill stratum above the primary landfill contained brick but no timbers, and extended between the modern pavement and as much as 13 feet below the surface (Louis Berger 1990: Figure 4.2); On the Telco Block the secondary fill, called "Fill category 1," was noted up to 1 foot above mean sea level, and extended below the water table (Rockman, Harris, and Levin 1982:77).

In some locations at Schermerhorn Row, the lowest levels of secondary fill exhibited "nearshore or tidal flat conditions," and just beneath the secondary fill stratum, a layer of river silts was recognized, probably a natural deposit from the time period between the filling of the cribbing and the placement of the secondary fill (Historic Sites Research 1991:278-279). Modern sources suggest that following the placement of landfill a period of from six to 18 months be set aside

before construction takes place, so that the fill can settle and consolidate (Historic Sites Research 1978:15-16).

Land Transportation Elements

As the center of commerce, the South Street shore was the terminus for multiple horse-drawn trolley cars and omnibuses during the 19th century, and lines which were electrified during the 20th century (Lawesson 1973-1974; Bromley 1879). The discovery of an undisturbed section of 1836 stone pavement (within four feet of the surface) at South and Clinton Streets during the construction of the South Street Viaduct suggests that track from railway lines may still be present within the impact zone of the APE. Early horse-drawn trolley tracks, however, were too delicate to support the weight of later electrified cars, and were commonly ripped up and replaced. Since no other subsurface features are associated with horse-drawn systems, no remnants of an early track system are anticipated in the APE.

Electrified trolley tracks, consisting of two outside tracks and a third electrified center rail, are commonly found throughout Manhattan, dating from the 1890s onward. The track may also be associated with saddles and switching stations, but since many of these lines ran through the 1940s, they were normally modified and updated. Subsurface remains of these systems retain little or no evidence of their original components (Hartgen and HPI 1997:23).

Although the study of small sections of track rails can be useful in the study of technological adaptations and processes in the evolution of transportation and transportation systems, extensive documentation already exists regarding the routes, technology, and construction of Manhattan's trolleys. (Historical Perspectives 1992:15; Hartgen and HPI 1997:23-24, 28-29). As a result, according to Tom Harrington, curator at the New York Transit Museum (1997), the presence of trolley tracks alone is not sufficient reason to designate former routes as potentially sensitive (Ibid.:28).

Wooden Water Mains

Prior to the introduction of Croton water to Manhattan in 1842, water within the city was distributed through mains operated by a private concern, the Manhattan Company, the corporate ancestor of present JP Morgan Chase. The Manhattan Company maintained numerous mains in Lower Manhattan, during its existence from 1799 to 1842 (Geismar 2005:1-3). At first, these water pipes were made of wood. On May 6, 1799, the Company water committee was empowered "to contract for as many pine logs as they think necessary for pipe and also for boring the same." The company also dug wells and built reservoirs and tanks, extending the distribution system to most parts of Manhattan south of City Hall (Anonymous ca.1913), which in the APE would mean as far north as the Brooklyn Bridge, north of present Dover Street. Cast iron pipes and hydrants replaced the wooden mains beginning in 1827 (Geismar 2005:1-3).

A number of the Manhattan Company's wooden mains have been recovered, most notably an old water gate which was dug up during construction on Park Row in 1900 (Anonymous ca.1913). More recently, sections of pipe were found within 4 feet of the surface in Coenties Slip, west of the APE. The wooden mains are believed to have been shallowly-buried so that they could be tapped by firemen in the performance of their duties, (Geismar 2005:1-3). In the course of archaeological monitoring (2006) on Beekman Street between Water and Pearl Streets (about 2

blocks west of the APE), archaeologist Alyssa Loorya encountered an 11-foot long section of yellow pine pipe joined to a second, smaller section of main. The join was fitted with a metal collar. Once these surviving mains were recovered, DEP removed them for preservation treatment. (Lower Manhattan 2006). Additional sections of wooden water mains have also been excavated recently in present Titanic Memorial Park, on Fulton Street between Pearl and Water Streets (Amanda Sutphin, personal communication to Cece Saunders, 2006).

Since wooden mains were no longer installed after 1827, potential wooden mains could have been present in the APE from Whitehall to the Brooklyn Bridge, the northerly boundary of the distribution system at that time.

Subsurface Conditions: Soil Borings Review

Although soil borings are useful in determining the extent of subsurface disturbance, in the case of the APE, they generally serve to confirm what is already known of the project area through documentary sources: that the APE is comprised of a thick stratum of fill which extends below the water table to what was once the East River floor; and that this fill, particularly that below the water table, will contain large rocks, as well as evidence of wood from cribbing and piles. Also noted is the presence or absence of river mud/silt and sand strata, important for discerning the survival of former submerged ground surfaces.

Soil boring logs, unless they are created specifically with archaeological concerns in mind, do not normally provide the detail necessary to determine the difference between primary landfill and secondary fill, despite the fact that both documentary and archaeological evidence indicates the potential for the existence of a thin deposit of river silt between the two fill strata. Rock Data Maps provided by DDC record miscellaneous fill and the presence of wood/timber and organic silt, but as already stated, do not generally differentiate substrata within the fill or provide the elevation of the water table (WPA 1937). On the other hand, soil boring logs should prove useful in determining the depth of fill strata, as well as the general elevations of river and glacial deposits. This data would help to identify the potential precontact land surface which existed prior to inundation by rising sea levels after the last glacial retreat, i.e., if they have survived adverse impacts from tidal and current action, dredging, and construction disturbance.

Types of Recorded Subsurface Disturbance

Although many forms of subsurface disturbance have occurred with the APE, documented disturbance can be divided under several major headings.

Subway Tunnels

The current Sanborn records five subway tunnels passing beneath the APE: BMT Tunnels at Broad and Whitehall Streets, Clark Street Tunnel (Old Slip), and at Fulton Street. These subaqueous tunnels, built by the shield tunneling method, were begun west of South Street, and by the time South Street was reached, were many feet below the current APE. For example, the Clark Street Tunnel shaft was begun on Front Street and is 54 feet below grade at South Street (Olmsted 1995). Therefore this construction would have no impact on archaeological resources in the APE.

Dredging

Dredging is a regular feature of port maintenance to remove accumulated mud and debris (artifacts) from channels and slips, and as a result, harbors and their channels are not generally environments conducive to the preservation of submerged archaeological sites (Stewart 1999:578). Contracts for dock, slip, and wharf maintenance farmed out by the New York City Common Council during the 17th and 18th centuries required the cleaning of "the said Dock, & slip in the Dock of all the Mudd & filth therein Soe deep as till they finde A sandy Bottom and During the said Lease shall soe Keep the same Clean" (4/13/1700, MCC 1905:I 104-105). The Common Council usually specified cleaning to the "sandy Bottom" (5/26/1702 , Ibid.: I:191; 2/15/1705, Ibid.: I 294), or "A Sandy foundation" (12/9/1703, Ibid.: I 250). Logically, this would mean that each time a dock or slip was cleaned some of the river bottom beneath the river mud and silts would be impacted by the procedure. One study of a number of 19th-century ships which burned and/or sank at Manhattan docks concluded that all were either raised or removed, partly because of the pressure for usable dock space (Historic Sites 1977).

Dredging activity was regularly recorded in the Department of Docks annual reports during the late-19th and early-20th centuries (e.g., Docks 1899:photos n.p.; 1937:15; Marine and Aviation 1950:14). According to the 1906 report, channels between the piers in the APE were dredged to varying depths between 26 and 35 feet below mean high water (Docks 1906:382-385). Furthermore, as old piers were removed and new piers constructed, dredging of the pier location consistently followed the removal of the "old works" and preceded the deposit of a new riprap foundation. Dredging reports also record the square yardage of "mud" and "crib" removed (Ibid.:175-181; 382-385).

Research by archaeologists Kardas and Larrabee concluded that between 1929 and 1976 the Army Corps of Engineers conducted at least 80 dredging and obstruction removal projects along the Manhattan riverfront. As test cases, the evidence regarding several well-known 19th-century wrecks which burned and/or sank at Manhattan docks was also examined, and all were either raised or removed to return the piers to revenue-producing status (Historic Sites 1977).

Dredging would most certainly have impacted archaeological resources on the riverbottom (and therefore below mean low water). In general, however, the impact of dredging upon potential archaeological resources, especially the most deeply buried precontact resources, is not precisely known, since the exact depths and frequency of the activity are not always recorded, particularly prior to the 20th century.

Pier Construction, Modernization, and Reconstruction

Manhattan's East River piers were constantly being updated and altered through time to meet the demands of more and larger vessels (Graham 1873). A comparison of historical maps shows major changes in the numbers and configuration of East River piers between 1891 and the 1910s, by which latter period the piers approximated their modern configuration. Some piers were removed and their locations became channels between enlarged piers; others were simply enlarged and renumbered (Viele 1865; Bromley 1891; Sanborn 1905; WPA 1936-1940) (e.g., Figures 25-28).

The earliest piers that reached as far into the East River as the APE were recorded on maps from the closing years of the 18th century (Directory 1789; Taylor Roberts 1797; Commissioners 1811), corresponding to the reconstruction of New York City's pier facilities following the depredations of the Revolutionary War. As described earlier in this report, construction methods during that period entailed preliminary dredging, followed by construction utilizing combinations of piles and crib or cobb work.

Civil engineer Carleton Greene's 1917 treatise on the construction of "modern" (i.e., late-19th to early-20th century) American piers and wharves describes not only the driving of wooden piles, but site preparation prior to pile-driving. This included measuring the depth of the "hard bottom" by means of wash borings and test piles, in order to determine the length of piles necessary. At the time, piles up to 60 feet in length were easily obtainable, and various species of pine were considered the most durable and economical. Lengths of 60 to 85 feet were difficult to come by, and the engineer would sometimes have to settle for inferior spruce. If piles greater than 85 feet were needed, splicing was necessary, although the availability of reasonably-priced fir piles of 110 feet in length, shipped from the Pacific Coast via the Panama Canal (completed in 1914) were anticipated (Greene 1917:28-33; Bone 1997:117).

Piles were generally driven down to rock or hardpan. Where the hard bottom was too deep to be reached, the pile was driven until the friction and cohesion between the mud/sand and the pile was so great that the pile could be driven in no deeper. Such conditions were frequently encountered along the Hudson shoreline, where "friction piles" had to be driven to depths of about 100 feet (Bone 1997:117).

Dredging was generally advised before testing. Greene noted an example from New York in which, prior to the driving of test piles, the center line of the pier was dredged to a depth of 15 feet, and 30 feet at the sides, although he does not provide the specific location. Where the water depth is not greater than 25 feet, Greene notes that "ordinary wooden piling" has a diameter of 14 to 16 inches. In deeper waters, or where the piles need additional support, riprap or broken stone not greater than 16 inches in any dimension, or round cobbles not greater than 6 inches in diameter, are placed before the piles are driven (Greene 1917:28-33).

Greene reports that the New York City Department of Docks follows the principles he describes "with the greatest thoroughness." Specifically, once the slips alongside the piers were dredged, pine piles were driven in a combination of the "single-pile" and "double-pile" row systems. Transverse rows of single piles were placed 10 feet apart. Within the single-pile row the piles were spaced 6 feet apart from center to center. The outer three rows of piles were doubled, and the number of piles in each row was doubled, resulting in a spacing of 2.5 feet, with double rows spaced about 23 feet apart. Additional white oak piles would be placed as fenders at the outer corners of the pier (Greene 1917:34, 38, Figs.1, 2) (Figure 8).

The annual reports of the Department of Docks support Greene's outline of the construction process, as they record the expenditures involved in replacing existing old piers in five steps: "Removal of old work"; "Dredging"; "Rip-rap foundation"; "Pier proper"; and "Shed." Records of completed dredging programs record not only the volume of mud, but also the volume of "crib" removed from the channels (Docks 1906:175-181; 382-385).

In addition to the impacts of dredging for pier construction, the driving of thousands of piles throughout the APE would have impacted potential archaeological resources which were then submerged and now, for the most part, are below the water table.

Bulkhead Wall Construction

Civil Engineer Greene also describes the evolving building methods for the construction of the East and Hudson River bulkheads and associated structural systems inaugurated in 1871 by the New York City Department of Docks (Bone 1997:99,102).[7] In the original bulkhead wall design of 1876, as well as modifications to 1899, the concrete and masonry bulkhead itself only extended about 15 feet below mean low water (Figures 9, 10). Because of the great depth of mud—in some places up to 170 feet deep—along the Manhattan shoreline, the bulkhead had to rest on piles, even though the piles could not extend to the hard bottom in all cases. According to Greene, the river mud was dredged "for a width of about 85 feet to a depth of 30 feet, more or less, depending on the consistency" (Greene 1917:88). According to Greene's schematic drawings, this width of dredging extended an equal distance on each side of the proposed bulkhead, therefore, approximately 42.5 feet out into the riverbed. Into that dredged surface the piles were driven, and the open spaces filled in with cobbles and riprap, to serve as a base and support for the concrete and masonry bulkhead (Greene 1917:88-94).

Where rock was not particularly deep, that is, about 40 feet or fewer below mean high water (mhw), or when the "hard bottom" was sufficient to keep the piles stationary without the addition of riprap, concrete was placed directly on the rock or atop the piles in the hard bottom. This still required the removal of mud, silt, sand, and clay through dredging so that the constructions could rest on the firm, relatively level surface. Greene's schematic drawings these bulkhead walls show greater horizontal impact on extending inland on landward side of the wall (greater than 25 to 30 feet), than that extending from the wall into the river (9 to 17 feet), although both are substantial (Greene 1917:62-65) (Figures 9, 10). Since dredging is not a precise art, a conservative estimate of 20 feet for the minimum *horizontal* distance of impact will be employed in the evaluation of disturbance. Dredging depths will be discussed within the individual APE segment evaluations.

Utility Installation

Numerous utility lines, including sewer and water mains, both recorded and unrecorded, exist beneath South and Marginal Streets. Because modern water mains, for example, are generally installed with 42" to 48" of surface cover, underground utilities are expected to be the chief sources of subsurface disturbance in the APE. Disturbance is particularly extensive at junctions of multiple lines, which generally occur at street intersections and at piers. Schematic maps of current sewer and water lines were provided by DEP: Amended Drainage Plans (ADP 2006) and Water Main Distribution Map (WMDM 2006). More detailed maps of utility placement, particularly of earlier lines—apparently not employed by present utility companies in their excavations—were created by the Works Progress Administration (WPA) were provided by the DDC (WPA 1936-1940).

[7] For the historical background of the East and Hudson River bulkheads, see the discussion in the Historical Period Overview section of this report.

The potential impact to archaeological resources by existing utility lines is limited by the size of the line and the depth and width of the trench required for installation. Two recent projects carried out adjacent to the Tweed Courthouse on Chambers Street (Hartgen 2003; 2004) have recovered numerous historical artifacts, as well as a number of intact features, in the midst of utility lines and other subsurface disturbance, both recorded and unrecorded. The overarching concern of the two studies, however, was the recovery of human remains, since both locations were within the African Burial Ground and Commons Historic District, and fragmentary human remains had been found in an adjacent part of Chambers Street in 1998 during work to repair a water main break. As a result, even highly disturbed contexts were considered to have high archaeological sensitivity.

At the same time, the Tweed Courthouse report also noted: "[c]ertain areas that have been disturbed by modern construction (various utility lines) are characterized by no to minimal sensitivity; areas disturbed by historic construction of utilities are moderate to highly sensitive, particularly for the presence of disturbed human remains" (Hartgen 2003:31). At the behest of the LPC, three test units to determine sensitivity were excavated within a 6- to 7-foot deep, 300-foot long trench (Chambers Street Trench 1), from which a 19th-century water main was removed and replaced. Two of the three identified historical fill deposits containing secondarily deposited human remains and scattered historical materials from 4 inches to 6.5 feet below the base level of the street.

The 2004 report on the archaeological monitoring of Con Edison utility trenches on Chambers Street between Broadway and Elk Street (north side of the Tweed courthouse) reported similar results, locating ten disturbed burials in two trenches. The report noted that "despite the amount of ground disturbance in the area, isolated pockets of intact human remains and other cultural features still exist" (Hartgen 2004:41). Meaningful conclusions drawn from the pockets of redeposited artifacts—from what might be a single, disturbed feature, possibly related to the military barracks or almshouse which once stood nearby—are more elusive. Regarding these 806 artifacts, the report was forced to conclude that "due to the amount of disturbance to these contexts little information about the feature from which they derived can be gleaned." (Ibid.:41). Another part of the trench, "characterized by modern disturbance associated with numerous utilities" yielded "cultural materials consisting of a mix of historic artifacts, modern trash, and a broken ceramic sewage pipe" (Ibid.).

In contrast to recorded land use in the APE, which after the deposition of fill from unknown sources became part of a wharf and/or street, the two sites discussed above were part of a graveyard, and later the grounds adjacent to a military barracks and then an almshouse. The sites were populated by small, discrete features (e.g., burials, ossuary pit, brick drain, etc.) which might be preserved if they were between utility line trenches. Although large numbers of historical artifacts were recovered from severely disturbed contexts, because the chronology of the almshouse and barracks is known, the artifacts provide some data because they can be related with some certainty to the occupants of the known structures.

Sections of wooden water mains (installed by the Manhattan Company from 1799 to 1827) have also been recovered in the midst of later utility line disturbance. In general, the mains were shallowly buried so that they could be tapped by firemen in the course of their duties, and

sections of pipe have been found within 4 feet of the surface in Coenties Slip, west of the APE (Geismar 2005:1-3). Additional examples were recovered in 2006 during archaeological monitoring conducted on Beekman Street between Water and Pearl Streets (about 2 blocks west of the APE) by Alyssa Loorya of Chrysalis Archaeological Consultants (Hope 2006), as well as in Titanic Memorial Park (Fulton Street between Pearl and Water Streets, 2 blocks west of the APE) (Amanda Sutphin, personal communication to Cece Saunders, 2006). Despite being vulnerable to destruction by subsequent utility line installation, the sheer length of wooden pipe in the old distribution network makes it a virtual certainty that small sections have survived in situ.

Archaeologist Loorya has found that the top two feet of the Beekman Street corridor lack archaeological potential due to disturbance from the creation of the roadbed (personal communication, Alyssa Loorya to Cece Saunders and Richard Schaefer, September 12, 2006). Monitoring on Beekman has also found deposits or pockets of historical artifacts, between and around existing utility trenches that run beneath the two-foot depth of disturbance. The precise nature and depositional history of the Beekman Street materials have yet to be interpreted, although newspapers have already reported the recovery of more than 3,000 historical artifacts (Hope 2006). Although Loorya has identified undisturbed deposits/features, including a foundation tentatively dated to ca. 1800, these have been recovered at approximately eight feet below grade, generally below existing utility line disturbance.

Battery Park Underpass Construction

The Battery Park Underpass links the South Street Viaduct with the West Street via a tunnel beneath Battery Park. The entrance or underpass portal is midway between Whitehall Street and the line of former Moore Street, within Segment 1 of the APE, and continues southwest beyond Whitehall Street. Contract plans appear to indicate that the area within the APE southwest of the approximate line of Moore Street (i.e., the area around the portal), was excavated using the cut-and-cover technique. Although the areal extent of excavation is not stated in the plans or profiles, they do record "Bridging and Decking" being placed over the tunnel itself, and "Decking and Supports" along current South and Marginal Streets in the APE. Disturbance related to the underpass and portal foundation construction extends to approximately 20 feet or more below current grade within the APE (Borough Works 1947:3).

South Street Viaduct Construction (1951-1954) and Reconstruction (1980s)

Numerous column footings for the original 90 spans of the South Street Viaduct were constructed in South and Marginal Streets. At present, the clearest picture of the subsurface impacts from viaduct construction is a photograph from the Opening Day Program of the viaduct (Borough 1954), showing a completed column footing. The foundation extends substantially below the projected five-foot impact zone of the current project, but since the viaduct will not be removed, no new excavation is planned for the column locations. In area, disturbance from column footing construction extends approximately three feet or less around the existing columns.

During a site inspection (7/6/06), it was observed that more than one type of viaduct column is present in the APE, suggesting that additional columns were added or earlier columns replaced during reconstruction in the early 1980s. This was also noted in a newspaper article of 1980

(*New York Times* 1980). The impact and significance of these later columns to this project are assumed to be similar to that caused by the original construction in the 1950s.

Roadbed Construction
As noted in the discussion of buried utility disturbance, and important in this section of the APE in which the majority of proposed impacts are not expected to extend more than two feet below the current street surface, recent archaeological monitoring on Beekman Street has noted that the top two feet of the streetbed lack archaeological potential due to disturbance from the creation of the roadbed (personal communication, Alyssa Loorya to Cece Saunders and Richard Schaefer, September 12, 2006).

Areas of Potential Archaeological Sensitivity

The following section incorporates data on the historical period usage of each segment of the APE, as well as recorded subsurface disturbance episodes, soil boring log data, and potential locations of archaeological resources. Areas within the APE boundaries that have been eliminated from further archaeological consideration are:

- **Areas filled post-1900:** Bulkhead construction by the Department of Docks along the shoreline in this part of the APE shoreline was completed in ca. 1900 and later. The replacement of old piers with new piers was roughly contemporary with bulkhead construction, while according to detailed maps of the shoreline dating from 1903 to 1910 (SSS 1903a; 1903b; 1907; 1910), real estate atlases from 1891 and 1905 (Bromley 1891; Sanborn 1905), and Department of Docks annual reports (e.g., Docks 1899; 1906; 1914) the filling and widening of South/Marginal Street lagged behind new bulkhead construction (see the Historical Overview section of this report for an extended discussion). Based on this cartographic and documentary evidence, those areas filled in ca. 1900 and later have been eliminated from further consideration for historical cultural remains, since any resources in the impact zone of the APE would date from the first decades of the 20th century and are not considered to be significant.

- **FDR Drive Columns:** As noted above, FDR Drive column foundations penetrate beyond the proposed five-foot below surface impact zone for the South and Marginal Street sections of the APE. The original columns of the South Street Viaduct and added or replaced columns from the 1980s reconstruction would have destroyed archaeological potential in their locations, and approximately three feet around those locations. Since the viaduct columns will not be altered or removed by this project, their locations will receive no further evaluation.

For ease of evaluation, the part of the APE discussed in this report—the inboard area from Whitehall Street to the north side of the Brooklyn Bridge (Roosevelt Street)—will be divided and analyzed in smaller sections.

Historical Period Usage Overview
According to historical maps, the entire APE south of the Brooklyn Bridge was submerged beneath the waters of the East River when the first European settlers arrived during the 17th

century. The shoreline was irregular, generally meandering within the path of present Water Street, although from Wall Sreet to Fulton Street there was a shallow cove where the shoreline pulled back to the south side of Pearl Street. A deep cove also indented the shoreline from the south side of Water Street at Dover Street to as far as Pearl Street east of Dover Street (Viele 1865) (Figure 5).

The earliest section of South Street to be filled and bulkheaded was between the east side of Whitehall Slip and the east side of present Moore Street, then also called "White Hall," which appears on maps between 1744 and 1754 (Grim 1813; Maerschalck 1754; Ratzer 1776). The actual width of the early one-block road is unclear, but appears to have been no greater than 70 feet. Expansion to the west or east was blocked by the functioning Whitehall Slip, and the city's chief wharfage: the Great Dock, a D-shaped basin originally built in 1676, and expanded, modified, and maintained until 1750 (Bone 1997:94).

As demand for piers and slips increased, the basins of the Great Dock were eventually filled in, and South Street was expanded to the west side of Coenties Slip, although still interrupted by Exchange Slip at the foot of Broad Street. In June 1795, the Common Council had the location from White Hall Slip to Coenties Slip surveyed for the "70 feet Street on the East River." The surveyors set a point out in the East River for the outer limit of the street, noting that the area of the future street had been "docked out, but not filled in." By April of 1796, the street was "nearly" finished (MCC 1917:II 157-158, 161, 228), and the 70-foot wide street was ordered expanded to Exchange Slip in July 1796 (MCC 1917 II 260; Taylor Roberts 1797).

The remaining sections of South Street within this section of the APE were ordered begun in 1798, when the Common Council ordered the proprietors of water lots from Coenties Slip to Catharine Slip to fill in the lots "with good wholesome Earth" by January 1799 (Stokes 1926:1,350). It took a number of years, however, before the water lot proprietors actually accomplished this. In general, work tended to proceed from downtown to uptown. In 1801, "measures" were taken to fill the water lots from Fly Market Slip (Maiden Lane) to Wall Street Slip, but it was noted that given the great amount of earth required, the work would take a long time (MCC 1917:II 742, 748). In a possible compromise, Fly Market Slip was ordered bulkheaded and filled to the middle line of South Street only (that is, the northern 35 feet of the street's 70-foot width) in 1804 (MCC 1917:III 536).

By 1811, with some small exceptions, and the interruptions of South Street at the functioning slips—Whitehall, Exchange (Broad Street), Coenties, Old, Coffee House (Wall Street), Burling, and Peck—the street had been completed as far as Dover Street (Figures 14-17). Beyond Dover Street the natural eastward curve of the Manhattan shoreline created a difficulty in extending both Front and South Streets further uptown, since the lines of the streets, if continued, would meet at James Slip (Goodrich 1828). The Common Council resolved to continue South Street east to the pier at the foot of Roosevelt Street in 1819, and ordered the owners of the water lots to have the bulkhead made (MCC 1917:X 443-444, 502).

Based on the period of construction, and references to pier and bulkhead construction in the Council minutes, the bulkheads and piers were built of sunken cribwork blocks, linked by bridges to form piers (described in 1820, MCC 1917:XI 316-317). As shown on the 1849 Alvord

survey of East River wharves and piers, drawn by City Surveyor David Ewen, the width of South Street—on average 70 feet—ranged from 62.6 feet to as much as 89 feet wide (Alvord 1849) (Figures 18-24).

The slips were filled in gradually: Whitehall Slip between 1844 and 1849 (USC&GS 1844; Alvord 1849), Exchange Slip between 1819 and 1827 (Cohen and Augustyn 1997:115; MCC 1917:X 575), Old Slip in 1834, Coffee House Slip in 1834, Burling Slip in 1835 (Hooker 1838), and Peck Slip between 1828 and 1833 (Goodrich 1828; Hooker 1833). South Street at Fly Market Slip was widened from 35 feet to 70 feet before 1828 (Goodrich 1828). Coenties Slip was the last slip to be bulkheaded and filled; this was done during the 1880s, and the location became Jeanette Park (Bromley 1879; Robinson 1885), now Vietnam Veterans Plaza (Figure 1).

The Common Council was not idle in building revenue-producing piers along the new street. Because "the immediate erection of Piers Between the White Hall Slip and the fly Market is of the first importance to the Commercial Interest of this City," in January 1801 the Council ordered that the proprietors of lots on South Street build 15 piers in the area specified, to be completed by November 1802 (MCC 1917:II 698-699). As became the pattern, Council decrees were rarely followed, at least within the time specified. Only three piers are shown between Whitehall Street and Coenties Slip in 1803. These had multiplied to six in the same area by 1807, and 25 from Whitehall Street to Dover Street by 1811 (Cohen and Augustyn 1997:96-99; Commissioners 1811). Given the approximately 70-foot width of South Street at the time, and the present 125-foot width of South/Marginal Street to the modern bulkhead, roughly 55 feet of the bases of these piers would have been built within this part of the APE.

Segment 1: Whitehall Street to the south side of Broad Street

Historical Period Usage

South Street between the east side of Whitehall Street and the east side of Moore Street was first filled between 1744 and 1754 (Grim 1813; Maerschalck 1754), to no greater than 70 feet. Expansion to Broad Street on the east occurred after the Common Council had the future location of South Street surveyed in 1795, and the street was nearly finished from Whitehall Slip to Coenties Slip by April 1796 (MCC 1917:II 157-158, 161, 228; Taylor Roberts 1797) (Figure 14). The Whitehall Street section of Segment 1 was not filled in until between 1844 and 1849, when the slip was eliminated (USC&GS 1844; Alvord 1849).

The orders of the Council were generally observed regarding the 70-foot width of the street. Interestingly, the 1849 Alvord Survey does not provide exact street width measurements for South Street below Coenties Slip (Alvord 1849) (Figure 18), but the street appears to be approximately 70 feet wide in 1849, as it still was in 1891 (Graham 1873; Bromley 1891).

Few changes in this section of the APE were made during the 19th century, possibly because of the concentration of commuter ferry lines from Whitehall Street to Moore Street. The major alteration to the APE during the late 19th century was the construction of ferry terminals, waiting rooms, and warehouses outboard of the old crib bulkhead, generally south of what was then the southern line of South Street, yet within the current APE. These structures were built on the piers, on pile-supported platforms and "bridges" between the piers. The Union Ferry Company, which operated ferries to Brooklyn, occupied the area to the west of Pier 2 at the Whitehall Street

intersection (the southern 90 feet of this section of the APE), its buildings encroaching on South Street. The Union Ferry structures had been present since as early as 1849 (Alvord 1849; Bromley 1879) (Figure 18). Additional Union Ferry structures extended as far east as Pier 3, just west of Moore Street. Erected in the 1880s, these extended southward from the old bulkhead, leaving a section of the 70-foot-wide South Street unobstructed (Robinson 1885; Bromley 1891). As of 1905, Pier 3 remained a public pier with no structures (Sanborn 1905) (Figure 25). The ferry buildings in South Street at the foot of Whitehall Street, however, were still present until after 1924, and were finally removed by the late 1940s, when the Battery Park Underpass was constructed (USC&GS 1919, 1924, 1959).

Piers and Wharves

Pier 2 (Whitehall Slip East): The eastern edge of Whitehall Slip is recorded as the landing for the ferry to Staten Island as early as 1767 (Ratzer 1776; Taylor Roberts 1797). A small pier, built between 1782 and 1789, extended into the East River there, with its base in the APE (Cohen and Augustyn 1997:89, 92).

In 1795, the Common Council ordered water lot proprietors to construct five piers, each 120 feet long and 40 feet wide, along the east side of South Street from Whitehall Slip to Coenties Slip. Each was to consist of "two Piers or Blocks and two Bridges of equal Distances" (MCC 1917:II 144). By 1797, no pier is depicted in this location (Taylor Roberts 1797) (Figure 14), and a second order for larger piers passed in 1801 with a completion date of November 1802, suggesting that the first order was ignored (Figure 14). The resolution specified a pier on the northeast side of Whitehall Slip, extending 200 feet into the river. It was to consist of two 30-foot square blocks, and a third block 30 by 40 feet, at the water end. The blocks were to be connected by three bridges, each 33 feet 4 inches in length (MCC 1917:II 745).

Eventually, the Council's Committee on Wharves and Slips superintended the construction itself, and bill payments for sinking piers between Whitehall Slip and Exchange Slip appear in the Council minutes in 1806 and 1807 (MCC 1917:IV 282, 328,382), which coincides with Pier 2's first appearances on maps in 1807 (Cohen and Augustyn 1997:99). The addition of an extra block at the end of the pier, usually built to provide additional area for unloading vessels (see e.g., MCC 1917:VI 634-635), also makes its appearance by 1807. By the time of the 1849 Alvord wharf and pier survey, Pier 2 had been lengthened beyond the ell with additional blocks and bridges, for a total length of 456 feet (Alvord 1849) (Figure 18).

The western half of Pier 2, two pier slips to the west, and Pier 1 operated as a landing for ferries from Brooklyn (one to Atlantic Street, the other to Hamilton Avenue) by the 1840s, and continued in this use into the 20th century (Alvord 1849; Sanborn 1905) (Figure 25).

Pier 3 (Moore Street): Moore Street was the eastern terminus of South Street until the end of the 1780s (Directory 1789; Taylor Roberts 1797), and was included in the 1795 Common Council order to the water lot proprietors to construct five piers along the east side of South Street between Whitehall Slip to Coenties Slip.

Pier 3 was to be near Moore Street, but the water lot proprietors requested that it be built directly opposite the street, and this request was granted by the Council in 1796 (MCC 1917:II 228). Like

the adjacent piers, Pier 3 was not built immediately, and first appears on maps between 1799 (Figure 14) and 1807, slightly to the west of the foot of Moore Street (Taylor Roberts 1797; Cohen and Augustyn 1997:97, 99). It was shorter than the adjacent piers by 68 feet, and in 1820 the wharf owners between Exchange and Whitehall Slips asked for and received permission to extend the pier farther into the East River for the accommodation of North River sloops (MCC 1917:XI:235, 268). Yet another block was to be added in 1826, because Pier 3 was still shorter than the neighboring piers, and it was noted that a "bar," probably a sand bar, a short distance from the end of the pier prevented ships from utilizing the pier end at low water (MCC 1917:XV 252, 322). In 1849, the pier was recorded at 474 feet long (Alvord 1849) (Figure 18).

Pier 4 (Broad Street West/Exchange Slip West): Prior to the construction of South Street, Broad Street was at the center of the Great Dock, with enclosing piers extending from Front Street at Moore Street and Water Street at Coenties Slip forming a D-shaped dock, and a central pier extending from Water Street at the foot of Broad Street (Ratzer 1767). The Great Dock had been filled in by the 1780s, and by 1789 a short pier had been built from the foot of Front Street on the west side of what was to become Exchange Slip (Directory 1789). The existence of a pier at this location is indicated by Peter Goelet's 1791 request to the Common Council for permission to build stairs at foot of his wharf at Exchange Slip (MCC 1917:I 632).

As described above, in 1795 the Common Council ordered water lot proprietors to construct five piers along the east side of South Street from Whitehall Slip to Coenties Slip. By 1797, no pier is depicted in this location (Taylor Roberts 1797) (Figure 14), and the 1801 order for larger piers suggests that the first order was ignored. The second resolution specified a pier to be located 20 feet from the southwest side of Broad Street Slip, extending 200 feet into the river. It was to consist of two 30-foot square blocks and a third block, 30 by 40 feet, at the water end. The blocks were to be connected by three bridges, each 33 feet 4 inches in length (MCC 1917:II 745). Despite the order, the first and second payments for constructing (also referred to as sinking) a pier near Exchange Slip did not appear in the Council minutes until October of 1806 (MCC 1917:IV 282), and the pier appears cartographically for the first time in 1807, when it is shown with an extra block and bridge at the end, forming a sheltering "ell" toward the mouth of Exchange Slip (Cohen and Augustyn 1997:99).

Pier 4, which was 200 feet in length, was originally longer than the pier on the east side of Exchange Slip (Pier 5). This was noted by the Council in 1808, which in an effort to secure public control of the sections of the piers fronting the East River slips, offered to lengthen Pier 5 to the same length as Pier 4, if the water lot proprietors from Exchange to Coenties Slips would relinquish their rights to the piers on the west sides of those two slips (Piers 4 and 6) (MCC 1917:V 105).

In 1810, dealers in "plaister of Paris" requested the right to unload their cargoes on Pier 4, which apparently was granted (MCC 1917:VI 272). By the time of the Goodrich map in 1828, Pier 4 had lost its "L," and the Alvord survey records it at 485 feet long in 1849 (Goodrich 1828; Alvord 1849) (Figure 18). It is noted as a public pier in 1867 (Dripps 1867).

East River Bulkhead

The next major development in this portion of the APE was the construction of the modern bulkhead system, under the program begun in 1871 by the New York City Department of Docks. The bulkhead eventually defined the present southern boundary of this segment of the APE. According to the Department's own 1873 map, the bulkhead project also involved substantial landfill along the river side of South Street. South Street was to be widened, and a Marginal Street added to provide pedestrian and vehicular access to the piers and bulkhead. As noted above, the proposed combined width of the streetbed was originally 200 feet, but according to an 1895 article in the *New York Times,* this was later modified to 150 feet to provide an additional 50 feet for piers in the somewhat narrow East River (*New York Times* 1895). In reality, South/Marginal Street as completed is generally 125 feet wide (e.g. Bromley 1921).

By the time of the 1905 Sanborn, the bulkhead had been built only in the eastern 55 feet of South Street fronting on Broad Street (Sanborn 1905) (Figure 25). The Department of Docks annual report from 1906 notes that the remainder of the modern bulkhead wall in this segment of the APE had not been finished by that year, seemingly because of work on a new Whitehall Terminal for ferries. Only $1,772.66 had been spent on the bulkhead for the section from Whitehall Street to Broad Street, and it was listed as "*In progress*" (Docks 1906:201, 226). According to the 1919 harbor chart, old Piers 2 and 3 had been removed, and the new bulkhead was complete from the east side of Whitehall Street to Broad Street by that year.

Disturbance

Bulkhead Construction

Because of the great depth of mud generally encountered—in some places up to 170 feet deep—along the Manhattan shoreline, the bulkhead had to rest on piles, even though the piles could not extend to the hard bottom in all cases. According to Greene, the river mud was dredged "for a width of about 85 feet to a depth of 30 feet, more or less, depending on the consistency" (Greene 1917:88). According to Greene's schematic drawings (Figures 9, 10), this width of dredging extended an equal distance on each side of the proposed bulkhead, or approximately 42.5 feet into the area of the APE on present South/Marginal Street, and to a depth of 35 to 40 feet below mhw.[8] Into that dredged surface the piles were driven, and the open spaces were filled in with cobbles and riprap, to serve as a base and support for the concrete and masonry bulkhead. The new street area would have been further filled with "earth, ashes, &c." as Greene notes in his 1876 bulkhead drawing (Figure 9) (Greene 1917:88-94). In this section of the APE, the impact of 20th-century bulkhead construction would have extended at least 42.5 feet north of the bulkhead, and to a depth of 35 to 40 feet below mhw.

Dredging

Accurate records of dredging, or even maps of pier slip depths prior to 1857, are not available to document routine dredging impacts in now-filled sections of the APE. For those areas beyond the old bulkhead line incorporated into the present APE, the 1906 harbor chart records pier slip depths between old Piers 2, 3, and 4 at ≤13 feet below mhw (mean high water) (USC&GS 1906), and the 1857 readings are even shallower than that (Harbor Commissioner 1857). The Department of Docks annual report of 1906 notes that at old Pier 4, at the eastern edge of Segment 1, the old pier works were removed, the location was dredged, and a riprap foundation

[8] Greene's calculations were based on mean low water at 4.85 feet below mean high water (mhw).

was laid (Docks 1906). At the opposite end of the segment, routine dredging at Whitehall Ferry Terminal in 1906 was to a depth of 25 feet below mhw (Docks 1906:382).

Battery Park Underpass Construction

The chief subsurface disturbance in Segment 1 of the APE was the construction of the Battery Park Underpass and its portal (see above). Contract plans show that approximately 100 feet west of Whitehall Street the underpass is shallowly covered by bridging and decking, with the tunnel roof at 4'6" below the surface, indicating cut-and-cover excavation in this area and to the east in Segment 1, where the underpass meets the surface. The foundations and supports for the "bridging and decking" and the overpass extend approximately 20 feet below the current surface. This disturbance would be expected west of the line of Moore Street in the South Street and Marginal Street sections of this segment (Borough Works 1947:3).

Buried Utility Lines

The present (8'x5' interceptor) sewer line which runs between the Battery Park Underpass portal west of Moore Street and Broad Street is buried at an extreme depth below surface (>21 feet) because it passes beneath the underpass, as shown in the cross section of the tunnel west of Whitehall Street. This would extend the deep subsurface disturbance relating to the underpass as far as Broad Street, the eastern edge of Segment 1. The remaining, more modern utility mains in the adjacent parts of South Street are only 4 to 5 feet below the surface (Borough Works 1947:3; ADP 2006). In Marginal Street there is only a single 4" water line (1950) and hydrant connection (WMDM 2006).

Soil Boring Logs

Soil borings conducted in this segment of the APE during the 1930s show an extremely shallow depth of bedrock, which has implications for construction disturbance. "Mica schist" is encountered at depths ranging from 18.7 feet to 32.4 feet below mhw (WPA 1965: Sheet 1 #217, #218, #465-471; See Appendix). In such cases, early cribwork, the modern bulkhead, and the foundations of the Battery Park Underpass would have been laid directly on rock, rather than on muddy or sandy riverbottom strata.

As is expected given the usage history of the APE, boring logs show large layers of miscellaneous fill containing brick, sand, and stone, extending beneath the paving to between 5.8 and 23.7 feet below mhw. This fill stratum should represent landfill materials placed within cribworks and behind the modern bulkhead. In four of nine logs, the identified fill rests directly atop sand/clay/gravel strata (#217, #465, #466, #468), and in one case on Marginal Street, atop rock (#467). Given the expected presence of timber cribworks, stone/wood embankments, or even a sunken vessel used as a landfill retaining device, the fact that no wood is noted in any of the logs is unusual, and suggests that either timber was subsumed under the category of "Misc. fill," or that some undocumented construction disturbance impacted this part of the APE.

The four remaining boring logs show combinations of river mud mixed with sand, gravel or silt between the fill strata and the sandy till-like strata. Some of these seem to be part of the overlying fill (#470), while the mud/sand/gravel strata, by their composition and location, suggest mud introduced during the backfilling of the modern bulkhead (#218, #469, #471).

Potential Archaeological Sensitivity
Categories of potential archaeological remains for Segment 1 are submerged precontact remains, 18th- and 19th-century piers and landfill retaining devices, sunken vessels, 18th- and 19th-century landfill, 18th- and 19th-century riverbottom remains, and 19th-century wooden water mains.

All dredging episodes and depths have not been individually and specifically recorded, but given the shallowness of the bedrock stratum in this area (18.7 feet to 32.4 feet below mhw), it is likely that river mud and glacial till strata were removed during the preparation of the riverbottom for the sinking of cribworks for piers and bulkheads during the first half of the 19th century. Routine dredging to 25 feet below mhw at Whitehall Ferry Terminal, and recorded dredging prior to new pier construction at old Pier 4, support this scenario, at least for the beginning of the 20th century. Soil borings tend to show missing or disturbed mud strata, which suggest at the very least that the mud and some of the sandy layer beneath it were impacted during these operations.

Another major historical disturbance impact to the potential precontact land surface was the construction of the modern bulkhead and piers during the early part of the 20th century. As noted above, dredging depth preparatory to bulkhead construction was from 35 to 40 feet below mhw, extending approximately 42.5 feet north of the current bulkhead. Since bedrock was shallower than this standard dredging depth, the river deposits and sandy undermantle would have been removed prior to modern bulkhead construction. This activity would have eliminated all of the potentially sensitive strata in this part of Segment 1.

Thirdly, the construction disturbance from the Battery Park Underpass—at greater than 20 feet below street level—as well as the buried utilities which were routed beneath the underpass foundations, would also have penetrated this section of the APE down to the bedrock stratum. This construction disturbance would have eliminated any surviving strata potentially sensitive for archaeological remains.

Segment 2: Broad Street to Vietnam Veterans Plaza, on South and Marginal Streets
For the purposes of this evaluation, the Segment 2 area will also include the small, generally triangular section of Segment 3 which extends north of Marginal Street in the Broad Street intersection, abutting Segment 2.

Historical Period Usage
South Street between the west side of Broad Street and east side of Coenties Slip (Vietnam Veterans Plaza) was filled at the end of the 18th century, after the Common Council had the future location of South Street surveyed as a 70-foot wide thoroughfare in 1795. The street was nearly finished from Whitehall Slip to Coenties Slip by April 1796 (MCC 1917:II 157-158, 161, 228; Taylor Roberts 1797). An exception within Segment 2 was Exchange Slip, in the center of present Broad Street, which was filled between 1819 and 1827 (Cohen and Augustyn 1997:115; MCC 1917:X 575). The 1891 atlas records the width of South Street as approximately 70 feet from Whitehall to Broad Street, little different than it was in 1849 (Graham 1873; Bromley 1879).

The only visible alteration to the APE during the late 19th century was the construction of a warehouse on the outboard side of the old bulkhead between old Piers 4 and 5 by the New York Central and Hudson River Railroad, which had its freight depot on Pier 5. Construction occurred after 1867 (Dripps 1867; Bromley 1879). The structure was likely built on a pile-supported platform between the piers, and was partially within the southwest corner of the APE Segment 2, and the western end of Segment 3.

Piers and Wharves

Pier 5 (Broad Street East/Exchange Slip East): As described above, prior to the construction of South Street, Broad Street was at the center of the Great Dock (Ratzer 1767). The Great Dock had been filled in by the 1780s, and by 1789 a long L-shaped pier had been built from the foot of Front Street on the east side of what was to become Exchange Slip, extending into the South Street APE (Directory 1789). The "ell" faced eastward and, with the mirror-image pier on the west side of Coenties Slip, formed a sheltered basin (Directory 1789).

When the water lots to South Street were filled, the Common Council ordered water lot proprietors to construct five piers, the required characteristics of which are noted above. By 1797, no pier is depicted in this location, although the South Street location is noted in 1797 as "Delafields Wharf," most likely after John Delafield, listed as one of the proprietors of the area between Exchange and Coenties Slips in 1808 (Taylor Roberts 1797; MCC 1917:V 105). Delafield had come to America from England in 1783, and was a prominent marine underwriter as well as a founder of the Mutual Insurance Company and the United Insurance Company. In 1793 he became director of the New York branch of the Bank of the United States (Goebel and Smith 1980:129*n*). The pier appears cartographically for the first time in 1799 (Figure 14) (Cohen and Augustyn 1997:97).

In 1808 the Council, in an effort to secure public control of the sections of the piers fronting the East River slips, offered to lengthen the pier on the east side of Exchange Slip (Pier 5) to the same length as that on the west side of the slip (Pier 4), and add an "ell" at the end, if the water lot proprietors from Exchange to Coenties Slips would relinquish their rights to the piers on the west sides of both Coenties and Exchange Slips (Piers 4 and 6) (MCC 1917:V 105). This offer does not appear to have been accepted at the time, since Pier 5 was still at its original 120-foot length in 1811 (Commissioners 1811). Also in 1808, the executor for the estate of the late Dr. Samuel Nicoll, owner of the pier between Exchange Slip and Coenties Slip (most likely Pier 5), attempted to surrender it to the City in order to secure funds for Nicoll's children (MCC 1917:V 287).

Nevertheless, by 1828, Pier 5 was roughly twice its former length, about 250 feet, with the additional L-block at the end, extending the pier eastward. Again, as in 1789, it formed the west side of a basin with the pier on the west side of Coenties Slip, labeled 'Lent's Basin" on maps—echoing the name of one of the water lot proprietors of 1808, James W, Lent (MCC 1917:V 105; Goodrich 1828; Alvord 1849). By 1849, the pier had been further lengthened, and was 490 feet long (Alvord 1849) (Figure 18). It is noted as a public pier in 1867 (Dripps 1867)

Pier 6 (Coenties Slip West): Pier 6 was long known as the Albany Pier. The original pier was built in 1750, and extended from Pearl Street as far as Front Street along the west side of

Coenties Slip (Maerschalck 1754; Bone 1997:96). Funds were appropriated by the Council to extend the pier in 1767, which seems to have been accomplished with uncharacteristic alacrity, since the change already appears on the 1767 Ratzer survey, with the pier now extending into the South Street APE (MCC 1905:VII 77; Ratzer 1767). The pier and the characteristic eastward "ell" at Front Street were repaired in 1788 (MCC 1917:I 372), and a second, westward-facing "ell" was added before 1789, when the pier formed the eastern side of a protective basin with Pier 4 at Exchange Slip West (Directory 1789).

With the filling of the shoreline to the west for South Street, Pier 6 was subsumed within the new bulkhead, and the location was included in the 1795 Council order for the proprietors of water lots from Whitehall to Coenties Slip to make five piers. Pier 6/Albany Pier seems to be the only pier built in response to this order, with a short pier appearing at this location on the 1797 map (Taylor Roberts 1797; Commissioners 1811) (Figure 14). In 1801 a complaint was lodged with the Council that the piers at Coenties Slip were intended for the use of North River vessels, but were being occupied over the winter by sea vessels, since the fine for this was cheaper than placing the ships in legal winter storage (MCC 1917:II 718-719).

By 1828, Pier 6 was roughly twice its former length, about 250 feet, with the additional "ell"-block at the end, extending the pier westward. Again, as in 1789, it formed the east side of a basin with the pier on the east side of Exchange Slip, labeled 'Lent's Basin" on maps—echoing the name of one of the water lot proprietors of 1808, James W. Lent (MCC 1917:V 105; Goodrich 1828; Alvord 1849). By 1849, the pier had been further lengthened, and was 430 feet long (Alvord 1849) (Figure 18). It is noted as a public pier in 1867 (Dripps 1867)

Pier 7 (Coenties Slip Middle Pier): In an effort to provide more wharfage, the residents of the area around Coenties Slip discussed and subscribed to the construction of a pier in the middle of the slip, extending from the ell in Pier 6 (MCC 1917:II 260). The Council voted to contribute £800 in September 1796 to build from the "L to and beyond the new street of 70 feet wide [South Street]," therefore into the South Street APE. In December the subsidy was increased by £150 (MCC 1917:II 227,308). The work was completed before 1803 (Cohen and Augustyn 1997:97), and the pier was referred to as "Middle Pier" and Pier 7 (Hooker 1833). Pier 7 was further extended to provide more wharfage, when in 1820 a complaint was lodged with the Council that vessels vending codfish were occupying the pier, excluding market vessels. As a compromise, the Council required Pier 7 to be extended parallel with the piers on the east and west sides of the slip (MCC 1917:X 730). When Coenties Slip was filled to Front Street between 1838 and 1849 (Hooker 1838; Alvord 1849), the ell was eliminated, and Pier 7 extended directly from the Front Street bulkhead. On the 1849 Alvord survey, the pier is shown as 710 feet long (Alvord 1849) (Figure 19). It is noted as a public pier in 1867 (Dripps 1867)

East River Bulkhead

The next major development in this portion of the APE was the construction of the modern bulkhead system, under the program begun in 1871 by the New York City Department of Docks. The bulkhead eventually defined the present southern boundary of this segment of the APE. The Department of Docks had proceeded as far as plans and authorization for the new bulkhead wall and two new piers between Broad Street and Coenties Slip in December 1899. The proposed bulkhead line was to run along the southern side of the railroad warehouse mentioned above

(Docks 1899:82, map n.p.). By 1902 the bulkhead had been completed, with South Street expanded to 125 feet, and New Piers 4 and 5 had replaced old Piers 5 and 6 (Sanborn 1905; Docks 1906:175; 227) (Figure 25).

Disturbance

Bulkhead Construction

Because of the general depth of mud—in some places up to 170 feet deep—along the Manhattan shoreline, the bulkhead had to rest on piles, even though the piles could not extend to the hard bottom in all cases. According to Greene, the river mud was dredged "for a width of about 85 feet to a depth of 30 feet, more or less, depending on the consistency" (Greene 1917:88). According to Greene's schematic drawings (Figures 9, 10), this width of dredging extended an equal distance on each side of the proposed bulkhead, therefore, approximately 42.5 feet into the area of the APE on present South/Marginal Street, and to a depth of 35 to 40 feet below mhw.[9] Into that dredged surface the piles were driven, and the open spaces filled in with cobbles and riprap, to serve as a base and support for the concrete and masonry bulkhead. The new street area would have been further filled with "earth, ashes, &c." as Greene notes in his 1876 bulkhead drawing (Figure 9) (Greene 1917:88-94). In this section of the APE, however, the impact of 20th-century bulkhead construction could not have extended to the full 35 to 40 foot depth because of the shallowness of the bedrock stratum. The 1906 Department of Docks report notes dredging here for the bulkhead to extend to a depth of 29.3 feet below mhw (Docks 1906:382).

Dredging

Dredging would have occurred within this part of the APE during the early 19th century. Accurate records of dredging, or even maps of pier slip depths prior to 1857, are not available in order to document routine dredging impact in now-filled sections of South Street within the APE. Dredging depths at the 19th-century pier slips to the east and west of Segment 2 in what is now Marginal Street range from 25 to 35 feet below mhw (Docks 1906:382). This is in contrast to pier slip depths of less than 18 feet below mhw on the 1906 harbor chart, and less than 12 feet below mhw in 1857 (Harbor Commissioner 1857; USC&GS 1906).

Buried Utility Lines

Historical utility disturbance is concentrated in the landward (western) 15 feet of the South Street roadbed, in which WPA maps record a 4'x2'8" sewer (1892), 12" water (1884), 8" gas, telephone (2'6" of cover), and electric ducts (WPA 1939:4). More modern facilities in this area include a 4'x5'/7'6"x5' sewer line leading to a junction 30 feet to 47 feet east of Broad Street (ADP 2006).

A second concentration of utilities extends riverward (east) from this junction, and connects with a now unused overflow chamber, which links eastward with the river shore, through the landward end of former Pier 5, on the east side of Broad Street. A 5'x8" sanitary interceptor sewer and 30" water main (1932) also pass through this part of Segment 2, occupying the eastern 25 feet of the segment (bordering on Segment 3), mainly impacting the location of former Pier 5 (WPA 1939:4; ADP 2006).

[9] Greene's calculations were based on mean low water 4.85 feet below mean high water (mhw).

The remaining South Street parts of this segment contain a number of water mains: a 16" high pressure water, a 12" water (1950), and a 30" water (1950), as well as nine east/west connections crossing South Street, linking the mains to street hydrants. There are also two shallowly buried electrical ducts (WPA 1939:4; ADP 2006; WMDM 2006).

Soil Boring Logs
Soil borings conducted in Segment 2 of the APE identify expected thick fill strata extending to between 12.2 and 21.6 feet below mhw (WPA 1965:Sheet 1 #472-#477; Appendix). Two of the boring logs (#474, #477) also note wood within the muddy/sandy stratum beneath the fill layer, also expected in an area of landfill with various buried wooden landfill retaining devices.

The shallow depth of bedrock in Segment 2 of the APE is also notable, ranging from 19.9 to 25.7 feet below mhw. It accounts for the very thin strata of river mud and sand beneath the fill, which would have been subjected to normal dredging as well as dredging in preparation for 19th and 20th century pier and bulkhead construction. These works would have been laid directly on the rock, rather than on muddy or sandy riverbottom strata.

The soil boring logs from South Street, where early cribworks were sunk, show mixtures of sand, silt, gravel, mud, and even some shell in strata 6 feet thick or less between the identified fill and rock (#472, #476), or a mixture of mud, wood and gravel (#474), that suggest fill or fill mixed with wooden cribbing. The soil boring logs from Marginal Street, which would have been impacted by 19th-century dredging and modern bulkhead construction, show either missing river mud strata (#473), or very thin mud and sand strata (#475, #477), also indicating heavy dredging impacts.

Potential Archaeological Sensitivity
Categories of potential archaeological remains for Segment 2 are submerged precontact remains, 18th- and 19th-century piers and landfill retaining devices, sunken vessels, 18th- and 19th-century landfill deposits, 18th- and 19th-century riverbottom remains, and 19th-century wooden water mains.

Submerged Precontact Resources
Since they would pre-date the inundation of the APE, potential precontact archaeological resources would be expected in the first few feet of the sandy, glacial till layer beneath river-deposited strata, such as mud and silt. This sandy stratum could represent the pre-inundation land surface of ca. 12,500 to 2,600 BP.

Although dredging episodes and depths have not been individually and specifically recorded, soil borings and usage history indicate that because of the extremely shallow bedrock stratum in Segment 2, the river mud and glacial till strata were removed in preparation of the riverbottom for the sinking of cribworks for piers and bulkheads during the first half of the 19th century, as well as for the modern bulkhead in the early 20th century. This activity would have eliminated any potential pre-inundation land surface, as well as potential precontact resources there.

Riverbottom Remains

As with potential submerged precontact resources, riverbottom remains—located in the rivermud strata above the glacial till layer—would also have been removed by dredging and other pre-construction preparation associated with the construction of piers and bulkheads during the 18th through 20th centuries.

Sunken Vessels and 18th- and 19th-century Piers, Landfill Retaining Devices, and Landfill Deposits

Piers and landfill retaining devices, sunken vessels used as landfill retaining devices, and the landfill deposited in and around them, would be expected within the South Street section of Segment 2, i.e., the area within the 19th century bulkhead, generally the northern 70 feet of the segment. The depth of these resources would be between the stratum disturbed by surface paving (0.0 to 2.0 feet below grade) and the bedrock stratum (19.9 to 25.7 feet below mhw): the existing strata composed of fill, mud and sandy strata. For a generalized graphic description of the relationships between the potential resource strata, see Figure 12.

Since this area of potential archaeological sensitivity is beyond the disturbance caused by the modern bulkhead, the only documented construction disturbance is that caused by buried modern utilities, which could have impacted the upper strata of potential resources depending on the size of the main and the depth to which it was installed. Although some areas of potential sensitivity may have been destroyed, buried utilities could not have completely eliminated potential sensitivity for these categories of remains, given their great depth (basically from just below the surface to as much as 25.7 feet below mhw).

Unfortunately, utility maps do not provide the accuracy necessary to pinpoint the areas of deep disturbance caused by utility installation, as well as to identify the small locations—often between and abutting buried mains—which may have archaeological potential. Even the utility companies and agencies do not rely on their own maps to locate their own mains, because they are not sufficiently precise; rather, they routinely excavate test pits for this purpose. Therefore, the northern 70 feet of Segment 2 (including the triangular section of Segment 3 in the Broad Street intersection evaluated with Segment 2) must be considered potentially sensitive for 18th- and 19th-century piers and landfill retaining devices, sunken vessels, and 18th- and 19th-century landfill deposits. See the Conclusions section of this report for recommendations.

Early 19th-century piers and wharves also extended into the East River beyond the northern 70 feet of Segment 2. These locations, however, would have been impacted by preparation and construction of the modern bulkhead. Given the Department of Docks standard removal of old pierworks and the deep dredging to bedrock that occurred in this part of the APE, potential piers and wharves and any landfill associated with them would have been eliminated.

Wooden Water Mains

Wooden water mains dating to before 1827 would be expected within the northern 70 feet of Segment 2 (and the triangular section of Segment 3 in the Broad Street intersection evaluated with Segment 2), which corresponds to the area of South Street within the 19th-century bulkhead. Stratigraphically they would be found within the first four feet of the existing fill stratum, beneath modern paving; as a result, wooden water mains are the most susceptible to

modern utility disturbance and street regrading. On the other hand, given the inaccuracy of utility maps and the potential for scattered pockets of shallow remains to survive even large concentrations of modern utility disturbance (see discussion above), as well as the sheer number of feet of wooden main laid beneath the street, it is probable that sections of wooden main have survived subsequent construction disturbance within Segment 2. See the Conclusions section of this report for recommendations.

Segment 3: Broad Street through Old Slip, on Marginal Street[10]
As noted above, the small, generally triangular section of Segment 3 which extends north of Marginal Street in the Broad Street intersection abutting Segment 2, was evaluated with Segment 2. The remainder of Segment 3 is evaluated here.

Historical Period Usage
South Street between the west side of Broad Street and east side of Old Slip was partially filled at the end of the 18th century, after the Common Council had the future location of South Street surveyed as a 70-foot wide thoroughfare in 1795. The street was nearly finished from Whitehall Slip to Coenties Slip by April 1796 (MCC 1917:II 157-158, 161, 228; Taylor Roberts 1797). Beyond Coenties Slip, South Street was ordered filled to Catharine Slip by January 1799 (Stokes 1926:1,350). Despite the deadline, South Street was bulkheaded and filled gradually. In 1801, the Council issued orders to build new piers on the south side of South Street between Coenties Slip and Old Slip—which were to be completed by November 1802—indicating that this section of the street had been completed by 1801 (MCC 1917:II 745). The three exceptions to this within Segment 3 are Exchange Slip, in the center of present Broad Street, filled between 1819 and 1827 (Cohen and Augustyn 1997:115; MCC 1917:X 575); Coenties Slip , which was filled during the 1880s (Bromley 1879; Robinson 1885); and Old Slip, which was filled in 1834 (Hooker 1838).

While the 1849 Alvord Survey does not provide exact street width measurements for South Street below Coenties Slip (Alvord 1849), between Broad Street and Coenties Slip South Street appears to be approximately 70-feet wide in 1849, as it still was in 1891 (Bromley 1891). From Coenties Slip East to Old Slip East, South Street increases in width from 67 feet to 76.6 feet (Alvord 1849) (Figure 19). There is no discernable difference in street width in 1891 (Bromley 1891).

Segment 3 was unchanged through 1891 (Bromley 1891). Between 1891 and 1905, a building was constructed at the head of the pier slip between old Piers 10 and 11 New York and Baltimore Transportation Line, which had a freight depot on old Pier 11 at Old Slip west (Sanborn 1905) (Figure 26). It was most likely constructed on a platform between the piers, supported by piles.

Piers and Wharves
See Segment 2 section, above, for a discussion of Piers 5, 6, and 7.

Pier 8 (Coenties Slip East): The east side of Coenties Slip had been filled as far as Front Street by 1767, when Front Street from Coenties Slip East to Old Slip is labeled "Krugers Warf," which

[10] The sections of APE Segment 3 beyond the modern bulkhead are evaluated in the outboard resources report.

was actually a wharf built in 1740 parallel to Water Street, preceding Front Street (Ratzer 1776; Huey 1982:15). The Holland Map of 1776 records a pier extending from the east side of Front Street, reaching as far as the western edge of South Street (Cohen and Augustyn 1997:83). This pier, later known as Pier 8, appears to have been lengthened by the time of the 1789 Directory Map, and extends into South Street, but not into the APE (Directory 1789). By 1797 an eastward-facing ell was added to the end of the pier, also outside the APE (Taylor Roberts 1797) (Figure 15).

With the bulkheading and filling of the shoreline out to South Street, it became necessary to build a new pier at the foot of the new 70-foot street. The Common Council ordered the water lot owners from Coenties Slip to Old Slip to have piers "sunk" on the northeast side of Coenties Slip and on the southwest side of Old Slip (1801). The new piers were to extend 200 feet into the East River, and consist of three blocks, the first two 30 feet square, and the outer block 30 by 40 feet. These were to be connected by three bridges of 34 feet 4 inches each, and were to be completed by November 1802 (MCC 1917:II 745). The deadline was not met, and the Council hired Justus Dearman to build the pier on the east side of Coenties Slip in June 1809 (MCC 1917:V 580). This agrees with the historical maps, which indicate that Pier 8 was not completed until ca.1811, when it appears on the Commissioners Plan (Commissioners 1811; Cohen and Augustyn 1997:99,103, 104).

Maps show little change to Pier 8 through 1828 (Goodrich 1828). In May 1829, however, because of unloading delays at Coenties Slip, a 130-foot extension was ordered, the addition of two blocks and two bridges. Work proceeded quickly, with the first payment to William Hockman authorized on 27 July, and the last on 19 October (MCC 1917:XVIII 52, 212, 239, 328). The 1833 map shows the lengthened pier, and the Alvord survey gives the length as 348 feet, approximately the sum of the original 200 feet plus the 130-foot extension (Alvord 1849) (Figure 19). Pier 8 is noted as a public pier in 1867, with its eastern side and slip utilized by the New York & Erie Railroad Company (Dripps 1867).

Pier 9 (Between Coenties Slip and Cuylers Alley): As described above, Coenties Slip East to Old Slip West had been filled as far as Front Street by 1767. The Holland Map of 1776 records two piers extending from the east side of Front Street to the east and west of Cuylers Alley (Cohen and Augustyn 1997:83). The pier on the west side had a double ell at its tip, giving it a T shape. This appears on maps between 1776 and 1797, and in the latter year was labeled "Ten Eyck's Wharf." The 1803 Mangin-Goerck Plan shows the head of the pier within present South Street but outside the APE (Cohen and Augustyn 1997:83, 85, 89, 97; Taylor Roberts 1797) (Figure 15).

As noted above, the Common Council ordered water lot owners from Coenties Slip to Old Slip to have piers "sunk" on the northeast side of Coenties Slip and on the southwest side of Old Slip in 1801, but no orders appear for piers between the two slips (MCC 1917:II 745). A pier is first shown cartographically on this part of South Street between 1807 and 1811, equal in length to the 200-foot pier at Coenties Slip East (Cohen and Augustyn 1997:103; Commissioners 1811). This timeframe corresponds with a complaint to the Council made by Thomas Ten Eyck in 1807. Ten Eyck had built a pier on the east side of Coenties Slip (which approximates the location of Pier 9), spending $4,787, and kept the pier in repair, but received no compensation from the City

for the public wharfage he provided. After deliberating, the Council decided he was entitled to partial reimbursement for his expense (MCC 1917:IV 469, 591).

On the 1833 Hooker map, Pier 9 is associated with the name Dustan (Hooker 1833), which must refer to the family of Peter Dustan, who was a water lot proprietor in 1799, and was cited for not having filled his lot to the South Street bulkhead. He and Thomas Storm also requested permission to build a lime house on a wharf between Coenties and Old Slips in December 1800 (MCC 1917:II 539-541, 687). Storm dealt in produce, including coffee, tea, and sugar. He was noted as a "wholesale grocer," operating the firm of Thomas Storm & Son from 9 Coenties Slip between 1796 and 1808, when he retired. His son Garrit Storm ran the company until 1824 (Depew 1895:596; Barrett 1885:V 323-325).

Pier 9 appears to have been lengthened between 1833 and 1836 (Hooker 1833; Colton 1836), and the 1849 Alvord survey shows the pier as 343 feet long, with a projected 136-foot addition (Alvord 1849) (Figure 19).

Pier 10 (Between Cuylers Alley and Old Slip): The Holland Map of 1776 records a pier on Front Street between Cuylers Alley and Old Slip (Cohen and Augustyn 1997:83). The 1797 plan shows two piers in this area, labeled "Linch & Stoughtons" Wharf and Constables Wharf, of which only Constables Wharf extended into present South Street, but not into this part of the APE (Cohen and Augustyn 1997:83, 85, 89; Taylor Roberts 1797).

As noted above, the Common Council ordered the water lot owners from Coenties Slip to Old Slip to have piers "sunk" on the northeast side of Coenties Slip and on the southwest side of Old Slip in 1801, but no orders appear for piers between the two slips (MCC 1917:II 745). A pier is first shown cartographically on South Street east of Cuylers Alley between 1807 and 1811, equal in length to the 200-foot pier at Coenties Slip East (Cohen and Augustyn 1997:103; Commissioners 1811).

On the 1833 Hooker map, Pier 10 is associated with the name Saltus (Hooker 1833), which refers to the firm of Saltus Son and Co. which was cited for not having filled its portion of the South Street bulkhead (MCC 1917:II 539-541, 687). Brothers Francis and Nicholas Saltus acquired the water lot in 1812, which had been originally granted to Cornelius Van Horne in 1734 (MCC 1917:X 270). Between 1825 and 1835 and beyond, their firm shipped iron and steel bars, nails, hoops, and other iron products, as well as coal and salt, to customers around New York State[11] (Sun 1846:25). Pier 10 appears to have been lengthened between 1833 and 1836 (Hooker 1833; Colton 1836), and the 1849 Alvord survey shows the pier as 342 feet long, with a projected 133-foot addition (Alvord 1849) (Figure 19).

Pier 11 (Old Slip West): The Holland Map of 1776 records two short, closely spaced piers extending from the west side of the slip from Front Street, neither of which extended into the South Street APE (Cohen and Augustyn 1997:83). In 1797, the single pier shown here was labeled Crugers Wharf, which extends into the present South Street APE (Figure 15) (Cohen and

[11] This information is from the company's daybook, in the collections of the library at SUNY Albany (See: library.albany.edu/speccoll/business,htm).

Augustyn 1997:83, 85, 89; Taylor Roberts 1797). At the end of the 18th century, Crugers Wharf had become a locational toponym, rather than an indicator of ownership.

New piers were required when South Street was bulkheaded and filled, and the Council ordered the owners from Coenties to Old Slips to sink piers on the northeast side of Coenties Slip (Pier 8), and 20 feet from the southwest side of Old Slip, which became known as Pier 11. The new piers were to extend 200 feet into the East River, and consist of three blocks, the first two 30 feet square, and the outer block 30 by 40 feet. These were to be connected by three bridges of 34 feet 4 inches each, and were to be completed by November 1802 (MCC 1917:II 745). The deadline was not met, since the historical maps indicate that Pier 11 was not completed until ca. 1811, when it appears on the Commissioners Plan (Commissioners 1811; Cohen and Augustyn 1997:99,103, 104).

Maps show that Pier 11 was lengthened before 1828 (Goodrich 1828), and the Alvord survey gives its length as 336 feet, with a proposed 133-foot extension (Alvord 1849) (Figure 19). In 1867, the western pier slip was used by the Savannah Packets (Dripps 1867).

East River Bulkhead

The next major development in this portion of the APE was the construction of the modern bulkhead system, under the program begun in 1871 by the New York City Department of Docks. The bulkhead eventually defined the present southern boundary of this segment of the APE. By December 1899, the Department of Docks had proceeded as far as plans and authorization for the new bulkhead wall and two new piers between Broad Street and Coenties Slip (Docks 1899:82, map n.p.). By 1902 the bulkhead to Coenties Slip East had been completed, with South Street expanded to 125 feet, and New Piers 4 and 5 had replaced old Piers 5 and 6. Old Piers 7, 8, 10, and 11 had been removed and their locations dredged in 1905-1906 (Docks 1906:175-176; 227). Construction of the remaining section of bulkhead, between Coenties Slip East to Old Slip East, had begun by 1914, and was completed by 1919 (Docks 1914:170; USC&GS 1919).

Disturbance

Bulkhead Construction

In this section of the APE, the impact of 20th-century bulkhead construction could not have extended to the full 35 to 40 foot depth, because of the shallowness of the bedrock stratum. The 1906 Department of Docks report does note dredging here for the bulkhead at Broad Street to a depth of 29.3 feet below mhw (Docks 1906:382).

Dredging

Accurate records of dredging, or even maps of pier slip depths prior to 1857, are not available in order to document routine dredging impact in now-filled sections of South Street within the APE. Dredging depths from Broad Street to Old Slip recorded in the 1906 Department of Docks Report range from 25 to 35 feet below mhw (Docks 1906:382). This is in contrast to pier slip depths of less than 21 feet below mhw on the 1906 harbor chart, and less than 18 feet below mhw in 1857 (Harbor Commissioner 1857; USC&GS 1906).

Buried Utility Lines

Segment 3 is irregularly shaped, but generally limited to Marginal Street except for small areas at its western (Broad Street West) and eastern (Old Slip East) ends, where it includes small sections of South Street. Current and historical utilities at the filled location of former Pier 5 (east side of Broad Street; Bromley 1891) include a 4' circular sewer and regulator chamber; a 30" water main; and a 12" water main (1950) (WPA 1939:4; ADP 2006; WMDM 2006). Current and historical utilities at the filled location of former Pier 6 (Coenties Slip West) include a 30" water main and a 12" water main (1954), both running parallel to South Street, and a shallowly buried (2'1") electrical duct along the western edge of the pier location (WPA 1939:4; ADP 2006; WMDM 2006).

Current and historical utilities at the filled location of former Pier 7 (location of present Pier 6) include a late 19th-century 60"/54" sewer running east/west through the center of the former Pier 7 location, and a current 12" water main (1954) which zigzags through the APE section of the former Pier 7 site (WPA 1939:4; ADP 2006; WMDM 2006). Current and historical utilities at the filled location of former Pier 8 (at the foot of the eastern edge of Vietnam Veterans Plaza/Coenties Slip) include a modern 30" water main (1962) (WPA 1939:4; ADP 2006; WMDM 2006).

Current and historical utilities at the filled location of former Pier 9 (at the foot of former Cuyler's Lane, midway between Vietnam Veterans Plaza and Old Slip) include a 30" water main (1962), which runs parallel with South Street through the old pier location (WPA 1939:4; ADP 2006; WMDM 2006). Current and historical utilities at the filled location of former Pier 10 (east of former Cuyler's Lane, west of Old Slip) include a 30" water main (1962), which runs parallel with South Street through the old pier location (WPA 1939:4; ADP 2006; WMDM 2006).

Current and historical utilities at the filled location of former Pier 11 (at the foot of Old Slip West) include a 30" water main (1962), which runs parallel with South Street (WPA 1939:4; ADP 2006; WMDM 2006).

The section of Segment 3 in the Old Slip intersection is a triangular area (approximately 82' N/S and 34' E/W at its widest dimensions) that hosts the following utilities running parallel with South Street: a 30" water (1932) main; 16" high pressure water main; and, currently, a 6" water connection to a hydrant on the landward side of South Street that runs perpendicular to South Street (WPA 1939:4; WMDM 2006).

Soil Boring Logs

The section of Segment 3 evaluated here lies within Marginal Street, a location heavily impacted by dredging, construction, and fill associated with the modern bulkhead. The soil borings conducted in Segment 3 of the APE identify the expected thick fill strata extending to between 15.9 and 39 feet below mhw (WPA 1965:Sheet 1 #475 and odd-numbered logs through #499; Appendix).[12]

[12] In one boring log, #473 conducted at the base of Old Pier 5 at Broad Street, where the old pier works were dredged, removed, and the bulkhead was built, fill is identified to only 4.9 feet below mhw.

The fairly shallow depth of bedrock in Segment 3 of the APE is also notable, ranging from 21.6 to 41.9 feet below mhw. It accounts for the very thin or missing strata of river mud and sand beneath the fill, which would have been subjected to normal dredging as well as dredging in preparation for 19th and 20th century pier and bulkhead construction, which works would have been laid directly on the rock, rather than on muddy or sandy riverbottom strata. This can be observed in logs (#475, #477, #479, #483, #489, #491), as can completely missing sandy till strata (#493), mixed deposits created by dredging impacts on multiple strata in logs (#473, #481), and fill directly atop rock (#499). Also notable is the absence of timbers and the few appearances of wood (#477, #491, #499); this absence would be expected if the early cribwork had been removed for modern construction. One seemingly anomalous log (#487) shows 11 feet of mud and silt atop a very thin (2.4 feet) stratum of sand, which suggests dredging and then exposure to river mud before filling.

Another sign of modern bulkhead construction is the appearance of riprap in three of the logs (#483, #495, #497), as well as an unexplained 36.5 feet of concrete at #485.

Potential Archaeological Sensitivity
Categories of potential archaeological remains for Segment 3, since it lies in Marginal Street beyond the 19th-century bulkhead, are submerged precontact remains, 19th-century riverbottom remains, and 19th-century landfill retaining devices, wharves, and piers. Areas of potential archaeological sensitivity in the triangular section of Segment 3 in the Broad Street intersection north of Marginal Street, are noted within the discussion of Segment 2.

Submerged Precontact Resources
Since they would pre-date the inundation of the APE, potential precontact archaeological resources would be expected in the first few feet of the sandy, glacial till layer beneath river-deposited strata, such as mud and silt. This sandy stratum could represent the pre-inundation land surface of ca. 12,500 to 2,600 BP.

Although dredging episodes and depths have not been individually and specifically recorded, soil borings and usage history indicate that because of the extremely shallow bedrock stratum in Segment 3, the river mud and glacial till strata were removed during the first half of the 19th century for preparation of the riverbottom for the sinking of cribworks for piers and bulkheads, as well as during the much deeper dredging (an estimated 35 to 40 feet below mhw) in the early 20th century for the modern bulkhead. This activity would have impacted or eliminated any potential pre-inundation land surface, as well as potential precontact resources, in an area of the APE extending approximately 42.5 feet north of the current bulkhead, which encompasses all of Segment 3.

Riverbottom Remains
As with potential submerged precontact resources, 19th-century riverbottom remains, located in the rivermud strata above the glacial till layer, would also have been removed by dredging and other pre-construction preparation associated with the construction of the modern bulkhead to an estimated depth of 35 to 40 feet below mhw, and extending approximately 42.5 feet north of the current bulkhead, which encompasses all of Segment 3.

Landfill Retaining Structures, Wharves, and Piers
In Segment 3, this category refers to old Piers 5-11, built on the south side of the South Street bulkhead in the early 19th century. As noted in the soil boring log review, little or no wood was encountered in this segment. This is not surprising, given that preparation for construction of the modern bulkhead specifically included the "removal of old work" and dredging of the location (Docks 1906:175-176). Although standard preparation for the construction of the modern bulkhead involved dredging from 35 to 40 feet below mhw, given the relative shallowness of bedrock in this location, this activity would have extended down to bedrock and eliminated potential sensitivity for this category of potential remains in the portions of the APE within 42.5 feet of the modern bulkhead, i.e., Segment 3.

Segment 4: Old Slip to the North Side of Pier 15 between Fletcher and John Streets
Historical Period Usage
Beyond Coenties Slip, South Street was ordered filled to Catharine Slip by January 1799 (Stokes 1926:1,350). Despite the deadline, South Street was bulkheaded and filled gradually. The orders for new piers along the south side of newly built South Street indicate the approximate completion dates of the street. The section from Old Slip to Coffee House Slip (Wall Street) was ordered completed by 1804, and pier construction was to be completed by May 1804 (MCC 1917:III 241-242). From Wall Street to Burling Slip, new piers were ordained—although not necessarily built—from 1801-1803 (MCC 1917:II 745, III 130, 291, 309-310).

As noted previously, the orders of the Council were generally observed regarding the 70-foot width of the street. The 1849 Alvord Survey records the width of South Street from Old Slip East to John Street as between 70 and 89 feet, with notably wide areas between Old Slip and Gouverneur Lane (85.6 to 89 feet wide) and at the foot of Wall Street/Coffee House Slip (approximately 99 feet wide) (Alvord 1849) (Figure 20). Nevertheless, there is no discernable difference in street width in 1891 (Bromley 1891).

Piers and Wharves
Pier 12 (Old Slip East): Front Street at Old Slip East is recorded filled by 1782, as shown on the Hills Plan (Cohen and Augustyn 1997:89), with a pier from Front Street extending into the South Street APE by 1789 (Directory 1789). Bulkheading and filling proceeded slightly to the east of this pier, creating what the Taylor-Roberts plan calls "Beach's Wharf" (Taylor Roberts 1797). "Beach's Wharf" extended into the South Street APE as well (Figure 15). Beach was actually Bache, after Theophylact Bache, one of the water lot proprietors. Bache was an English-born importer and seller of a variety of European and "India" goods, including madeira, sugar, molasses, and green tea, as well as flour, salt, and cordage. He brought his son into the firm in 1803, and the company was styled Theophylact & Andrew Bache. They traded with Bristol, Poole, and the west of England, and dealt with the Newfoundland fisheries (Stevens 1867:43, 52). At his death, Bache owned two warehouses, 44 and 45 South Street, and the pier into the East River, which in 1807 was noted as illegally built beyond the 400 foot limit (MCC 1917:IV:638-639).

Although South Street east of Old Slip was ordered built in 1798, a petition for the filling of lots from Old Slip to Coffee House Slip (Wall Street), and the erecting of piers there by May 1804, was passed by the Council in 1803 (MCC 1917:III 241-242). In the same month the Council

directed the proprietors to build four piers, one on the east side of Old Slip, a second on the south side of Coffee House Slip, and two others in between (Ibid.:284-285).

The pier on Old Slip was not built by the 1804 deadline, and in 1809 the proprietors petitioned the Council for a 250-foot pier there, which was granted (MCC 1917:V 551). Pier 12 first appears on the 1811 map (Commissioners 1811). The Alvord survey of 1849 records the pier at 342.2 feet long, with a projected lengthening of 122 feet pending (Alvord 1849) (Figure 20). The 1867 map notes that Pier 12 was a public pier, and the western pier slip was the landing place for the "Propeller Line to Philadelphia" (Dripps 1867).

Pier 13 (Gouverneurs Lane): Front Street at Gouverneur Lane was not filled until after 1782, as shown on the Hills Plan (Cohen and Augustyn 1997:89). By 1789, however, a pier at the foot of Gouverneurs Lane appears to extend into the South Street APE (Directory 1789). The 1797 map labels the pier "Governeur's Wharf" (Taylor Roberts 1797). Herman Gouverneur is recorded as owning "large Commodious Store Houses" on Gouverneur Wharf at the corner of Front Street and "Governeurs Alley." He was a merchant in general business, but was chiefly involved in the West India and Curaçao trades until he was lost at sea in 1773 (Stevens 1867:136). Nicholas Gouverneur, who held a quitrent on a nearby water lot in 1775 (MCC 1917:I 659), was one of his executors (Stevens 1867:136). No Gouverneurs are listed among the six proprietors responsible for the water lots between Old Slip and Wall Street in 1797, although the 1803 list includes the mercantile firm of "Gouverneur & Kemble" (MCC 1917:I 659, II 350; III 284-285), which included Herman's nephew Isaac Gouverneur. In 1800, Gouverneur & Kemble imported dry goods and "other foreign and domestic commodities" (Depew 1895:555; Stevens 1867:136).

As described above, although South Street east of Old Slip was ordered built in 1798, a petition for the filling of lots from Old Slip to Coffee House Slip(Wall Street), and the erecting of piers there by May 1804, was passed by the Council in 1803 (MCC 1917:III 241-242). In the same month the Council directed the proprietors to build four piers (Ibid.:284-285).

The two piers between Old Slip and Coffee House Slip were evenly spaced. Pier 13 was built on the west side of Gouverneur Lane, and Pier 14 was built to the east at the foot of Jones Alley, both first appearing on maps between 1807 and 1811 (Commissioners 1811). A late 1806 construction date is suggested, based on a petition to the Council by Bailey & Bogert for permission to store hemp on Pier 13, which was made and rejected on 29 September 1806 (MCC 1917:IV 276). The Alvord map shows a pier of under 330 feet (Figure 20). In 1867 the slips on either side of Pier 13 were being used by the "Kangaroo Line" of steamships to Australia (Dripps 1867).

Pier 14 (Jones Alley): As noted above, a petition was passed by the Council in 1803 for the filling of lots from Old Slip to Coffee House Slip(Wall Street), and the erecting of piers there by May 1804 (MCC 1917:III 241-242). In the same month the Council directed the proprietors to build four piers (Ibid.:284-285).

The two piers between Old Street and Coffee House Slip were evenly spaced, and Pier 14 at the foot of Jones Alley first appears on maps between 1807 and 1811 (Commissioners 1811). The 1833 Hooker map refers to Pier 14 as Jones Wharf, but this may be a reference to the street

location, rather than the proprietor (Hooker 1833). A John Jones was cited in a list of water lot owners who had not completed their bulkheads to South Street in 34 years earlier, in 1799 and in 1803, but evidence better links John Jones with the Pier 15 location (see below) (MCC 1917:II 539-541; III 284-285). The Alvord map shows a pier of approximately 310 feet long, shorter than its neighbors (Figure 20). In 1867 the western pier slip was utilized by the "Baltimore Line of packets (Dripps 1867).

Pier 15 (Coffee House Slip [Wall Street] West): Front Street at Coffee House Slip West is recorded filled between 1767 and 1776 (Ratzer 1776; Cohen and Augustyn 1997:83), and a pier is recorded on Front Street extending into the South Street APE by 1789 (Directory 1789). The 1797 plan notes the pier with a westward-facing ell at its tip, extending into the South Street APE, labeled "Jones's Wharf" (Taylor Roberts 1797). John Jones was a wealthy wine merchant who resided on Wall Street (Barrett 1885:V 183). With the completion of the South Street bulkhead here in ca. 1804, this pier was incorporated into the street and bulkhead, as shown on the Mangin-Goerck Plan (Cohen and Augustyn 1997:97; MCC 1917:III 241-242) (Figure 15).

Despite an order from the Common Council to build a pier in line with the "South Side of Coffee House Slip" in 1803, petitions from the proprietors for the pier to be built in 1803 (MCC 1917:III 284-285, 307), and a petition by John Jones for a pier there in front of the property belonging to the estate of John Jones in 1809 (Ibid.:V 567), no pier was built at this location until between 1834 and 1836. What appears to be the eastern half of 70-foot wide South Street at the future Pier 15 location is not even shown as bulkheaded and filled in 1828 (Goodrich 1828). The Council minutes suggest a struggle between the Council and proprietors over control of the slip sides of the piers (Ibid.:III 307).

A short pier was drawn here in 1836 (Goodrich 1828; Desobry 1834; Colton 1836). When designated Pier 15, the late date of construction confused the already-established numbering system for the piers farther uptown, causing the former Pier 15 to be renamed Pier 16, for example.

A rebuilding in the public slip to the east, to accommodate the ferries to Bay Ridge and Montague Street in Brooklyn, resulted in the lengthening of Pier 15 to 337.6 feet, as shown on the 1849 Alvord survey (Figure 21). Additional bulkheading in the slip created a small platform, which was expanded beyond the line of the modern bulkhead during the 1850s (Alvord 1849; Dripps 1852; Harbor Commissioner 1857). The pier slip to the west was a berth for the steam boats to Philadelphia and Washington (Dripps 1867).

Pier 16 (Coffee House Slip [Wall Street] East): The Front Street location at Coffee House Slip East was bulkheaded and filled between 1735 and the early 1740s, creating a wharf parallel with Water Street called "Burnet's Key" in 1754 (Cohen and Augustyn 1997:61, 63, 65). In ca.1767, "Murray's Wharf" was built there, extending from Front Street into the South Street APE (Ratzer 1767). The 1789 plan notes the pier with an eastward-facing ell at its tip, which by 1797 had been partially incorporated into the new South Street, yet still labeled "Murray's Wharf" (Taylor Roberts 1797). The pier was completely incorporated into South Street by 1799 (Figure 15). Murray's Wharf was named after Robert Murray (d. 1786), a Quaker merchant from Pennsylvania who came to New York in 1753. By 1769 he was said to own more shipping

tonnage than any man in America, and was involved in "every sort of mercantile business" (Barrett 1885:I 289). His son, John Murray Jr., was recorded as the owner of the adjacent property in 1793, when he and his partner Henry H. Kip requested permission to build warehouses there (Barrett 1885:I 289-290; MCC 1917:II 37). The Council's "engrossed grant" of the water lot at this location to John Murray Jr. was approved in 1797, and in 1801 he was ordered to "fill the opening" in the pier on the east side of Wall Street Slip (MCC 1917:II 345, 742). John Murray Jr. was involved in the tea trade through the firm of Murray, Mumford & Bowen, although he is linked to Crane Wharf at Beekman Street, and later to Peck Slip, rather than the Pier 16 location (see discussion of Pier 23, below) (Barrett 1885:V 190-191).

With the completion of the South Street bulkhead here, as shown on the Mangin-Goerck Plan (Cohen and Augustyn 1997:97; MCC 1917:III 241-242) (Figure 15), in 1801 the Council required the water lot proprietors between Wall Street Slip and Fly Market Slip (Maiden Lane) to sink a pier on the northeast side of Wall Street Slip, 20 feet beyond the slip edge, and a second on the southwest side of Fly Market Slip. They were to extend 200 feet into the East River, each consisting of three blocks, two 30 feet square, and the end of the pier 30 by 40 feet. Connected by three bridges 33 feet 4 inches in length, the piers were to be completed by November 1802 (MCC 1917:II 745).

Despite the order, maps show no pier at this location until between 1807 and 1811 (Commissioners 1811). In 1816 the proprietors complained that Pier 16 "at Murray's Wharf on the east side of Coffee House Slip" was shorter than the adjacent piers, and requested an extension (MCC 1917:VIII 614). Neither the reason for the complaint, nor its solution, is discernable from the historical maps (Commissioners 1811). The 1833 Hooker map still designated the pier as "Murray," and the Alvord survey shows a 330-foot long pier at the location (Figure 21). When Pier 15 was built on the west side of the slip in the early 1830s, "Murray's Wharf" was renumbered as Pier 16 (Hooker 1833; Alvord 1849).

By the 1850s, the ferries to Bay Ridge and Montague Street, Brooklyn occupied the slip between Piers 15 and 16 (Dripps 1852; Harbor Commissioner 1857), and the pier slip to the east served "Havanna & San Francisco" (Dripps 1867).

Pier 17 (Pine Street): As noted above, the Front Street location at Pine Street (then King Street) was bulkheaded and filled between 1735 and the early 1740s, creating a wharf parallel with Water Street called "Burnet's Key" in 1754 (Cohen and Augustyn 1997:61, 63, 65). A pier was constructed at the foot of Pine Street by the time of the 1776 Holland Map, labeled "Bruce's Wharf" in 1797. The wharf does not appear to extend into the South Street APE in 1797 (Figure 16) (Directory 1789; Taylor Roberts 1797).

With the completion of South Street in this area by 1803, the proprietors petitioned the Council for a new 200-foot long pier at the foot of Pine Street, which was granted (MCC 1917:III 291, 309-310). The new Pier 17 does not appear on maps until between 1807 and 1811 (Commissioners 1811). The 1828 map records a lengthening of the pier by that date (Goodrich 1828). The 1833 Hooker map labels the pier "Pine St." rather than Bruce's as seen earlier (Hooker 1833), and the Alvord survey records a pier 310 feet long (Figure 22), with the western slip used during the 1850s by the "X Line of London Packets" (Dripps 1852; 1867).

Pier 18 (Fly Market Slip [Maiden Lane] West): The Front Street location at Fly Market Slip West was bulkheaded and filled between 1735 and the early 1740s, creating a wharf parallel with Water Street called "Burnet's Key" in 1754 (Cohen and Augustyn 1997:61, 63, 65). A pier was constructed at the west side of Fly Market Slip by the time of the 1789 Directory Map, when the slip was utilized by the ferry to "Long Island" (Directory 1789), and in 1801 it is noted as the landing place of the ferry to Brooklyn, when the owner was recorded as Gerard Walton (MCC 1917:II 730).

With the completion of the South Street bulkhead here—as shown on the 1803 Mangin-Goerck Plan (Cohen and Augustyn 1997:97; MCC 1917:III 241-242) (Figure 16)—in 1801 the Council required the water lot proprietors to sink a pier on the west side of Fly Market Slip (Maiden Lane). It was to extend 200 feet into the East River, consist of three blocks, two 30 feet square, and the end of the pier 30 by 40 feet. Connected by three bridges 33 feet 4 inches in length, the pier was to be completed by November 1802 (MCC 1917:II 745).

No pier appears here cartographically until between 1807 and 1811 (Cohen and Augustyn 1997: 100; Commissioners 1811), although the Council resolution to negotiate for the purchase of the pier on the west side of Fly Market Slip from its owners in June 1804 (MCC 1917:III 536) suggests an existing pier, or perhaps one under construction. This desire was repeated in 1806, and the City Corporation purchased the eastern half of the pier in 1808 (Ibid.:IV 213, V 216).

Fears of ice damage to the piers on Fly Market Slip, because they were considered too short, moved the Council to authorize a lengthening in 1810, which would also accommodate the "dry cars" of fisherman who needed wharf space. The pier on the west side of the slip was only 195 feet long and 30 feet wide, and the Council recommended the sinking of an additional block to form an ell of 30 to 30 feet, connected to the main pier by a bridge of 25 or 30 feet long (MCC 1917:VI 634-635). The new ell never appears on any subsequent map, and was apparently never built (Goodrich 1828), although an 1829 petition for lengthening the pier—"now 190 feet"—by one block and one bridge was approved by the Council (MCC 1917:XVIII 219).

During the 1820s, the pier was leased for the use of the steamboats *United States* and *Linnaeus*, the latter of which sailed from Flushing (Ibid.:XIII 369, 639, XIV 318). By 1849, Pier 18 was recorded as 340 feet long (Alvord 1849) (Figure 22). The 1867 map labels it a public pier (Dripps 1867).

Pier 19 (Fly Market Slip East): The Front Street location at Fly Market Slip East was bulkheaded and filled between 1735 and the early 1740s, creating a wharf parallel with Water Street called "Burnet's Key" in 1754 (Cohen and Augustyn 1997:61, 63, 65). A pier was constructed at the east side of Fly Market Slip at the foot of Fletcher Street by the time of the 1789 Directory Map, when the slip was utilized by the ferry to "Long Island" (Directory 1789). In 1797 the pier appears to extend into the South Street APE (Taylor Roberts 1797), but the Mangin-Goerck Plan shows this was not the case (Figure 16). A number of the water lots owners at Front Street between Fly Market and Burling Slips are recorded, but none seems to be directly associated with the early pier there. Wynant Van Zandt requested the grant in front of his property there in

1789, and Abijah Hart and Elias Cowles are noted as the owners of the filled water lot at Fletcher Street in 1796 (MCC 1917: I 483, II 222).

With the completion of the South Street bulkhead here, as shown on the 1803 Mangin-Goerck Plan (Figure 16) (Cohen and Augustyn 1997:97; MCC 1917:III 241-242), in 1802 the water lot owners from Fly Market Slip to Burling Slip were required to build one pier on the northeast side of Fly Market Slip, 20 feet from "the present range of slip," extending 200 feet in to East River, and 30 feet wide, to be completed by December 1802 (MCC 1917:III 130). A second order for the construction of the pier was passed in June 1807, and a third in 1809 (Ibid.:IV 465-466, V 557, 580). No pier appears here cartographically until between 1807 and 1811 (Cohen and Augustyn 1997: 100; Commissioners 1811), although an 1810 Council resolution notes the pier on the east side of the slip was 250 feet long, which indicates it had not only been completed by 1810, but had also been lengthened by 50 feet (MCC 1917:VI 634-635). By the time of the 1849 Alvord survey, Pier 19 had been lengthened to 337 feet (Alvord 1849) (Figure 22). During the 1850s the western pier slip was utilized by the Star Line of Liverpool Packets, and is noted as a public pier in 1867 (Dripps 1852; 1867).

East River Bulkhead

The next major development in this portion of the APE was the construction of the modern bulkhead system, under the program begun in 1871 by the New York City Department of Docks. The bulkhead eventually defined the present southern boundary of this segment of the APE. The old bulkhead and, therefore, the width of South Street in Segment 4 was relatively unchanged from 1849 to 1903 (Alvord 1849; SSS 1903a; 1903b) (Figures 21, 22). Since the 1850s, no additional structures had been built in this part of the APE outside the old bulkhead as in other segments (Bromley 1891; Sanborn 1905) (Figure 26).

The Department of Docks report of 1906 recorded the bulkhead as "in progress" from Old Slip to the south side Wall Street, and the bulkhead from the south side of Wall Street to Burling Slip as completed in 1904 (Docks 1906:227-228). Construction on new Piers 10, 11, 13, 14, and 15 was begun in 1905, and all except Pier 11 were completed by 1906, and the old piers were removed (Ibid.:228; Sanborn 1905). New Piers 11 and 12, and the remainder of the bulkhead were finished by 1914 (Docks 1914:170).

Disturbance

Bulkhead Construction

Because of the general depth of mud—in some places up to 170 feet deep—along the Manhattan shoreline, the bulkhead had to rest on piles, even though the piles could not extend to the hard bottom in all cases. According to Greene, the river mud was dredged "for a width of about 85 feet to a depth of 30 feet, more or less, depending on the consistency" (Greene 1917:88). According to Greene's schematic drawings (Figures 9, 10), this width of dredging extended an equal distance on each side of the proposed bulkhead, therefore, approximately 42.5 feet into the area of the APE on present South/Marginal Street, and to a depth of 35 to 40 feet below mhw.[13] Into that dredged surface the piles were driven, and the open spaces filled in with cobbles and riprap, to serve as a base and support for the concrete and masonry bulkhead. The new street area would have been further filled with "earth, ashes, &c." as Greene notes in his 1876 bulkhead

[13] Greene's calculations were based on mean low water 4.85 feet below mean high water (mhw).

drawing (Figure 9) (Greene 1917:88-94). During the construction of the Segment 4 section of the bulkhead, the Department of Docks annual report noted that "[e]arth filling is being placed in rear of that portion of the wall built" (Docks 1906:228).

In parts of APE Segment 4 below Wall Street, the impact of 20th-century bulkhead construction could not have extended to the standard 35 to 40 foot depth because of the shallowness of the bedrock stratum, as will be seen in the following soil boring logs discussion. From Wall Street to the east, however, the increasing depth of bedrock would have meant that the standard dredging depth was followed.

Dredging

Accurate records of dredging, or even maps of pier slip depths prior to 1857, are not available in order to document routine dredging impact in now-filled sections of South Street within the APE. In what is now part of Marginal Street in Segment 4, dredging at old Piers 13 and 14 was to between 33 and 35 feet below mhw in 1906 (Docks 1906:382). This is in contrast to pier slip depths of less than 30 feet below mhw on the 1906 harbor chart, and less than 17 feet below mhw in 1857 (Harbor Commissioner 1857; USC&GS 1906). This would suggest the removal of more than 15 feet of early 19th-century riverbottom strata, which should result in an absence of rivermud strata in the Marginal Street boring logs.

Buried Utility Lines

Sewer and water maps recording historical and current utilities in the northern section of Marginal Street between Old Slip and Wall Street (16 feet or less in width) show one 30" water main (1951/1985) running parallel with the street from Old Slip to Wall Street, and a second (1932) also running parallel to the street for the length of the segment. Additional utilities in this area run perpendicular to Marginal Street: a 6" water line (ca. 1884), an 8" water line and manhole (1884), and a 20" water line, at and adjacent to the location of present Pier 11 (east of Gouverneur Lane); and an electrical duct with its related manhole, a <12" water line, and a water line with hydrant, in and adjacent to Wall Street.

Current and historical utilities at the filled location of former Pier 15/16 (foot of Wall Street, Bromley 1891; SSS 1903a) include a 30" water main, running parallel to Marginal Street along the former bulkhead line (head of the pier); an electrical duct running along the modern bulkhead line parallel to Marginal Street; and two <12" water mains laid perpendicular to Marginal Street running into the locations of Piers 15 and 16, respectively (WPA 1939:4; ADP 2006; WMDM 2006). Current and historical utilities at the location of former Pier 17 include a 30" water main (1962), which runs parallel with Marginal Street through the old pier head location. An electrical duct and manhole was also laid through the pier location parallel to Marginal Street along the ca. 1939 shoreline, after former Pier 17's removal in the early 20th century. A second electrical duct runs parallel to the pier through the location (WPA 1939:4; ADP 2006; WMDM 2006).

Current and historical utilities at the filled location of former Pier 18 (west of Maiden Lane, Bromley 1891; SSS 1903a) include a 30" water main (1932), which crossed the head of the pier, and an electrical duct which crosses the location, both parallel to Marginal Street (WPA 1939:4; ADP 2006; WMDM 2006). Current and historical utilities at the filled location of former Pier 19

(foot of Fletcher Street, Bromley 1891; SSS 1903a) are limited to one electrical duct which crosses the location parallel to Marginal Street (WPA 1939:4; ADP 2006; WMDM 2006).

Most of the historical buried utilities in South Street are in the landward 35 feet of the street. The remaining evaluated sections of the segment are relatively sparsely disturbed by main and duct installation. The chief of these is a 16" high pressure water main, running parallel with South Street the entire length of the segment, about 56 feet from the landward (western) side of South Street (WPA 1939:10).

Although there are multiple connections to hydrants, with smaller water lines crossing the segment perpendicular to South Street, these are widely spaced (8 feet apart or more) in a large area and as such would have little effect on potential archaeological sensitivity. Two areas of South Street had greater concentrations of utility lines. The first is the intersection of South Street and Maiden Lane, where in addition to the mains described above, there is a 30" low pressure water main running parallel with South Street (shifts west into South Street from Marginal Street); a 12" high pressure water main, telephone ducts, and electrical ducts running perpendicular and diagonal to South Street; and an approximately 27'x25' sewer chamber connecting with a 6'x6' sewer main, passing through the segment perpendicular to South Street.

The second concentration of utility lines in this part of South Street is at the head of present Pier 15, where in addition to the mains described above, there is a 30" low pressure water main running parallel with South Street (which shifts west into South Street from Marginal Street); an electrical main on a diagonal across South Street, and an approximately 27'x25' sewer chamber about 60 feet north of Fletcher Street, with a 4' circular barrel sewer crossing the segment and continuing on to current Pier 15.

Soil Boring Logs

Soil borings that have been conducted in Segment 4 clearly reflect the known construction history of this part of the APE (WPA 1965: Sheet 1 #496-#509, Sheet 4 #329-#350). All logs identify an expected thick fill strata extending to between 13.9 and 45.6 feet below mhw.

In addition, the boring logs from South Street on the north (even-numbered logs #496 to #508, and odd numbered logs #329 to #349) show a marked contrast with those from Marginal Street on the south (odd-numbered logs #497 to #509, and even-numbered logs #330 to #350), illustrating the impact of modern bulkhead construction on Marginal Street. The South Street boring logs—where landfilled 18th- and 19th-century cribwork piers and bulkheading are expected—show thick fill strata containing "timbers" and wood, which would be the remains of cribwork. In most cases, the timber-bearing fill or mud stratum extends to bedrock (e.g., #498), or to a sand stratum (e.g., #496, #335, #347), indicating the prepared surface upon which the cribbing was sunk. River mud strata tend to be within or between strata with timbers or fill (e.g. #506, #329, #333, #335), suggesting a time lag between filling episodes in which river deposits were able to accumulate, rather than slip bottom accumulations.

The Marginal Street boring logs show a general absence of timbers, although there are a few stray appearances (#509, #330, #338, #340) in fill, as might be expected. There are few or no thick river mud strata, which indicates the results of dredging preparation for modern bulkhead

construction, in which river mud deposits were removed to a sand stratum, and the piles stabilized by the addition of riprap (#497, #330).

Boulders, the possible fill for the lower section of cribworks, were noted in many logs in both South and Marginal Streets (#497 to #501, #506, #507, #509, #329, #332, #337, #343, #344, #345, #347, #348).

The shallow depth of bedrock noted in other parts of the APE to the west continues into Segment 4 from Old Slip to the center of Wall Street, where bedrock ranges from 24.5 to 50.0 feet below mhw. As one proceeds from the center of Wall Street east to Burling Slip West, the rock stratum becomes progressively deeper, from 56.8 feet below mhw at Wall Street to 205.9 feet at Burling Slip West (#330, #350).

Where bedrock is shallow, i.e., ≤40 feet below mhw, dredging in preparation for pier and bulkhead construction would be expected to go down to bedrock, eliminating all or most of the intermediate mud, silt, and till strata, so that the works could be laid directly on the rock, rather than on muddy or sandy riverbottom strata. Where bedrock is deep, standard dredging to 35 to 40 feet below mhw for modern bulkhead construction was practiced, and piles were driven for support. Both scenarios account for the missing mud strata in the Marginal Street boring logs.

Potential Archaeological Sensitivity

Categories of potential archaeological remains for this section of the APE are submerged precontact remains, 18th- and 19th-century piers and landfill retaining devices, 18th- and 19th-century landfill deposits, 18th- and 19th-century riverbottom remains, and 19th-century wooden water mains.

Submerged Precontact Resources

Since they would pre-date the inundation of the APE, potential precontact archaeological resources would be expected in the first few feet of the sandy, glacial till layer beneath river-deposited strata, such as mud and silt. This sandy stratum could represent the pre-inundation land surface of ca. 12,500 to 2,600 BP.

Although dredging episodes and depths have not been individually and specifically recorded, soil borings and usage history indicate that because of the extremely shallow bedrock stratum in the parts of Segment 4 west of Wall Street, the river mud and glacial till strata were removed in preparation of the riverbottom for the sinking of cribworks for piers and bulkheads during the first half of the 19th century, as well as for the modern bulkhead in the early 20th century. This activity would have eliminated any potential pre-inundation land surface, as well as potential precontact resources there.

To the east of Wall Street, it would not have been practical to place bulkheads or pier cribs directly on rock, as this strata plunged to as much as 200 feet below mhw. Here also, although there are scattered pockets of river mud noted, most of this strata has been removed during dredging activities, both for the sinking of cribworks during the 19th century, and particularly the deep dredging during the removal of the old piers and the preparation of the location for the modern bulkhead. It is not conceivable that the first few feet of glacial till, which would be

sensitive for submerged precontact remains, would have been left intact when the mud overburden was removed during these operations.

Riverbottom Remains

As with potential submerged precontact resources, 18th- and 19th-century riverbottom remains—located in the rivermud strata above the glacial till layer—would also have been removed by dredging and other pre-construction preparation associated with the construction of piers and bulkheads during the 18th through 20th centuries.

Landfill Retaining Structures, Wharves, and Piers

As described above, landfilling work for South Street as far uptown as Catharine Slip was first ordered in 1798, although Common Council minutes suggest that bulkheading and filling in APE Segment 4 did not occur until between ca. 1801 and 1804, and Coffee House Slip (Wall Street) was not filled until 1828 to 1836.

Nine historical piers were also constructed within this part of the APE during the first decade of the 19th century, and additional piers extending from 18th-century bulkheads predated these piers and even the completion of the street itself. Therefore, their cribworks would have been preserved when the street was further filled and widened around them.

As noted in the soil boring log review, timbers and wood were abundant in the soil borings throughout the northern or South Street section of Segment 4, as would be expected. It is not possible to distinguish between landfill retaining devices and piers from soil borings, especially since many of the same techniques were used for both, and piers were often transformed into retaining structures. These timbers are present, however, occurring in fill and mud strata ranging between 4.1 feet above mhw (immediately beneath 1.5 feet of surface paving) and 44.0 feet below mhw.

Preparation for the construction of the modern bulkhead involved dredging from 35 to 40 feet below mhw. Given the relative shallowness of the cribworks recorded in the soil boring logs, they would have been removed prior to construction, as was standard practice (Docks 1914:172). This activity would have eliminated potential sensitivity for this category of potential remains in the portions of the APE within 42.5 feet of the modern bulkhead.

Utility installation would also have destroyed some of the upper sections of piers and landfill retaining devices in the remaining sections of Segment 4, depending on the size of the main and the depth to which it was installed. Although some areas of potential sensitivity may have been destroyed to depths greater than the five feet below the present surface that would be impacted by this project, buried utilities could not have completely eliminated potential sensitivity for this category of remains, given their great depth (basically, from the surface to as much as 40 feet below mhw). Unfortunately, utility maps do not provide the accuracy necessary to pinpoint these areas, as even the utility agencies do not rely on them to locate their own mains. Therefore, the remaining areas of this section of the APE must be considered potentially sensitive for buried landfill retaining structures, wharves, and piers, dating from the late 18th and early 19th centuries. See the Conclusions section of this report for recommendations.

Landfill Deposits

As noted in the previous discussion, landfilling on present South Street as far uptown as Catharine Slip was first ordered in 1798, although Common Council minutes suggest that bulkheading and filling in Segment 4 did not occur until ca. 1801 to 1804, and Coffee House Slip (Wall Street) was not filled until the period 1828 to 1836.

Nine historical piers were also constructed within this part of the APE during the first decade of the 19th century, and additional piers extending from 18th-century bulkheads predated these piers and even the completion of the street itself. Therefore, their cribworks would have been filled at the time of their construction and then surrounded with later fill, as they were engulfed by the widening of the street beyond 70 feet in the early 20th century.

Soil borings in the South Street section of this segment note "miscellaneous fill"—often with associated timbers which represent landfill retaining devices and piers—throughout this section of the APE. Historical fill ranges in depth from 4.1 feet above mhw (immediately beneath 1.5 feet of surface paving) to 45.6 feet below mhw. Although it is not possible to distinguish between primary landfill and secondary fill from the generalized descriptions provided by the available soil borings, secondary fill was earlier defined as extending from the surface to a few feet below mean low water, which in the APE is approximately 4.85 feet below mhw. The remaining strata of fill beneath the secondary fill would be considered primary landfill.

As noted earlier, preparation for the construction of the modern bulkhead involved dredging from 35 to 40 feet below mhw. Given the relative shallowness of the fill strata recorded in the soil boring logs, they would have been removed prior to construction along with the cribworks, as was standard practice (Docks 1906:176-177). This activity would have eliminated potential sensitivity for this category of potential remains in the parts of the APE within 42.5 feet of the modern bulkhead, and as noted earlier, any fill placed beyond the old 19th-century crib bulkhead during modern bulkhead construction would not be considered to have archaeological potential.

Utility installation also would have impacted the upper strata of landfill in the remaining sections of Segment 4 of the APE, depending on the size of the main and the depth to which it was installed. Although some areas of potential sensitivity may have been destroyed, buried utilities could not have completely eliminated potential sensitivity for this category of remains, given their great depth (basically from the surface to as much as 45.6 feet below mhw). Unfortunately, utility maps do not provide the accuracy necessary to pinpoint the areas of deep disturbance caused by utility installation, as well as to identify the small locations—often between and abutting buried mains—which may have archaeological potential. Therefore, the remaining areas of this section of the APE must be considered potentially sensitive for historical landfill dating from 18th through the end of the 19th century. See the Conclusions section of this report for recommendations.

Wooden Water Mains

Wooden water mains dating to before 1827 would be expected within the northern 70 feet of this segment of the APE, which corresponds to the area of South Street within the 19th-century bulkhead. Stratigraphically they would be found within the first four feet of the existing fill stratum, beneath modern paving. As a result they are the most susceptible to modern utility

disturbance and street regrading. On the other hand, given the noted inaccuracy of utility maps and the potential for scattered pockets of shallow remains to survive even large concentrations of modern utility disturbance, as well as the sheer number of feet of wooden main which would have been laid in the streetbed, it is probable that sections of wooden main have survived subsequent construction disturbance within Segment 4. See the Conclusions section of this report for recommendations.

Segment 7: North of Pier 15 (between Fletcher and John Streets) to the Brooklyn Bridge (Roosevelt Street East)[14]

Historical Period Usage

Beyond Coenties Slip, South Street was ordered filled to Catharine Slip by January 1799 (Stokes 1926:1,350). Despite the deadline, South Street was bulkheaded and filled gradually. The orders for new piers along the south side of newly-built South Street indicate the approximate completion dates of the street. Burling Slip (John Street) West was filled in ca. 1801-1803 when the Council required the water lot proprietors to construct a pier there (MCC 1917:II 745, III 130, 291, 309-310). The section from Burling Slip (John Street) East to Beekman Street (with the exception of Beekman Slip, now Fulton Street) was bulkheaded and filled by 1807, based on the orders to complete filling and sink piers in 1807 (MCC 1917:IV 465-466). Beekman Street to Peck Slip West was ready for pier construction by ca. 1809-1810 (MCC 1917:V:551,650, VI:137), and Peck Slip East to Dover Street was ready for pier construction in ca. 1806 (MCC 1917:IV:145, 248).

South Street remained "unimproved" in 1809, and the Council ordered the completion of the bulkhead there by November 1809. Dover Street to Roosevelt Street East was ordered completed by 1819 (MCC 1917:X 443). Lastly, Peck Slip was filled in during the period 1828 to 1833, and Burling Slip was filled in 1835 (Goodrich 1828; Hooker 1833, 1838).

The orders of the Council were generally observed regarding the 70-foot width of the street. The 1849 Alvord Survey records the width of South Street from John Street (Burling Slip) to Roosevelt as between 65.3 and 83.4 feet, with a notably wide areas in the area of the Fulton and Beekman Streets (Alvord 1849) (Figures 22-24). There is no great discernable difference in street width in 1891 (Bromley 1891), although more detailed maps from the Department of Docks note minor increases of five to 10 feet, with the widest changes centered on Fulton Street, where the bulkhead was widened from 82 to 84 feet in 1849 to ca. 98 feet in 1903 (SSS 1903b).

Piers and Wharves

Pier 20 (Burling Slip West): The Front Street location at Burling Slip West (then Rodman's Slip) was bulkheaded and filled between 1735 and the early 1740s, creating a wharf parallel with Water Street called "Burnet's Key" in 1754 (Cohen and Augustyn 1997:61, 63, 65; Ratzer 1767). A pier was constructed at the west side of Fly Market Slip at the foot of Fletcher Street by the time of the 1789 Directory Map, corresponding to the requests of Peter van Zandt for Council permission to build a pier from Front Street on the west side of Burling Slip in 1788 and 1789 (MCC 1917:I 399, 438, 483). The pier was labeled "Laplant's Wharf" in 1797, but was not long enough to extend into the South Street APE (Directory 1789; Taylor Roberts 1797) (Figure 16).

[14] This discussion also includes the sections of Segment 6 which lie within the bulkhead.

With the completion of the South Street bulkhead here, as shown on the 1803 Mangin-Goerck Plan (Figure 16) (Cohen and Augustyn 1997:97; MCC 1917:III 241-242), the water lot owners from Fly Market Slip to Burling Slip were required to build a 30-foot-wide pier set back 20 feet from the west side of Burling Slip in 1807, opposite the property of John Rogers, deceased (MCC 1917:IV 465-466). The order was repeated in 1809 (Ibid.:V 557, 580). Pier 20 appears here cartographically in 1811 (Commissioners 1811).

Pier 21 (Burling Slip East): The Front Street location at Burling Slip East (then Rodman's Slip) was partially bulkheaded and filled by 1789, and a short pier projects into the East River from the east side of Burling Slip by 1797, but was not long enough to extend into the South Street APE (Directory 1789; Taylor Roberts 1797) (Figure 16).

An 1803 Council discussion of the water lots and a pier (believed to date from ca. 1773) on the east side of the slip indicates that South Street was neither bulkheaded nor filled here in 1803. By 1807, however, pier construction here along South Street was possible. In that year the Common Council reasoned that because Burling Slip had become filled with refuse, it was necessary to build piers on its banks to provide wharfage room. The Council specified the construction of a pier set back 30 feet from the east side of Burling Slip, opposite the property of Peter Schermerhorn and George Codwise. The pier was to be 40 feet wide and 240 feet long (MCC 1917:IV 465-466). It appears cartographically in 1811 (Commissioners 1811), and appears lengthened by 1828 (Goodrich 1828). In 1833 the eastern pier slip is noted as the landing place of the steamboat from Connecticut (Hooker 1833), and further construction in the pier slip between Pier 21 and 22 created two berths for the Fulton Ferry to Brooklyn by the time of the 1849 Alvord survey (Figure 23). Pier 21, a public pier, was recorded as 323.3 feet long (Alvord 1849; Dripps 1852).

Pier 22 (Beekman Slip [Fulton Slip/Street] East): At Beekman Slip East, now the east side of Fulton Street, Water and Front Streets shift abruptly eastward, and as a result, the area was bulkheaded and filled to Front Street by 1797, when a short pier projects into the East River from the east side of Beekman Slip, but was not long enough to extend into the South Street APE (Directory 1789; Taylor Roberts 1797) (Figure 17).

An 1803 Council discussion of the water lots between Burling and Beekman Slips indicates that South Street was neither bulkheaded nor filled here in 1803. By 1807, however, pier construction here along South Street was possible, and the Council specified the construction of a pier set back 20 feet from the east side of Beekman Slip, opposite the property of John Rogers, deceased. The pier was to be 30 feet wide and 250 feet long (MCC 1917:IV 465-466, 472), consisting of four bridges and four blocks (Ibid.:520). Construction was delayed, apparently by the water lot owners, although one, Lewis Moore, petitioned the Council several times for the work to begin, and eventually offered to build the first block and bridge at his own expense before the end of 1807 if he could collect the wharfage fees on the east side and end of the pier until his neighbors paid their share of the costs (MCC 1917:IV 506, 520, V 557). This explains the stump of a pier that appears cartographically in 1811 (Commissioners 1811). Construction for the full 250-foot length continued into 1810, and Council minutes refer to the pier "lately built" on the east side of Beekman Slip in April 1810 (MCC 1917:VI 167, 471, 753), and the pier appears at its full length in 1828 (Goodrich 1828).

By the 1840s, construction in the western pier slip at the foot of Fulton Street between Piers 21 and 22 created two berths for the Fulton Ferry to Brooklyn (Alvord 1849). Pier 22, a public pier, was recorded as 323.4 feet long in 1849 (Alvord 1849; Dripps 1852) (Figure 23).

Pier 23 (Beekman Street [Fulton Slip East/Crane Wharf]): At Beekman Street East, Water and Front Streets shift abruptly eastward, and as a result, the Front Street east of Beekman Slip was not bulkheaded and filled until after 1796, when a petition went to the Council asking that it be opened from Beekman Street to Peck Slip (MCC 1917:II 229). A pier called Crane Wharf had already been erected by Robert Crommelin in 1787, at his property at the foot of Beekman Street, which was called Crane Wharf Alley. The pier was only 100 feet long (MCC 1917:I 338, XII 203). Crommelin was a dealer in books, in "English and Scotch" goods by the 1740s, and in imported tiles, stoves, mantelpieces, and coal grates by the 1760s (Thomas 1874:234; Singleton and Sturgis 1906:197). From ca. 1784 to 1789, however, Crane Wharf was associated with the firm Murray, Mumford & Bowen, an important firm of tea importers in the East India trade (see discussion of Pier 16 above) (Barrett 1885:V 107, 190).

With continued filling along the shoreline, Crane Wharf appears to have been lengthened, since the 1797 Taylor Roberts Map shows the pier labeled "Crane's Wharf" extending into the South Street APE (Taylor Roberts 1797).

The filling and bulkheading of South Street had not taken place by 1804, when the Council was still granting water lots between Front and South Streets at Cranes Wharf. Other water lots near Crane Wharf were unfilled in 1809 (MCC 1917:XII 204). By 1810, however, the property owners in the vicinity requested a pier at Crane Wharf like the ones that had been lately built at Beekman and Peck Slips (MCC 1917:VI 137), and this would correspond with the appearance of a pier at the location on the 1811 map (Commissioners 1811).

Oddly, after the completion of the new pier, there were still requests to the Council for a pier at Crane Wharf Street in 1821, and references to the pier "lately built" there (MCC 1917:XI 720, XII 151, 204), despite the fact that there were also Council minute entries regarding repairs to the existing pier in January 1820 and September 1821 (Ibid.:X 695, XII 14). The possibility that the first pier at Crane Wharf was replaced in 1821 is supported by the fact that the pier on the 1811 map is east of Beekman Street, while on post-1821 maps, it is directly in line with the street (Commissioners 1811; Goodrich 1828). Also, Council minutes note the intention of creating one or two basins between Beekman Slip and Peck Slip in 1809, and there seem to have been difficulties with the existing pier locations (MCC 1917:V 699).

By the time of the 1849 Alvord survey, Pier 23 was recorded at 313.8 feet long and 33.6 feet wide (Alvord 1849) (Figure 23). By 1852, a fish market building had been erected beyond the early bulkhead extending from Pier 23 to Pier 22 (Dripps 1852). The pier slip to the east of Pier 23 was the docking place of the "Black Ball Line of Liverpool Packets," in 1867 (Dripps 1867).

Pier 24 (Peck Slip West [Stevens Wharf]): The western side of Peck Slip was not bulkheaded and filled to Front Street until after 1796, when a petition went to the Council asking that Front Street be opened from Beekman Street to Peck Slip (MCC 1917:II 229). The 1797 Taylor

Roberts Map shows a few short piers west of Peck Slip, but none long enough to extend into the South Street APE (Taylor Roberts 1797). The Mangin-Goerck Plan of 1803 indicates that Stevens Wharf, on the west side of Peck Slip, had been lengthened since 1797, and the end of the pier with its westward-facing ell occupied part of the South Street APE (Figure 17) (Cohen and Augustyn 1997:97).

Ebenezer Stevens was noted as one of New York's wealthiest merchants from the 1790s to the 1820s, operating from a store on Stevens Wharf on Front Street between Peck Slip and Beekman Street by 1789. He was involved in the Antigua trade, exchanging American produce for rum, and also imported brandy, wines, and fruit from Bordeaux by the 1790s. In 1796 he became involved in the trade in hides and indigo (Barrett 1885:V 233-238).

As noted above, South Street remained "unimproved" in 1809, and the Council ordered the completion of the bulkhead there by November 1809. This necessitated the construction of new piers, and the Council also ordered the construction of two piers, one on each side of Peck Slip (MCC 1917:V 551, 650), and the 1811 map shows a completed pier west of Peck Slip (Commissioners 1811). Repairs to the pier are noted in 1815 (MCC 1917: X 574).

By 1820 there were complaints that the pier needed to be further raised, since it was being overflowed by high tides. This was quickly addressed, since an assessment of the pier in 1821 reported that it was in "good order" (MCC 1917:XI 345, XII 14). When Ebenezer Smith died in 1827, his sons John A. and Horatio Gates Stevens continued to operate the firm from the same location, then 110 South Street (Barrett 1885:V 233-238).

In 1849 Pier 24 was recorded as 367 feet long (Alvord 1849) (Figure 23). During the 1850s a double berth was created in the slip between Piers 24 and 25 for ferries to Connecticut (Dripps 1852; Harbor Commissioner 1857; Dripps 1867).

Pier 25 (Peck Slip Middle): The middle pier at Peck Slip was contracted to be completed by December 1809, and by August of that year three blocks had already been sunk by Halsey and Westervelt (MCC 1917:V 584, 640). Unlike Coenties Slip, which was long and deep enough to accommodate a center pier, the middle pier at Peck Slip had to be attached to the bulkhead by a "bridge," which caused a minor tug of war between the property owners on either side of Peck Slip over which should receive this benefit. In December 1809 the Council decided that the bridge should link the pier to the west side of Peck Slip (Ibid.:V 694,765). Maps subsequent to 1809 show an arm extending eastward from the north side of South Street to the middle of Peck Slip, and then the middle pier running perpendicular to South Street into the river (Commissioners 1811). When Peck Slip was filled in between 1828 and 1833, the pier base became part of the new section of South Street.

The Alvord survey in 1849 shows Pier 25 as a public pier 30 feet wide and 244 feet in length, probably the original 1809 dimensions. The pier slip to the east, between Piers 25 and 26, was used by the Williamsburg Ferry (Alvord 1849) (Figure 24). By 1852, the steamboat to Hartford, Connecticut was using the slip on the west of the pier. During the 1850s a double berth was created in the slip between Piers 24 and 25 for ferries to Connecticut (Dripps 1852; Harbor Commissioner 1857; Dripps 1867).

Pier 26 (Peck Slip East): The eastern side of Peck Slip was bulkheaded and filled to Front Street between 1789 and 1797, when the 1797 Taylor Roberts Map shows Front Street reaching the east side of Peck Slip, with a short pier there, but not long enough to extend into the South Street APE (Taylor Roberts 1797). The Mangin-Goerck Plan of 1803 indicates that a pier on the east side of Peck Slip had been lengthened since 1797, and the end of the pier with its eastward-facing ell occupied part of the South Street APE (Figure 17) (Cohen and Augustyn 1997:97).

South Street was bulkheaded and filled here by February 1806, when the Council granted the water lot owners permission to build a pier on the east side of Peck Slip. The pier, 40 feet from the slip bulkhead, was to be 30 feet wide and 250 feet long. By July, two blocks had already been sunk (MCC 1917: IV 145, 248). The completed pier was mentioned in the 1809 Council minutes, and repairs are noted in 1811 and 1812 (Ibid.: V 516, VI 485, VII 243). The pier appears cartographically in 1811 (Commissioners 1811). Pier 26 was recorded at 242.8 feet long and 29 feet wide on the 1849 Alvord survey, its original dimensions (Figure 24). The pier slip to the west, between Piers 25 and 26, was used by the Williamsburg Ferry (Alvord 1849; Dripps 1852).

Pier 27 (Dover Street): Front Street had not been bulkheaded and filled beyond Peck Slip in 1797, and the 1803 Mangin-Goerck Plan records numerous short piers between Peck Slip and Roosevelt Street; however, none extends more than a few feet beyond the south side of Front Street (Figure 17) (Taylor Roberts 1797; Cohen and Augustyn 1997:97). Front Street was not finished in July 1804, but the Council resolved that it should be completed to Catharine Slip by 1805 (MCC 1917:III 562).

In 1806 the Council granted permission to the water lot proprietors to build a pier on a line with Dover Street, 30 feet wide and 250 feet long (MCC 1917:IV 145), presumably from the south side of Front Street. Since the block between Front and South Streets is only 142 feet wide, the new pier would have extended through the then 70.6-foot-wide South Street. The 1811 Commissioners Map shows a 250-foot pier west of Dover Street, extending from the south side of South Street. An ell at the end of the pier extends to the east. The accuracy of this is uncertain, since the map also shows South Street continuing as far as James Slip, when the Council minutes note that the street ended at Dover Street until 1819 (Commissioners 1811; MCC 1917:X 444). On the other hand, later maps do show the same ell configuration (Hooker 1833; 1836) The Alvord survey records a 247-foot long pier with an eastward-facing ell at the end (Figure 24). A projected 100-foot extension to Pier 27 was completed by 1857 (Alvord 1849; Harbor Commissioner 1857).

Pier 28 (East of Dover Street): Front Street had not been bulkheaded and filled beyond Peck Slip in 1797, and the 1803 Mangin-Goerck Plan records numerous short piers between Peck Slip and Roosevelt Street, but none extends more than a few feet beyond the south side of Front Street (Figure 17) (Taylor Roberts 1797; Cohen and Augustyn 1997:97). Front Street was not finished in July 1804, but the Council resolved that it should be completed to Catharine Slip by 1805 (MCC 1917:III 562). In 1822 the Common Council granted permission to "Benjamin Minturn, et al." to build a 30-foot-wide pier between Dover and Roosevelt Streets (MCC 1917:XII 342). The pier was one of the few referred to by its number, which until the pier renumbering in the 1830s was Pier 27. It was also commonly known as Elephant Wharf (MCC 1917:XVII 237), and

appears on the 1828 map (Goodrich 1828). In 1849 the Alvord survey shows the Pier 28 as 247 feet long (Alvord 1849) (Figure 24).

Pier 29 (Roosevelt Street West): Front Street had not been bulkheaded and filled beyond Peck Slip in 1797, and the 1803 Mangin-Goerck Plan records numerous short piers between Peck Slip and Roosevelt Street, but none extends more than a few feet beyond the south side of Front Street (Figure 17) (Taylor Roberts 1797; Cohen and Augustyn 1997:97). Front Street was not finished in July 1804, but the Council resolved that it should be completed to Catharine Slip by 1805 (MCC 1917:III 562).

In 1822 the Common Council granted permission to William Agnew, John Agnew, and Samuel Mitchell to build a 30-foot-wide pier near Roosevelt Street, in front of "their premises." The following year they were given permission to extend the pier to 250 feet (MCC 1917:XII 342). Pier 29, which appears on the 1828 map (Goodrich 1828), was also commonly known as "India Wharf." In 1831, the Council decided to take over the eastern side of the pier for public use, reimbursing the proprietors one-third the cost of the pier, which had been over ten thousand dollars in 1823 (Ibid.:XIX 429). The 1849 Alvord survey records Pier 29 as 245.7 feet long and 31 feet wide, of which the eastern half was public (Alvord 1849) (Figure 24). During the 1850s the eastern pier slip between Piers 29 and 30 was built up to provide two berths for the Bridge Street (Brooklyn) Ferry (Harbor Commissioner 1857).

East River Bulkhead

The next major development in this part of the APE was the construction of the modern bulkhead system, under the program begun in 1871 by the New York City Department of Docks. The bulkhead eventually defined the present southern boundary of this section of the APE. Little or no bulkhead work was completed in this part of the APE to 1900. The old bulkhead and, therefore, the width of South Street in Segment 7 was relatively unchanged on maps from 1849 to 1903, except for a widening to approximately 98 feet at Fulton Street (Alvord 1849; SSS 1903b). Since the 1850s, in addition to the Fulton Ferry buildings between old Piers 21 and 22 (Bromley 1891), and the Connecticut ferry structures at Peck Slip, a number of structures had been built on the old bulkhead line, on piers, and between piers on platforms supported by piles, particularly in the vicinity of the Fulton Fish Market, between Fulton Street and Peck Slip (Bromley 1891; Sanborn 1905) (Figures 27, 28).

At the bulkhead line between Piers 22 and 23, the building labeled "Fish Market" in 1891 (Bromley 1891) was the Wholesale Fish Market, run by the Fulton Market Fishmongers' Association (FMFA) and built before 1852 (Dripps 1852). It was removed in 1905 to make way for the new bulkhead. The 1906 Docks report notes a temporary platform built in 1906 outside the new bulkhead between new Piers 18 and 19 for the FMFA, where "the fish business is now temporarily carried on," while the FMFA awaited the completion of their new structure between new Piers 17 and 18 (Docks 1906:229).[15]

East of old Pier 23 to old Pier 24, the area which presently hosts the New Market Building was empty of structures on the 1891 atlas (Bromley 1891), but in 1903 was labeled an "Oyster Basin." At the crib bulkhead in present Marginal Street were a series of small, irregular

[15] This structure is a New York City Landmark, and is sometimes referred to as the "Tin Building."

structures, which seem to be shops or stalls, which extended from the old bulkhead line out beyond the southern edge of the APE (SSS 1903b).

The Department of Docks report of 1906 recorded that 113 feet of the bulkhead between Burling Slip and Beekman Street had been completed in 1901, and work resumed in 1905, with the expectation of completing the section from Burling Slip to Beekman Street in 1906 (Docks 1906:228-229). Construction on new Piers 16, 17, and 18 had been completed by 1906, and the old piers were removed (Ibid.178; Sanborn 1905) (Figure 27).

East of Beekman Street through Roosevelt Street, the entire bulkhead had been completed in 1904, except for the paving of Marginal Street, which was being done in 1906 (Docks 1906:229). New Piers 19 and 20 had been completed, leaving only old Piers 27 and 28 at the west and east sides of Dover Street (Docks 1906:178-179; Sanborn 1905) (Figure 28), which were replaced by new Pier 21 before 1919 (USC&GS 1919). Old Pier 29, which formed a platform linked to one of the Brooklyn Bridge abutments, was not reconfigured until after 1924, when the modern bulkhead was finally completed at Roosevelt Street (USC&GS 1924, 1959).

The New York Wholesale Fish Dealers' Association (NYWFDA) had submitted plans in 1906 for a two-story steel market on a new platform to be erected outside the APE between Piers 18 and 19. This was the predecessor of the current New Market Building. Another fishmongers group, the New York Independent Fish Dealers' Association, was also granted a permit for a two-story steel shed (20 feet by 100 feet) abutting the north side of the NYWFDA structure, and extending approximately 25 feet north of the modern bulkhead, within the APE (Sanborn 1905; Docks 1906:229) (Figure 28).

Disturbance

Bulkhead Construction

Because of the general depth of mud—in some places up to 170 feet deep—along the Manhattan shoreline, the bulkhead had to rest on piles, even though the piles could not extend to the hard bottom in all cases. According to Greene, the river mud was dredged "for a width of about 85 feet to a depth of 30 feet, more or less, depending on the consistency" (Greene 1917:88). According to Greene's schematic drawings (Figures 9, 10), this width of dredging extended an equal distance on each side of the proposed bulkhead, therefore, approximately 42.5 feet into the area of the APE on present South/Marginal Street, and to a depth of 35 to 40 feet below mhw.[16] Into that dredged surface the piles were driven, and the open spaces filled in with cobbles and riprap, to serve as a base and support for the concrete and masonry bulkhead. The new street area would have been further filled with "earth, ashes, &c." as Greene notes in his 1876 bulkhead drawing (Figure 9) (Greene 1917:88-94).

Dredging

Accurate records of dredging, or even maps of pier slip depths prior to 1857, are not available in order to document routine dredging impact in now-filled sections of South Street within the APE. In what is now part of Marginal Street in Segment 7, dredging at old Pier 21 between Burling Slip and Fulton Streets was to 25.5 feet below mhw in 1899 (Docks 1899:210), and to 26 feet below mhw in 1906 (Docks 1906:384). In 1906, dredging at "Old 20" for the removal of old

[16] Greene's calculations were based on mean low water 4.85 feet below mean high water (mhw).

cribbing was recorded at 32 feet below mhw (Ibid.). This is in contrast to pier slip depths of less than 21 feet below mhw on the 1906 harbor chart, and less than 18 feet below mhw in 1857 (Harbor Commissioner 1857; USC&GS 1906). This would suggest the removal of more than 7.5 feet of the early 19th-century riverbottom, which should result in an absence of rivermud strata in the Marginal Street boring logs, discussed below.

Buried Utility Lines

A concentration of current and historical utility lines has been identified in the South Street part of Segment 7 between John Street (Burling Slip) and Peck Slip West. All running parallel with South Street, these include: a 16" high pressure water main, a 5'x8'/6'x8' sanitary interceptor sewer, and a 30" low pressure water main. In addition to these, there were and are numerous water lines running perpendicular to South Street, connecting the water mains to hydrants and piers/former piers (WPA 1939:23,33; ADP 2006; WMDM 2006).

Current and historical utilities in the remaining South Street sections of Segment 7 between Peck Slip West and Dover Street include telephone ducts, a 5'x8' interceptor sewer, and a 30" water main (1932), all running parallel to South Street. Additional lines in the Peck Slip intersection include: a 16" high pressure water main, also parallel to South Street, and several lines laid perpendicular to South Street (a 72" sewer, 30" sewer, telephone ducts, two 12" water mains, a <12" water main, and electrical ducts). Additional lines in the Dover Street intersection include a network of postal cables and telephone ducts (2'3" coverage), with two related manholes, and a 20" water main (1985).

Current and historical utilities in the remaining South/Marginal Street sections of Segment 7 east of Dover Street to Roosevelt Street are concentrated in the landward 38 feet of South Street. These include telephone ducts, a 5'x8' sanitary interceptor sewer, a 4' circular sewer (1888), a 12" water main (1884), a 16" high pressure water main, and 8" and 6" gas mains. In the remaining South/Marginal Street sections of Segment 7 east of Dover Street, utilities are more widely spaced, but generally run along the old ca. 1900 shoreline. Running parallel with South Street are postal cable ducts, 30"/48" water (1932), and a 12" water (1985/1963). Other sections of this part of the APE contain utilities, but these are widely spaced and shallow.

Current and historical utilities at the filled location of former Pier 20 (west of John Street, Bromley 1891; SSS 1903b) include an electrical duct that crosses the pier head, and a 4' circular barrel sewer which runs down the center of the former pier location (WPA 1939:23; ADP 2006; WMDM 2006). Current and historical utilities at the filled location of former Pier 21 (east of John Street, Bromley 1891; SSS 1903b) are limited to a <12" water main that crosses the pier head location, running perpendicular to Marginal Street (WPA 1939:23; ADP 2006; WMDM 2006). No current or historical utilities are recorded at the filled location of former Pier 22 (east of Fulton Street, Bromley 1891; SSS 1903b) (WPA 1939:23,33; ADP 2006; WMDM 2006).

Current and historical utilities at the filled location of former Pier 24 (west of Peck Slip, Bromley 1891; SSS 1903b) are limited to one 4" water main, which runs parallel to the old pier, along its western edge (WPA 1939:4; ADP 2006; WMDM 2006). Current and historical utilities at the filled location of former Pier 25 (foot of and west of Peck Slip, also partially in Segment 7; Bromley 1891; SSS 1903b) include a 72" sewer and a 48" water main, which run parallel to

Marginal Street through the northern corner of Segment 6, across the old pier head. A sewer chamber (approximate dimensions 10'x8') is buried at the western corner of the pier head, and a 30" sewer main runs perpendicular to South Street through the former pier location into the East River. An electrical duct extends into the eastern part of the pier location, ending at a manhole adjacent to the shore (WPA 1939:33; ADP 2006; WMDM 2006).

Current and historical utilities at the filled location of former Pier 26 in South and Marginal Streets (east of Peck Slip, Bromley 1891; SSS 1903b) include a 48" water main, a 72" sewer, and a 30" water main (1932), all of which run parallel to Marginal Street through the head of the old pier (WPA 1939:33; ADP 2006; WMDM 2006). Current and historical utilities at the filled location of former Pier 27 in South and Marginal Streets (east of Peck Slip, Bromley 1891; SSS 1903b) include a 48" water main, a 72" sewer, and a 30" water main (1932), all of which run parallel to Marginal Street through the head of the old pier, as well as a 20" water main running parallel with the old pier itself (WPA 1939:33; ADP 2006; WMDM 2006).

Current and historical utilities in South and Marginal Streets at the filled location of former Pier 28 (east of Dover Street, Bromley 1891; SSS 1903b) include a 48" water main that cuts across the head of the pier, parallel with South Street, and a sewer chamber (approximate dimensions 34'x34') that occupies the pier location in the APE (WPA 1939:44; ADP 2006; WMDM 2006). Current and historical utilities in Marginal Street at the filled location of former Pier 29 (foot of former Roosevelt Street, Bromley 1891; SSS 1903b) include a 30" water main (1932) crossing the pier head parallel with South Street, an electrical duct and manhole, and a sewer chamber approximately 12 feet wide that extends from the pier head about 59 feet through the center of the old pier location (WPA 1939:44, 45; ADP 2006; WMDM 2006).

Soil Boring Logs

Soil borings performed in the South Street and the northern Marginal Street sections of Segment 7 record the large fill strata expected in made land (WPA 1965: Sheet 4 #347-#362, Sheet 5 #123-#150). Fill ranges from beneath modern paving to between 6.8 and 46.5 feet below mean high water, with most fill strata extending to between 30 feet and 40 feet below mhw. Out of 44 boring logs, only 10 record fill to less than 28 feet below mhw, and these also show river mud/silt strata below fill (e.g., #354, #356-#358, #127, #132, #134, #143, #145-#146). This suggests that river mud was dredged and replaced with fill prior to the sinking of cribwork and modern bulkheading, although a few clusters of deep pockets of mud escaped this impact, notably: the northern side of Marginal Street between Burling Slip and Fulton Street East (#354, #356-#358), where river mud/silt extends to 33.7 feet below mhw, and as deep as 50.4 feet below mhw; Peck Slip Center and East (#132, #134), where mud/silt goes down to ca. 39 feet below mhw; and South and Marginal Streets midway between Dover and Roosevelt Streets (beneath the Brooklyn Bridge span #143, #145, #146), where mud/silt extends to 36 below mhw.

Timbers within the fill are recorded in 18 logs throughout the segment, and wood is recorded in an additional three, as can be expected in a location composed of wooden cribwork and landfill. It is possible that timbers were found in additional boring logs, since many only describe the fill stratum as "Misc. fill." In a number of boring logs the timbers are infiltrated by river mud/silt, or sandwich a mud/silt stratum, also expected in cribwork (#352, #361, #131, #138, #140, #148, #150). The timbers were not encountered in strata deeper than 46.4 feet below mhw.

Aside from the ten exceptions containing mud/silt, the majority of the soil boring logs note thick strata of sand, sometimes with gravel, extending down to deep bedrock, which ranges from 105.0 feet to 205.9 feet below mhw.

Potential Archaeological Sensitivity
Categories of potential archaeological remains for Segment 7 are submerged precontact remains, 18th- and 19th-century piers and landfill retaining devices, 18th- and 19th-century landfill deposits, 18th- and 19th-century riverbottom remains, and 19th-century wooden water mains.

Submerged Precontact Resources
Since they would pre-date the inundation of the APE, potential precontact archaeological resources would be expected in the first few feet of the sandy, glacial till layer beneath river-deposited strata, such as mud and silt. This sandy stratum could represent the pre-inundation land surface of ca. 12,500 to 2,600 BP.

Dredging episodes and depths have not been individually and specifically recorded, but soil borings logs indicate that most of the river mud/silt stratum in Segment 7 from Burling Slip West to Roosevelt Street has been removed during the preparation of the riverbottom for the sinking of cribworks for piers and bulkheads during the first half of the 19th century. The removal of the mud/silt stratum would have also impacted the first few feet of the glacial till stratum directly beneath it, the area which would be potentially sensitive for precontact archaeological remains.

Three locations where this mud stratum remains have been identified within this part of the APE, indicating that a potentially sensitive preinundation land surface may be preserved in the three to four feet of the sandy stratum beneath the mud. These strata would be in: the northern side of Marginal Street between Burling Slip and Fulton Street East, at depths greater than 33.7 feet below mhw to more than 50 feet below mhw; northern Marginal Street from Peck Slip Center to Peck Slip East, at depths greater than 39 feet below mhw; and South and Marginal Streets midway between Dover and Roosevelt Streets (beneath the Brooklyn Bridge span) at depths greater than 36 feet below mhw.

A second major historical disturbance impact to potential precontact resources that could exist on this possible land surface was the construction of the modern bulkhead. As noted above, dredging depths preparatory to bulkhead construction were from 35 to 40 feet below mhw, which would most likely have severely impacted the potential pre-inundation surfaces in an area of the APE extending approximately 42.5 feet north of the current bulkhead. Although this depth of dredging may have adversely impacted some areas of the potential preinundation surface, the great depth of the top of this possible surface in the three locations (greater than 36 to 50.4 feet below mhw) indicates that modern bulkhead construction would not have limited the southern extent of potential precontact sensitivity in these three locations.

If potential precontact submerged archaeological resources have survived inundation, tidal action, and river currents, which is unlikely, these three sections of the Segment 7 APE are potentially sensitive for deeply buried precontact archaeological resources. For recommendations, see the Conclusions section of this report.

Riverbottom Remains

Riverbottom remains would be expected within river mud and silt strata, some of which represent historical shoreline deposits which have accumulated after the construction of piers and wharves. According to the soil boring logs, routine dredging appears to have removed most of the river mud/silt stratum within South and northern Marginal Streets. Three locations within this part of the APE seem to have escaped this impact: the northern side of Marginal Street between Burling Slip and Fulton Street East, where river mud was encountered between 25.5 and 50.4 feet below mhw to more than 50 feet below mhw; northern Marginal Street from Peck Slip Center to Peck Slip East, at depths 25.4 to 39 feet below mhw; and South and Marginal Streets midway between Dover and Roosevelt Streets (beneath the Brooklyn Bridge span) at depths greater than 6.8 to 35.8 feet below mhw.

The area of potential sensitivity would be limited by subsurface disturbance from modern bulkhead construction. Because this involved dredging from 35 to 40 feet below mhw, and given that the recorded pier channel depths in 1906 in this part of the APE are all shallower than 22 feet below mhw (and less than 18 feet below mhw in 1857), it is unlikely that potential 18th- and 19th-century riverbottom remains would have extended beyond these depths. Therefore, this potentially sensitive stratum would have been removed prior to construction, eliminating potential sensitivity for this category of potential remains in the parts of the APE within 42.5 feet of the modern bulkhead, although not affecting potential sensitivity in locations greater than 42.5 feet north of the modern bulkhead. For recommendations, see the Conclusions section of this report.

Landfill Retaining Structures, Wharves, and Piers

As described previously, landfilling work for South Street as far uptown as Catharine Slip was first ordered in 1798, although Common Council minutes indicate that bulkheading and filling of South Street in Segment 7 between Burling Slip West and Roosevelt Street East did not occur until between ca. 1801 and 1810, with the Dover Street to Roosevelt Street section finished in ca. 1819, Burling Slip filled in 1835, and Peck Slip was not filled until 1828 to 1833.

Ten historical piers were also constructed within this part of the APE between the first decade of the 19th century and the 1822, and additional piers extending from 18th-century bulkheads predated these piers, and even the completion of the street itself. Therefore, their cribworks would have been preserved when the street was further filled and widened around them.

As noted in the soil boring log review, timbers and wood were abundant in the soil borings throughout South Street and the northern Marginal Street and section of the APE, as would be expected. It is not possible to distinguish between landfill retaining devices and piers from soil borings, especially since many of the same techniques were used for both, and piers were often transformed into retaining structures. These timbers are present, however, occurring in fill and mud strata ranging from immediately beneath modern street paving to 44.4 feet below mhw.

Preparation for the construction of the modern bulkhead involved dredging from 35 to 40 feet below mhw. Given the depths of the timbers recorded in the soil boring logs, they would have been removed prior to construction, as was standard practice (Docks 1906:177-179). This

activity would have eliminated potential sensitivity for this category of potential remains in the portions of the APE within 42.5 feet of the modern bulkhead.

Utility installation would also have destroyed some of the upper sections of piers and landfill retaining devices in the remaining sections of Segment 7, depending on the size of the main and the depth to which it was installed. Although some areas of potential sensitivity may have been destroyed to depths greater than the five feet below the present surface that would be impacted by this project, buried utilities could not have completely eliminated potential sensitivity for this category of remains, given their great depth (basically from the surface to as much as 40 feet below mhw). Unfortunately, utility maps do not provide the accuracy necessary to pinpoint these areas. Therefore, the remaining areas of this section of the APE must be considered potentially sensitive for buried landfill retaining structures, wharves, and piers, dating from the late 18th and early 19th centuries. See the Conclusions section of this report for recommendations.

Landfill Deposits

As noted in the previous discussion, landfilling on present South Street as far uptown as Catharine Slip was first ordered in 1798, although Common Council minutes suggest that bulkheading and filling of South Street in Segment 7 between Burling Slip West and Roosevelt Street East did not occur until between ca. 1801 and 1810. The Dover Street to Roosevelt Street section was finished in ca. 1819, Burling Slip was filled in 1835, and Peck Slip was not filled until 1828 to 1833.

Ten historical piers were also constructed within this part of the APE between the first decade of the 19th century and the 1822, and additional piers extending from 18th-century bulkheads predated these piers, and even the completion of the street itself. Therefore, their cribworks would have been filled at the time of their construction and then surrounded with later fill, as they were engulfed by the widening of the street beyond 70 feet in the early 20th century.

Soil borings in the South Street section of this segment note "miscellaneous fill"—often with associated timbers which represent landfill retaining devices and piers—throughout this section of the APE. Historical fill ranges in depth from immediately beneath 1.5 feet of surface paving to 46.5 feet below mhw. Although it is not possible to distinguish between primary landfill and secondary fill from the generalized descriptions provided by the available soil borings, secondary fill was earlier defined as extending from the surface to a few feet below mean low water, which in the APE is approximately 4.85 feet below mhw. The remaining strata of fill beneath the secondary fill would be considered primary landfill.

Preparation for the construction of the modern bulkhead involved dredging from 35 to 40 feet below mhw. Given the comparable depths of the fill strata recorded in the soil boring logs, they would have been removed prior to construction along with the cribworks, as was standard practice (Docks 1906:177-179). This activity would have eliminated potential sensitivity for this category of potential remains in the parts of the APE within 42.5 feet of the modern bulkhead, and as noted earlier, any fill placed beyond the old 19th-century crib bulkhead during modern bulkhead construction would not be considered to have archaeological potential.

Utility installation also would have impacted the upper strata of landfill in the remaining sections of Segment 7 of the APE, depending on the size of the main and the depth to which it was installed. Although some areas of potential sensitivity may have been destroyed, buried utilities could not have completely eliminated potential sensitivity for this category of remains, given their great depth (basically from the surface to as much as 46.5 feet below mhw). Unfortunately, utility maps do not provide the accuracy necessary to pinpoint the areas of deep disturbance caused by utility installation, as well as to identify the small locations which may have archaeological potential. Therefore, the remaining areas of this section of the APE must be considered potentially sensitive for historical landfill dating from 18th through the end of the 19th century. See the Conclusions section of this report for recommendations.

Wooden Water Mains

Wooden water mains dating to before 1827 would be expected within the northern 70 feet of this segment of the APE, which corresponds to the area of South Street within the early 19th-century bulkhead. Stratigraphically they would be found within the first four feet of the existing fill stratum, beneath modern paving. As a result they are the most susceptible to modern utility disturbance and street regrading. On the other hand, given the noted inaccuracy of utility maps and the potential for scattered pockets of shallow remains to survive even large concentrations of modern utility disturbance, as well as the sheer number of feet of wooden main which would have been laid in the streetbed, it is probable that sections of wooden main have survived subsequent construction disturbance within Segment 7. See the Conclusions section of this report for recommendations.

V. CONCLUSIONS AND RECOMMENDATIONS

According to both the Standards for Cultural Resource Investigations (1994, adopted by the New York State Historic Preservation Office [SHPO]) and the Guidelines for Archaeological Work in New York City (LPC 2002), the first level of evaluation for archaeological sensitivity is based on documentary evidence. This report, based primarily on documentation of subsurface disturbance, has fulfilled this first level of evaluation for the inboard locations of the East River Waterfront Esplanade and Piers APE from Whitehall Street north to the Brooklyn Bridge.

Based on the discussion of the categories of potential archaeological resources which may be present within this section of the APE, and also upon the examination of land use within the APE, the categories of potential archaeological remains were limited to submerged precontact resources; sunken vessels; 18th- and 19th-century landfill retaining structures, wharves and piers; 18th- and 19th-century landfill; 18th- and 19th-century riverbottom remains; and 19th-century wooden water mains.

According to present plans, three pavilions will be erected within Segments 4 and 7 of the APE from Whitehall Street to the Brooklyn Bridge. With their long axes running east/west or parallel with South/Marginal Street, one pair will be built extending west from Maiden Lane, and east from Fletcher Street; and the third pavilion will extend from Peck Slip east to Dover Street (Figure 29). As currently designed, the pavilions will be erected within Marginal Street, within 55 feet of the present bulkhead, with projected impacts of five feet below the current surface. In order to connect the pavilions to the utility grid on South Street, it may also be necessary to excavate utility main trenches between the pavilions and the north side of South Street, with projected impacts of up to five feet below the current surface. South Street, south of the Brooklyn Bridge, will also be reconstructed, with projected impacts of up to five feet below the current surface.

More substantial excavation, to depths greater than five feet below the current surface, will be required in Segments 1 and 2, the roadway area north of the Battery Maritime Building (BMB) to the Vietnam Veterans Plaza. Within this area the present entrance to the Battery Park Underpass—now in Segment 1—will be moved approximately 350 feet to the northeast, in Segment 2. The moving of the BPU entrance would allow for the creation of an at-grade pedestrian plaza at the entrance to the BMB. Deep excavation may also be necessary for the potential relocation of a sewer outfall.

Although not depicted cartographically on the sensitivity figures (Figures 29-33), the column footings for the FDR Drive viaduct were noted earlier in the discussion of subsurface disturbance types. The impact zone of the completed column footings consists of the column areas themselves as well as an area approximately three feet in radius surrounding each column. The depth of disturbance from the columns is greater than the depth of the projected impacts from the proposed project (approximately five feet). The column footings would not be altered with the project. In these distinct areas, the conclusions presented below regarding the potential for archaeological sensitivity do not apply.

Precontact Archaeological Resources

Soil boring logs indicate three locations within Segment 7 where deeply buried strata of glacial till are found beneath a layer of river mud/silt. The upper feet of the sandy till stratum may represent the preinundation land surface exposed during the precontact period – the possible locus of precontact archaeological potential. Given the lack of recorded disturbance in these areas, and the estimates that precontact sites from 10,000 years BP would be found at depths no greater than approximately 90 feet (below mhw) (Merwin et al. 2003:46-47), the possibility of submerged and then deeply buried former land surfaces which might contain precontact remains cannot be ruled out, providing these archaeological resources survived currents and tidal action at the time of inundation. The locations of the potential resources have been mapped (Figure 29), and the depths have been provided in Table 1.

Given that the areas of potential sensitivity are all greater than 33 feet below mhw, and because proposed subsurface disturbance in this section of the APE is not expected to extend beyond five feet below the surface, mitigation efforts are not recommended, since no impacts to strata potentially sensitive for precontact archaeological resources are planned. Therefore, unless additional, deeper impacts are planned, no additional study of or testing for this category of archaeological resources is recommended.

Sunken Vessels

As already noted in the discussion of sunken vessels as an archaeological resource category, it is unlikely that a vessel would have entered the archaeological record via sinking or simple abandonment in an outboard location, given the importance of the slips and wharfage to the commerce of the City. City authorities were vigilant to remove encumbrances to commerce. By the 1780s, the use of vessels as landfill retaining devices, at least in water lots which were to become municipal streets, was avoided by the Common Council, which appears to have monitored the practice. Although vessels were incorporated into landfill during the 18th century, when much of this part of the APE was bulkheaded and filled, this practice had become unlikely. The only relatively undisturbed section of the APE that meets these criteria is Segment 2 (together with the small, triangular, adjacent section of Segment 3[17]), which was bulkheaded and filled by 1796. Thus, there is the possibility that a sunken ship may have been incorporated into the location as a landfill retaining device. The sensitive areas for this potential resources have been mapped (Figure 30), and the depths have been provided in Table 1. Because potential sensitivity for these resources begins beneath the current pavement, that is, beneath the two feet of disturbance caused by the creation of the roadbed, this potential resource would be impacted by proposed subsurface disturbance when it will be greater than two feet below grade. See below for recommendations for further action in this location.

[17] This section of Segment 3, north of Marginal Street, and abutting Segment 2, was included in the Segment 2 evaluation.

Table 1

Resource	Location	Depth	Notes
Precontact	Segment 7: northern side of Marginal Street between Burling Slip and Fulton Street East	≥33.7 feet to ≥50.1 feet below mhw	Area within 42.5 feet of bulkhead not sensitive
Precontact	Segment 7: northern side of Marginal Street between Burling Slip and Fulton Street East	≥39 feet below mhw	Area within 42.5 feet of bulkhead not sensitive
Precontact	Segment 2 (and part of Segment 3)	≥36 feet below mhw	Area within 42.5 feet of bulkhead not sensitive
Sunken vessels	Segment 4	2.0 feet below grade to bedrock stratum (19.9 to 25.7 feet below mhw)	Northern 70 feet of South Street
Riverbottom remains	Segment 7	25.5 feet to 50.4 feet below mhw	Area within 42.5 feet of bulkhead not sensitive
Riverbottom remains	Segment 2 (and part of Segment 3)	25.4 feet to 39 feet below mhw	Area within 42.5 feet of bulkhead not sensitive
Riverbottom remains	Segment 7: South and Marginal Streets mid-way between Dover and Roosevelt Streets (beneath the Brooklyn Bridge span)	6.8 feet to 35.8 feet below mhw	Area within 42.5 feet of bulkhead not sensitive
Landfill retaining structures, wharves, piers	Segment 2	2.0 feet below grade to bedrock stratum (19.9 to 25.7 feet below mhw)	Northern 70 feet of South Street
Landfill retaining structures, wharves, piers	Segment 4	2.0 feet below grade to 44.0 feet below mhw	Area within 42.5 feet of bulkhead not sensitive
Landfill retaining structures, wharves, piers	Segment 7	2.0 feet below grade to 44.4 feet below mhw	Area within 42.5 feet of bulkhead not sensitive
Landfill deposits	Segment 2	2.0 feet below grade to bedrock stratum (19.9 to 25.7 feet below mhw)	Northern 70 feet of South Street
Landfill deposits	Segment 4	2.0 feet below grade to 45.6 feet below mhw.	Area within 42.5 feet of bulkhead not sensitive
Landfill deposits	Segment 7	2.0 feet below grade to 46.5 feet below mhw.	Area within 42.5 feet of bulkhead not sensitive
Wooden water mains	Segment 2 (and part of Segment 3)	Upper 4 feet beneath modern paving	Northern 70 feet of South Street
Wooden water mains	Segment 4	Upper 4 feet beneath modern paving	Northern 70 feet of South Street
Wooden water mains	Segment 7	Upper 4 feet beneath modern paving	Northern 70 feet of South Street

Riverbottom Remains

Soil boring logs indicate three locations within Segment 7 where thick river mud/silt strata appear to have survived dredging and construction activity, and represent the potential

riverbottom from the 18th and 19th centuries. These locations are shown on Figure 29. The depths of potential sensitivity for these resources in each location are provided in Table 1. Because these potential archaeological resources are deeper than 6.8 feet below mhw, and proposed subsurface disturbance in these sections of Segment 7 is not expected to extend beyond five feet below present grade, no impacts to strata potentially sensitive for riverbottom remains are anticipated. Therefore, unless additional, deeper impacts are planned, no additional study of or testing for this category of archaeological resources is recommended.

Landfill Retaining Structures, Wharves, and Piers

Soil boring logs indicate that portions of Segments 2, 3, 4, and 7 in this part of the APE are potentially sensitive for 18th- and 19th-century landfill retaining structures, wharves, and piers. These locations are shown on Figures 31 and 32. The depths of potential sensitivity for these resources in each location are provided in Table 1. Because potential sensitivity for these resources begins beneath the current pavement, that is, beneath the two feet of disturbance caused by the creation of the roadbed, this potential resource would be impacted by proposed subsurface disturbance only when the impact would be more than two feet below grade. See below for recommendations for further action in this location.

Landfill Deposits

Soil boring logs indicate that portions of Segments 2, 3, 4, and 7 are potentially sensitive for 18th- and19th-century landfill deposits. These locations are shown on Figures 31 and 32. The depths of potential sensitivity for these resources in each location are provided in Table 1. Because potential sensitivity for these resources begins beneath the current pavement, that is, beneath the two feet of disturbance caused by the creation of the roadbed, this potential resource would be impacted by proposed subsurface disturbance when it will be greater than two feet below grade. See below for recommendations for further action in this location.

Wooden Water Mains

The Manhattan Company's wooden water mains were installed in the 19th-century sections of South Street until 1827, when the distribution system extended from Whitehall Street to City Hall (Brooklyn Bridge). The northern 70 feet—representing 19th-century South Street—of Segments 2, 3, 4, and 7 are potentially sensitive for this archaeological resource (Figures 30, 33). Because potential sensitivity for wooden water mains begins beneath the current pavement, that is, beneath the two feet of disturbance caused by the creation of the roadbed, this potential resource would be impacted by proposed subsurface disturbance when it will be greater than two feet below grade. See below for recommendations for further action in this location.

Recommendations

As noted in the Introduction, the review of the Phase 1A technical report, which will include a Soil Borings Appendix, is to be conducted by SHPO. As established in the PA, "subsequent to the review of the Phase 1A by SHPO, LMDC and the City will cooperate in the preparation of a protocol ("Archaeology Monitoring and Testing Protocol") to define which portions of the Archaeological APE would be monitored during construction or would undergo Phase 1B field testing prior to construction, depending on the nature of the potential resources identified in the Phase 1A and the extent of construction that would take place in specific locations. The protocol will include an assessment of the feasibility and utility of monitoring versus field testing for all potentially sensitive archaeological areas that would be affected by the Esplanade Project. The protocol will also outline any areas to receive monitoring or field testing and will set forth the methodology."

In the proposed pavilion and South Street reconstruction areas where impacts to potentially sensitive areas will extend to five feet below existing grade, and where the proposed area of impact has sufficient horizontal square footage to afford visibility of potential resources, testing could be undertaken immediately prior to construction. The excavated area would need to be large enough to allow for the sides to be canted during excavation, as mandated by OSHA regulations. In potentially sensitive areas where narrow trench excavations (extending more than two feet below existing grade) would be undertaken for proposed utility lines, trench excavations could be monitored at the time of construction.

In areas of deep impact (i.e., the new portal for the Battery Park Underpass, which would involve construction in APE Segments 1 and 2), testing could be undertaken immediately prior to construction, if it is feasible. The excavated area would need to be large enough to allow for the sides to be canted during excavation, as mandated by OSHA regulations. The horizontal testable area may be limited due to the impact depths, the potential resources and the required canting of walls.

VI. BIBLIOGRAPHY

Alvord, Alonzo A.
1849 *Maps of the Wharves and Piers of the East River between the Battery and Corlears Hook.* No. 2. Drawn January 1, 1849 by Daniel Ewen, City Surveyor. (Collection: South Street Seaport Museum Library).

AMD (Amended Drainage Plans)
2006 Amended Drainage Plan. City of New York, Department of Water Resources, Bureau of Water Pollution Control, Division of Sewer Design. Borough of Manhattan. 4FW, 4GC, 4GI.

Anonymous
ca.1913 *Bank of the Manhattan Company: A Progressive Commercial Bank.* Irving Press, New York.

Barrett, Walter
1885 *Old Merchants of New York City.* Vols. I and V. Thomas R. Knox & Co., New York.

Bergoffen, Celia J.
2002 Historic Front Street Redevelopment: Block 97, Lots 18, 32, 37, 58, New York City Department of City Planning, Borough of Manhattan, Phase IA Archaeological Assessment Report. Prepared for Philip Habib and Associates. Prepared by Celia J. Bergoffen. November 13.

Bien, Joseph. R., and C. C. Vermeule
1891 *Atlas of the Metropolitan District and adjacent country comprising the counties of New York, Kings, Richmond, Westchester and part of Queens in the state of New York, the county of Hudson and parts of the counties of Bergen, Passaic, Essex and Union in the state of New Jersey.* Julius Bien & Co. New York.

Bird, David
1980 As City Rebuilds Its Highways, the Traffic Has to Bear It. *The New York Times.* October 24. The City. Pages B1 and B5.

Bone, Kevin, editor
1997 *The New York Waterfront: Evolution and Building Culture of the Port and Harbor.* The Monacelli Press, New York.

Borough of Manhattan (Borough)
1954 South Street Viaduct (Opening Day Program). May 28. (Collection: New York Public Library – SIBL).

Borough Works, Department of

1947 Contract No. 52 for the Construction of the Battery Park Underpass and Approaches thereto in, under & through Battery Park from West St at Battery Place to South St at Broad St. Postwar Project PM.27 Brooklyn Battery Tunnel Approaches and Connections. City of New York, Office of the President – Borough of Manhattan, Department of Borough Works. Michael Klein, chief engineer. April 15. 135 sheets. (Provided by URS).

Bromley, G. W.
1921 *Atlas of the Borough of Manhattan, City of New York.* Vol. 1. G. W. Bromley, New York.
1932

Bromley, G. W. and W. S. Bromley
1891 *Atlas of the City of New York. Manhattan Island.* G. W. Bromley & Co., Philadelphia.

Brouwer, Norman
1980 The Ship in Our Cellar. *Seaport.* 14(3), 20-23.

Buttenwieser, Ann L.
1999 *Manhattan Water-Bound.* Second edition. Syracuse University Press, Syracuse, NY.

Cantwell, Anne-Marie and Diana diZerega Wall
2001 *Unearthing Gotham: The Archaeology of New York City.* Yale University Press, New Haven, CT.

Cohen, Paul E. and Robert T. Augustyn
1997 *Manhattan in Maps 1527-1995.* Rizzoli, New York.

Colton, J. H.
1836 Topographical Map of the City and County of New-York, and the Adjacent Country. J. H. Colton & Company, New York.

Commissioners (Commissioners' Plan)
1811 This map of the city of New York and island of Manhattan as laid out by the commissioners. John Randel Jr., cartographer. William Bridges, New York.

Cotter, John L., Daniel G. Roberts, and Michael Parrington
1992 *The Buried Past: An Archaeological History of Philadelphia.* University of Pennsylvania Press, Philadelphia.

Department of Docks (Docks)
1899 *Twenty-ninth Annual Report of the Department of Docks and Ferries.* For the Year ending December 31, 1899. Martin B. Brown & Co., New York. (Collection: City Hall Library).

1906 *Thirty-sixth Annual Report of the Department of Docks and Ferries.* For the Year ending December 31, 1906. (Collection: City Hall Library).

1914 *Forty-fourth Annual Report of the Department of Docks and Ferries.* For the Year ending December 31, 1914. (Collection: City Hall Library).

1936 *Sixty-fifth Annual Report of the Department of Docks of the City of New York.* Pier A, North River, for the Year ending December 31, 1936. (Collection: City Hall Library).

1937 *Sixty-sixth Annual Report of the Department of Docks of the City of New York.* Pier A, North River, for the Year ending December 31, 1937. (Collection: City Hall Library).

1938 *Sixty-seventh Annual Report of the Department of Docks of the City of New York.* Pier A, North River, for the Year ending December 31, 1938. (Collection: City Hall Library).

Depew, Chauncey
1895 *1795-1895: One Hundred Years of American Commerce.* Vol. 2. D. O. Hynes & Co.. New York.

Desobry P.
1834 The Fireman's Guide: A Map of the City of New-York. P. Desobry, under the Direction of U. Wenman, New York.

Directory
1789 Plan of the City of New York. Published in *The New-York Directory, and Register for the Year 1789.* Printed for Hodge, Allen, and Campbell, New York.

Disturnell, J.
1835 Map of the City of New York. Drawn by D. H. Burr. J. Disturnell, New York.

Dripps, Matthew
1851 *Map of the City of New-York extending northward to Fiftieth Street.* John F. Harrison, C.E. M. Dripps, New York.

1867 Plan of New York City from the Battery to Spuyten Duyvil Creek. Based on surveys of Randell and Blackwell, and a special survey of J. F. Harrison. Matthew Dripps, New York.

Edwards and Kelcey
1982 South Street from Wall Street to Dover Street, Beekman Street from South Street to Pearl Street, Peck Slip from South Street to Pearl Street, Street Reconstruction Program, Borough of Manhattan, Preliminary Design Report. HW-430. Prepared by Edwards and Kelcey, New York. Prepared for the New York City Department of Transportation, Bureau of Highway Operations. March.

Emery, K. O. and R. L. Edwards
1966 Archaeological Potential of the Atlantic Continental Shelf. *American Antiquity.* 31(5), 733-737.

Geismar, Joan H.
1983 The Archaeological Investigation of the 175 Water Street Block, New York City. Prepared by Soil Systems, Division of Professional Service Industries, Inc. Report on file with the New York City Landmarks Preservation Commission.

1987 Landfill and Health, a Municipal Concern or, Telling It Like It Was. *Northeast Historical Archaeology.* 16:49-57.

2005 Construction of Coenties Slip Archaeological Report. Prepared for Trocom Construction Corporation, Inc. March.

Goebel, Julius L. Jr. and James H. Smith
1980 *The Law Practice of Alexander Hamilton.* Vol. IV. Columbia University Press.

Goerck[, Casimir] and Van Sheecburgh
1793 Whitehall to Peck Slip, East River. Copied from map on file in Public Works made by Goerck and Van Sheecburg (sp.?) (Collection: South Street Seaport Museum Library).

Goodrich, Andrew T.
1828 Plan of the city of New York and of the island: as laid out by the commissioners, altered and arranged to the present time. Engraved by J. F. Morin. A. T. Goodrich, New York.

Graham, Charles K.,
1873 *Map Showing the High and Low Water Mark and the Original City Grants of Lands under Water made to various parties from 1686 to 1873 extending from Battery to Fifty-first Street. New York City.* Made under the direction of the Department of Docks. Gen. Charles K. Graham, engineer-in-chief.

Gratacap, L. P.
1901 *Geology of New York.* Second edition. Irving Press, New York.

Greene, Carleton
1917 *Wharves and Piers: Their Design, Construction, and Equipment.* First edition. McGraw-Hill, New York.

Greenhouse (Greenhouse Consultants, Inc.)
1984 Assay Office: The Results of the Archaeological Testing and the Recommendations for Mitigation for the "Backyard Areas" in Lots 7, 8 & 9; 41, 42 & 43; Block 35, New York City. 83-299M. Prepared by Greenhouse Consultants, Inc., New York.

Harbor Commissioner
1857 *Harbor Commissioner's Map 1857.* Volume 2. Acc. no. 1779. (Collection: Manhattan Borough President's Office).

Hartgen
2003 Tweed Courthouse Archeological Survey and Data Retrieval Investigations. Vol. I.

Prepared by Hartgen Archaeological Associates, Inc., Brooklyn, NY. Submitted to New York City Economic Development Corp. June.

2004 Archeological Monitoring: Con Edison Utility Tranches, Chambers Street, Manhattan, City of New York, New York County. Prepared by Hartgen Archaeological Associates, Inc., Brooklyn, NY. Prepared for Consolidated Edison, New York. October.

Hartgen and HPI

1992 Contextual Study: Sunken Ships and Landfill Retaining Devices, Route 9A Reconstruction Project. Prepared for the New York State Department of Transportation, Federal Highway Administration and the City of New York. Prepared by Hartgen Archaeological Associates, Inc., Albany, NY and Historical Perspectives, Inc. Westport, CT.

1997 Draft Phase 1A Archaeological Assessment: Route 9A Segment 3: Canal Street 48", 12" and 20" Watermains. Prepared for Vollmer Associates, New York, NY. Prepared by Hartgen Archaeological Associates, Inc., Albany, NY and Historical Perspectives, Inc. Westport, CT. December 22.

Historic Sites Research

1977 Cultural Resource Reconnaissance East River Reach, New York Harbor Collection & Removal of Drift Project. Historic Sites Research (Susan Kardas and Edward M. Larrabee), Princeton, NJ. October.

1978 18th Century Landfill in Manhattan, an Archaeological Analysis of Tests in the Schermerhorn Row Block. Historic Sites Research (Susan Kardas and Edward M. Larrabee), Princeton, NJ.

1991 Summary Report of 1981–1983 Archaeological Excavation, The Schermerhorn Row Block. Prepared by Historic Sites Research, Princeton, NJ. Prepared for Bureau of Historic Sites, New York State Office of Parks, Recreation, and Historic Preservation and New York City Public Development Corporation. July.

Historical Perspectives, Inc.

1987 Phase IA Archaeological Assessment Report for the East River Landing Project Manhattan. Prepared by Historical Perspectives, Inc., P.O. Box 331, Riverside, CT. Prepared for Allee King Rosen and Fleming, Inc., New York. December 7.

1992 Phase IA Archaeological Documentary Study: Peter Minuit Park Map Change Site. Prepared by Historical Perspectives, Inc., P.O. Box 331, Riverside, CT. Prepared for Philip Habib & Associates, New York. February.

1995 Two Bridges Urban Renewal Area: Manhattan. New York, Phase 1A Archaeological Study. CEQR No. 94-HPD-019M. Prepared by Historical Perspectives, Inc., P.O. Box 331, Riverside, CT. September.

Hooker, William
1833 Hooker's new pocket plan of the city of New York. Compiled and surveyed by William Hooker, engraver, New York.

1838 Hooker's new pocket plan of the city of New York. With additions to 1838. Compiled and surveyed by William Hooker, engraver, New York.

Hope, Bradley
2006 Archaeologist Finds Pottery, Wood Water Mains Downtown. *The New York Sun.* November 27. (See: www.nysun.com/article/44173, accessed 1/21/07).

Huey, Paul R.
1984 Old Slip and Cruger's Wharf at New York: An Archaeological Perspective of the Colonial American Waterfront. *Historical Archaeology.* 18(1):15-37.

Isaacs, Stanley
1939-1941 Stanley Isaacs Papers. Boxes 3, 5, and 6. Manuscripts and Archives Division, New York Public Library.

Joseph, J. W., Theresa M. Hamby, and Catherine S. Long
2004 Historical Archaeology in Georgia. University of Georgia Laboratory of Archaeology Series Report Number 39, Georgia Archaeology Research Design Paper No. 14. Prepared for the Georgia Department of Transportation and the Historic Preservation Division, Georgia Department of Natural Resources. Prepared by New South Associates, Inc., Stone Mountain, Georgia. September.

Lawesson, Charles
1973-1974 Manhattan Street Car Maps and Franchise Data. Looseleaf notebook. (Collection: South Street Seaport Museum Library).

Lewis, R. Barry
2000 Sea-Level Rise and Subsidence Effects on Gulf Coast Archaeological Site Distributions. *American Antiquity.* 65(3), pp.525-541.

Louis Berger
1983 An Archaeological and Historical Assessment of the Barclays Bank Site, 100 Water Street, New York, New York. Prepared for Barclays Bank International, Ltd.

1987 Archaeological Investigation of Site 1 of the Washington Street Urban Renewal Area, New York City. Prepared by Louis Berger and Associates, Inc. East Orange, NJ. Prepared for Shearson Lehman/American Express through the New York City Public Development Corporation.

1990 The Assay Site: Historic and Archaeological Investigations of the New York City Waterfront. 83-229M. Prepared by The Cultural Resource Group, Louis Berger & Associates, Inc. East Orange, NJ. Prepared for HRO International, Ltd., New York.

November.

1991 Archaeological and Historical Investigations at the Assay Site, Block 35, New York, New York. Report on file with the New York City Landmarks Preservation Commission.

2003 Proposed New South Ferry Terminal, Lower Manhattan, New York, New York, Phase IA Archaeological Assessment. Prepared by The Louis Berger Group, Inc. New York. Prepared for New York City Transit, New York. July.

2004 Archaeological Resource Management Plan: South Ferry Terminal Project, Lower Manhattan, New York, New York. Prepared by The Louis Berger Group, Inc. East Orange, NJ. Prepared for New York City Transit, New York. July.

Lower Manhattan
2006 Downtown Holds Buried Treasure Below the Surface. www.lowermanhattan.info/news/downtown_holds_buried_treasure_99296.aspx (Last accessed 1/21/07).

Mangin, Joseph François and Casimir Goerck, surveyors
1803 Plan of the City of New-York drawn from actual survey. Peter Maverick, engraver.

Marine and Aviation
1950 *Port Progress Report 1950-1951.* Department of Marine and Aviation, City of New York. (Collection: City Hall Library).

Merwin, Daria E., Daniel P. Lynch, and David S. Robinson
2003 Submerged Prehistoric Sites in Southern New England: Past Research and Future Directions. *Bulletin of the Archaeological Society of Connecticut.* 65, 41-56.

Minutes of the Common Council (MCC)
1905 *Minutes of the Common Council of the City of New York 1675-1776.* Eight volumes, Dodd, Mead and Company, New York.

1917 *Minutes of the Common Council of the City of New York 1784-1831.* Nineteen volumes. City of New York.

NOAA (National Oceanic and Atmospheric Administration)
1979 Hudson and East Rivers, Governors Island to 67th Street. United States East Coast, New
1982 York and New Jersey. #12335.
1984
1986
1990
2000

New Map

1860 *New Map of that Part of the City of New York South from 20th Street on the Hudson and 35th Street on the East River.* Map Division, New York Public Library.

New York Times
1895 A Water-Front Purchase. *The New York Times.* May 14. Page 6.

1922 Repaving West Street. *The New York Times.* December 31. Page 105.

1950 Elevated Highway in South Street Pushed. *The New York Times.* July 24. Page 17.

1951 Work Starts in '52 on South Street Link. *The New York Times.* October 13. Page 14.

1952 Paving Laid in 1836 Found in South St. *The New York Times.* September 19. Page 25.

1963 Downtown Ramps Started. *The New York Times.* August 21. Page 18.

1968 Brooklyn Bridge Ramp Opened. *The New York Times.* April 17. Page 49.

1979 Section of Viaduct Collapses on Lot. *The New York Times.* June 14. The City. Page B5.

1980 F.D.R. Drive Project. *The New York Times.* July 9. The City. Page B2.

2006 The Drawing Center Finds Its Perch. *The New York Times.* January 11.

NYCEDC (New York City Economic Development Corporation)
2004 Cross Harbor Freight Movement Project Draft Environmental Impact Statement in Kings, Queens, Richmond Counties, New York and Hudson, Union, Middlesex, Essex Counties, New Jersey. Prepared by United States Department of Transportation, Federal Highway Administration, Federal Railroad Administration and New York City Economic Development Corporation. April.

Oasis Map
1996 Aerial photograph. (www.oasisnyc.net/oasismap.htm accessed 2/1/2007).

2004 Aerial photograph (www.oasisnyc.net/oasismap.htm accessed 2/1/2007).

Olmsted, Robert
1995 *New York City Transit Authority, Historical Properties Survey, Phase II.* Volume III. Prepared for the New York City Transit Authority, Brooklyn, New York.

Pickman, Arnold, and Nan A. Rothschild
1981 64 Pearl Street: An Archaeological Excavation in 17th Century Landfill. Sponsored by the New York Landmarks Conservancy. May.

Pownall, Thomas
1776 The provinces of New York and New Jersey; with part of Pensilvania, and the province

of Quebec. Drawn by Major Holland, Surveyor General, of the Northern District in America. Corrected and improved, from the original materials, by Thomas Pownall. Robert Sayer & John Bennett, London.

Profile of South Street (Profile)
ca.1851 Profile of South Street [from Roosevelt Street to Catharine Street]. File D69.22. Acc. No. 1162. Drawer 45. Collection: Manhattan Borough President's Office).

Raber, Michael S. and Norman J. Brouwer
1985 Todd Shipyards, Erie Basin, Addendum to: Cultural Resources Investigations in Brooklyn Reach I, New York Harbor Collection and Removal of Drift Project. Prepared by Raber Associates. Prepared for New York District, U.S. Army Corps of Engineers, New York, NY.

Ratzer, Bernard
1776 Plan of the City of New York. Surveyed in 1767. Faden and Jefferys, London.

Robinson, Elisha and R. H. Pidgeon
1885 *Atlas of the City of New York.* Vol. 1. E. Robinson, New York.

Rockman, Diana, Wendy Harris, and Jed Levin
1982 The Archaeological Investigation of the TELCO Block, South Street Historic District, New York, New York. Prepared by Professional Service Industries, Inc., Soil Systems, Inc. Subsidiary. Prepared for Jack Resnick and Sons, Inc.

Rosloff, Jay Paul
1986 The Water Street Ship: Preliminary Analysis of an Eighteenth-Century Merchant Ship's Bow. Unpublished masters thesis, submitted to the Graduate College of Texas A&M University. May.

Rothschild, Nan, and Diane Dallal
1983 City of New York, Department of Environmental Protection, Bureau of Sewers, Division of Sewer Design, Capital Project No. SE–544(HD387) for the Rehabilitation and Construction of Combined Sewers, Outfalls, Regulators ad Appurtenances in: South Street from Wall Street to Approx. 100' North of Dover Street and Capital Project No. WM–1 and WM–6 for the Installation of Water Mains and Appurtenances in: South Street from Wall Street to Approx. 100' North of Dover Street, Borough of Manhattan: Archaeological Survey. Prepared for the Center for Building Conservation, New York. September 21.

Rothschild, Nan A. and Arnold Pickman
1990 The Archeological Evaluation of the Seven Hanover Square Block: A Final Report. Submitted to the New York City Landmarks Preservation Commission, December 1990.

Sanborn
1905 *Atlas of the Borough of Manhattan, City of New York.* Vol. 1. Sanborn Map Company.
1955

1975

1928 *Insurance Maps of the City of New York: New York Harbor Pier Map.* Sanborn Map Company.

2006 *Sanborn Manhattan Landbook of the City of New York.* First American Real Estate Solutions, Jersey City, NJ.

Scharf, J. Thomas
1886 *History of Westchester County, New York.* 2 vols. L. E. Preston & Co. Philadelphia.

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

Shumway, Floyd M.
1975 *Seaport City, New York in 1775.* South Street Seaport Museum, New York.

Singleton, Esther and Russell Sturgis
1906 *The Furniture of Our Forefathers.* Vol. 1. Doubleday, Page, & Company. New York.

Small, Edwin W.
1941 Wharf Building Of a Century and More Ago. Popular Study Series History No. 9. U.S. Department of the Interior, National Park Service, Washington, D.C.

Smith, Elias L.
1846 Profile, of the proposed change of Grade at the Corner of South and Whitehall Streets, filed this day by Isaac U. Coles, Representative of the Estate of John B. Coles decd. Elias L. Smith, Street Commissioner. April 24. Sheet 1. Acc. No. 869, Drawer 44 (Collection: Manhattan Borough President's Office).

SSS (South Street Seaport)
1903a Pier and Dock Map: Old Slip–Fulton, ER. Nov. 19/03 (Collection: South Street Seaport Museum Library).

1903b Pier and Dock Map: Fulton–Oliver, ER. Dec. 3/03 (Collection: South Street Seaport Museum Library).

1907 Pier and Dock Map: Catharine to Jefferson. April 1/07 (Collection: South Street Seaport Museum Library).

1910 Pier and Dock Map: Jefferson St. – Gouverneur Slip. Withdrawn from use Apr 1/10 (Collection: South Street Seaport Museum Library).

1911 Pier and Dock Map: Gouverneur–Grand. (Withdrawn) Feb. 2/1911 (Collection: South Street Seaport Museum Library).

Stevens, John Austin Jr.
1867 *Colonial Records of the New York Chamber of Commerce, 1768-1784.* John F. Trow & Co., New York.

Stewart, David J.
1999 Formation Processes Affecting Submerged Archaeological Sites: An Overview. *Geoarchaeology: An International Journal.* 14(6), pp.565-587.

Stokes, I. N. Phelps
1926 *The Iconography of Manhattan Island.* Vol. 5. Robert Dodd, New York.

Sun
1846 *The Wealth and Biography of the Wealthy Citizens of the City of New York.* Tenth edition. The Sun, New York.

Taylor, Benjamin, and John Roberts
1797 A New & Accurate Plan of the City of New York in the State of New York in North America.

Thomas, Isaiah
1874 *History of Printing in America.* Second edition. Vol. II. Joel Munsell, Albany, NY.

URS
2003 Cultural and Archaeological Resources Assessment Work Plan for the Hudson River PCBs Superfund Site. Prepared by URS Corp. for General Electric Company, Albany, NY. August.

USC&GS (United States Coast and Geodetic Survey)
1844 *Map of New-York Bay and Harbor and the Environs* (#369). F. R. Hassler, Superintendent, U.S. Coast Survey, Washington D.C.

1866 *Bay and Harbor of New York* (Chart no. 369).
1878

1906 Hudson and East Rivers from West 67th Street to Blackwells Island, New York.
1919 Washington, D.C.
1924

1959 Hudson and East Rivers, Governors Island to 67th Street. United States East Coast,
1969 New York and New Jersey, #745.

USGS (United States Geological Survey)
1981 Jersey City Quadrangle New Jersey – New York. 7.5-minute series. Published 1967, photorevised 1981. United States Geological Survey, Reston, VA.

1995 Central Park Quadrangle New York – New Jersey. 7.5-minute series. United States Geological Survey, Reston, VA.

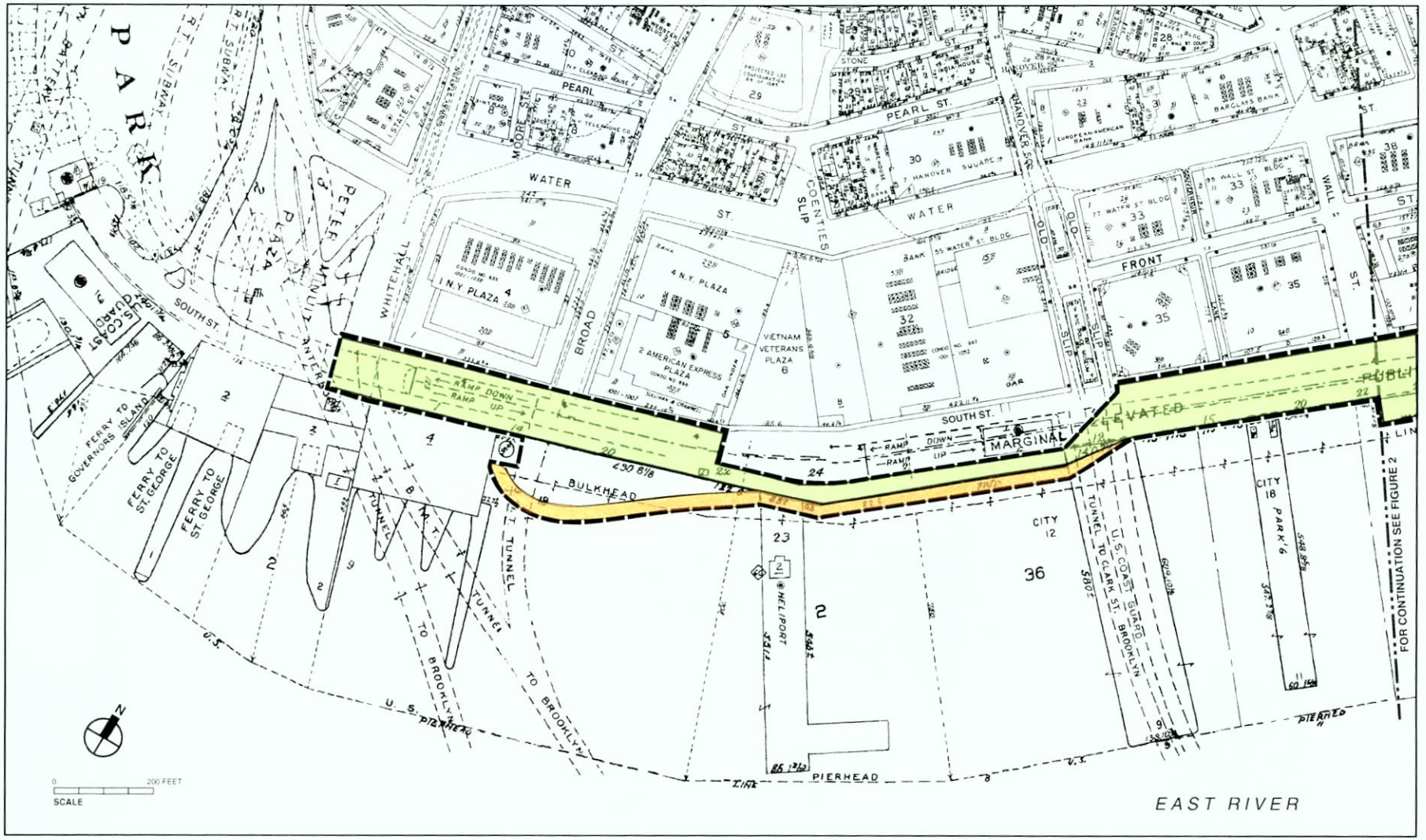
2003 Quaternary Lakes and River Systems. 3dparks.wr.usgs.gov/nyc/morraines/rivers.htm (Accessed 12/27/06).

Viele, Egbert L.
1865 Topographical Map of the Island of New York. New York.

WMDM (Water Main Distribution Map)
2006 New York City Department of Environmental Protection Water Main Distribution Map.

WPA (Works Progress Administration)
1936-1940 Subsurface Conditions. Prepared for the Department of Water Supply, Gas & Electricity. Some sewer revisions 1971. (Collection: New York City Department of Design and Construction).

1965 Rock Data Maps. Volume 1. 1937, revised 1965. Borough of Manhattan, Office of the President. John J. Murphy, Author.

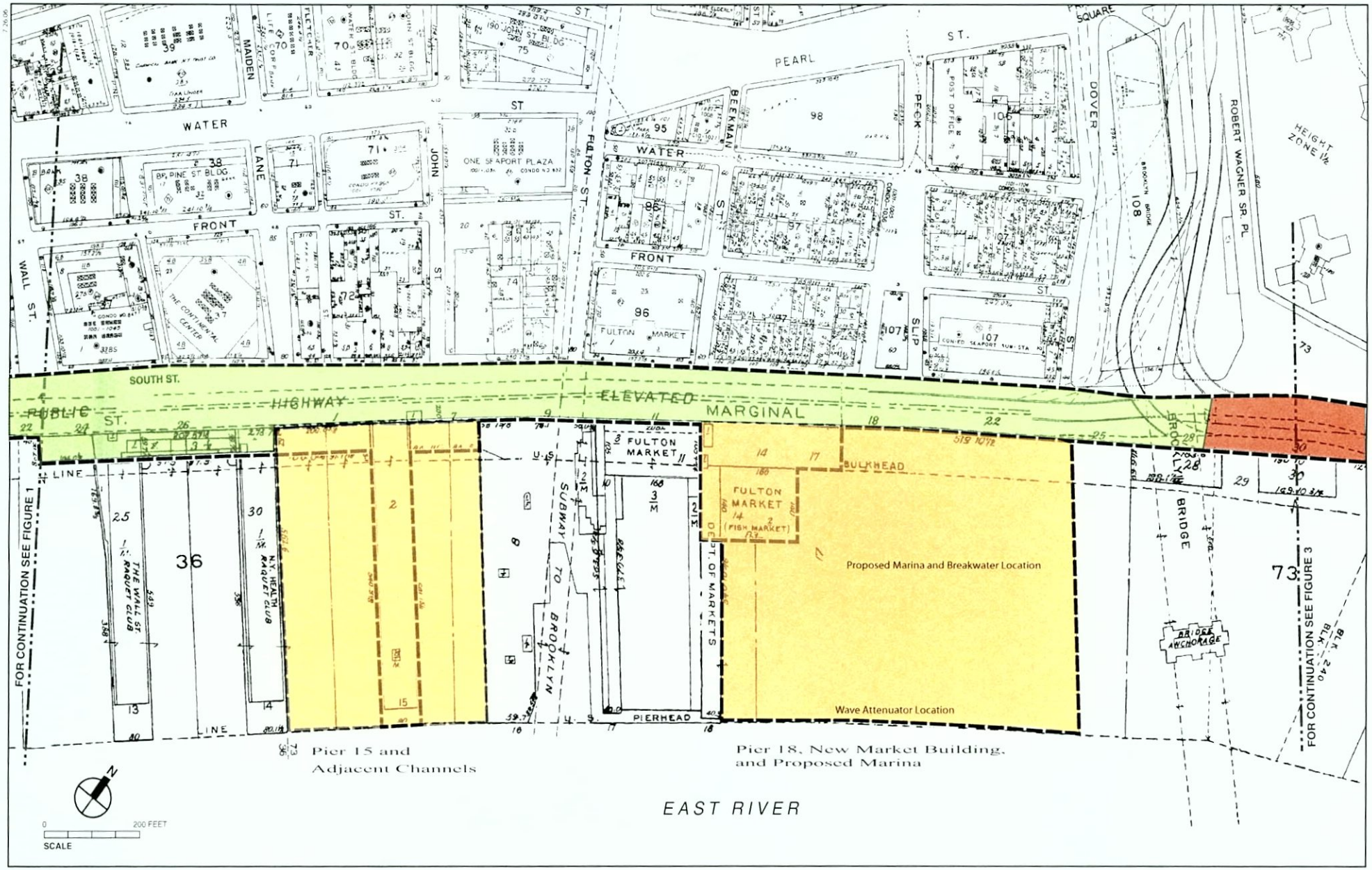


LEGEND

Area of Potential Effect	Outboard Resources APE -- Broad Street through Old Slip
APE South of the Brooklyn Bridge	APE North of the Brooklyn Bridge

EAST RIVER Waterfront Esplanade and Piers

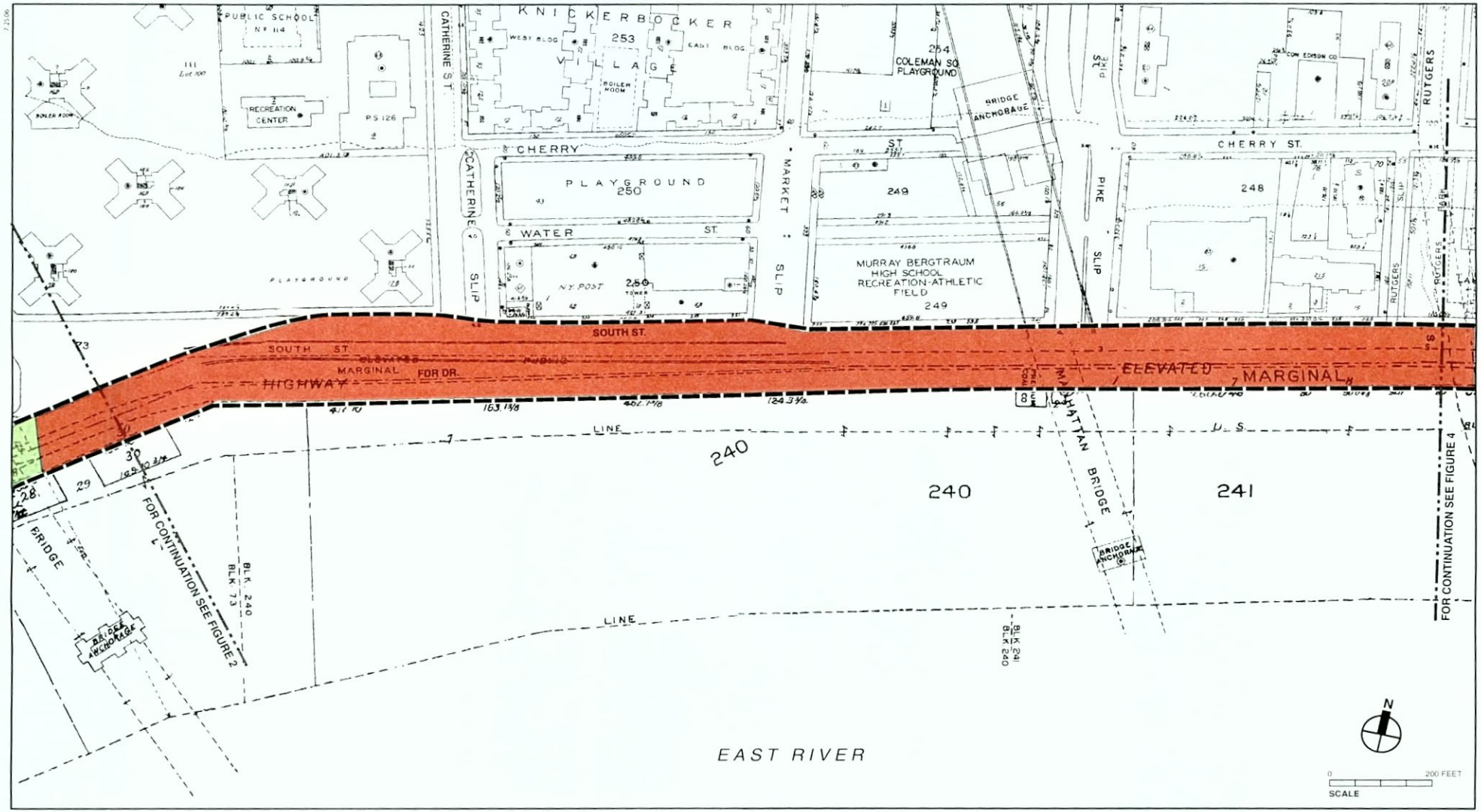
FIGURE 1: Current Sanborn Map (Battery Park to Wall Street)



Area of Potential Effect
APE South of the Brooklyn Bridge
Outboard Resources APE
APE North of the Brooklyn Bridge

EAST RIVER Waterfront Esplanade and Piers

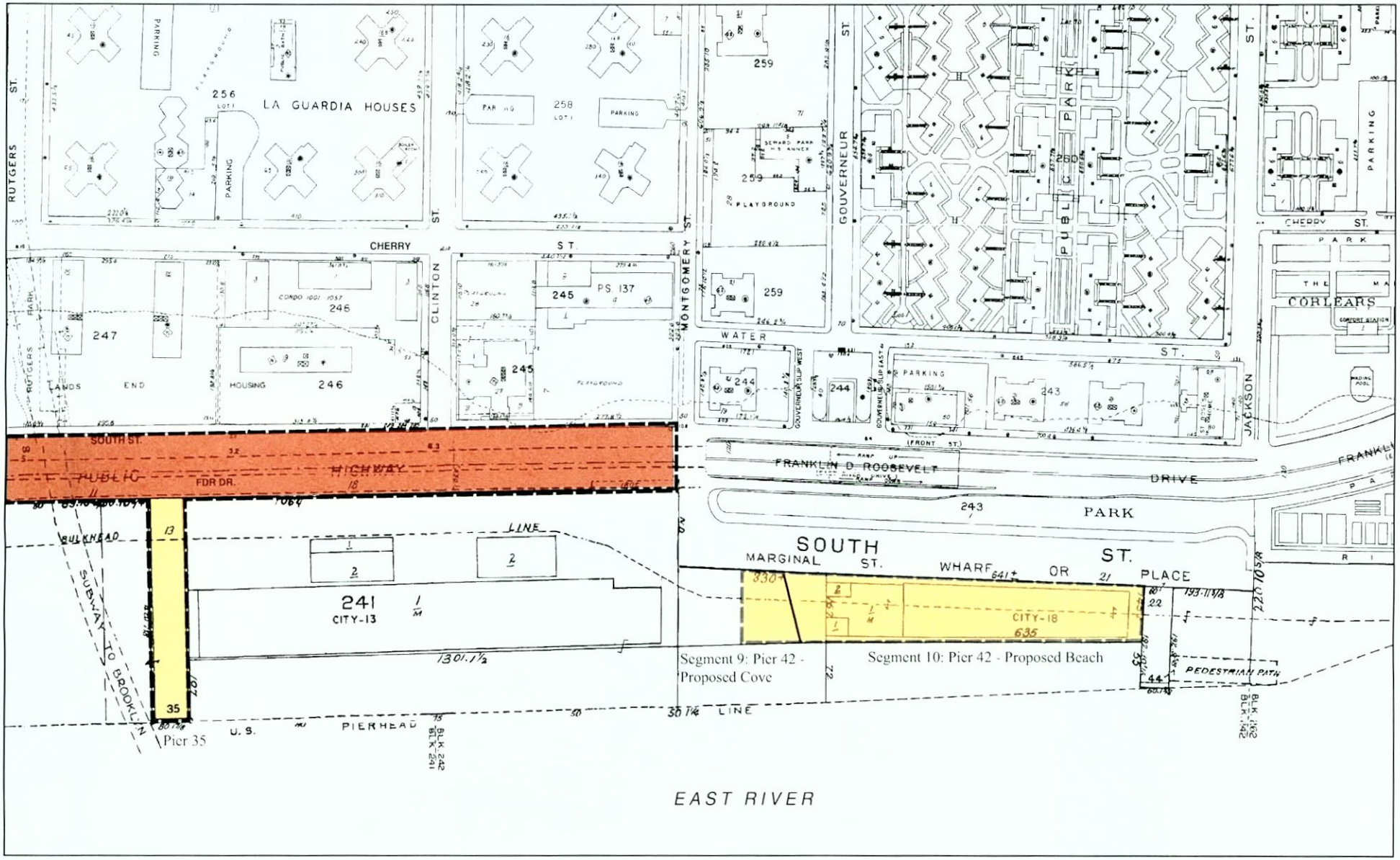
FIGURE 2: Current Sanborn Map (Wall Street to R. F. Wagner Place)



Area of Potential Effect
APE South of the Brooklyn Bridge
Outboard Resources APE
APE North of the Brooklyn Bridge

EAST RIVER Waterfront Esplanade and Piers

FIGURE 3: Current Sanborn Map (R. F. Wagner Place to Rutgers Street)



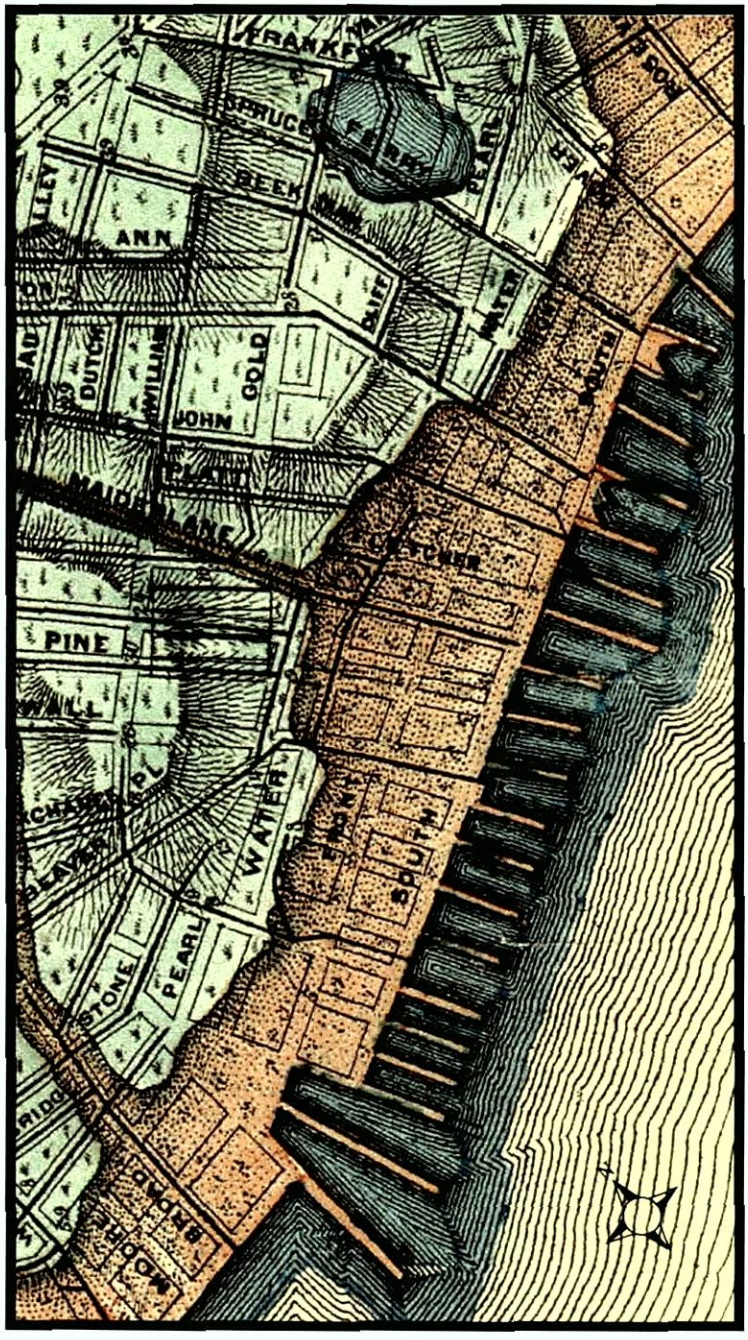
Segment 9: Pier 42 - Proposed Cove

Segment 10: Pier 42 - Proposed Beach

Area of Potential Effect	Outboard Resources APE
APE South of the Brooklyn Bridge	APE North of the Brooklyn Bridge

EAST RIVER Waterfront Esplanade and Piers

FIGURE 4: Current Sanborn Map (Rutgers Street to Jackson Street)



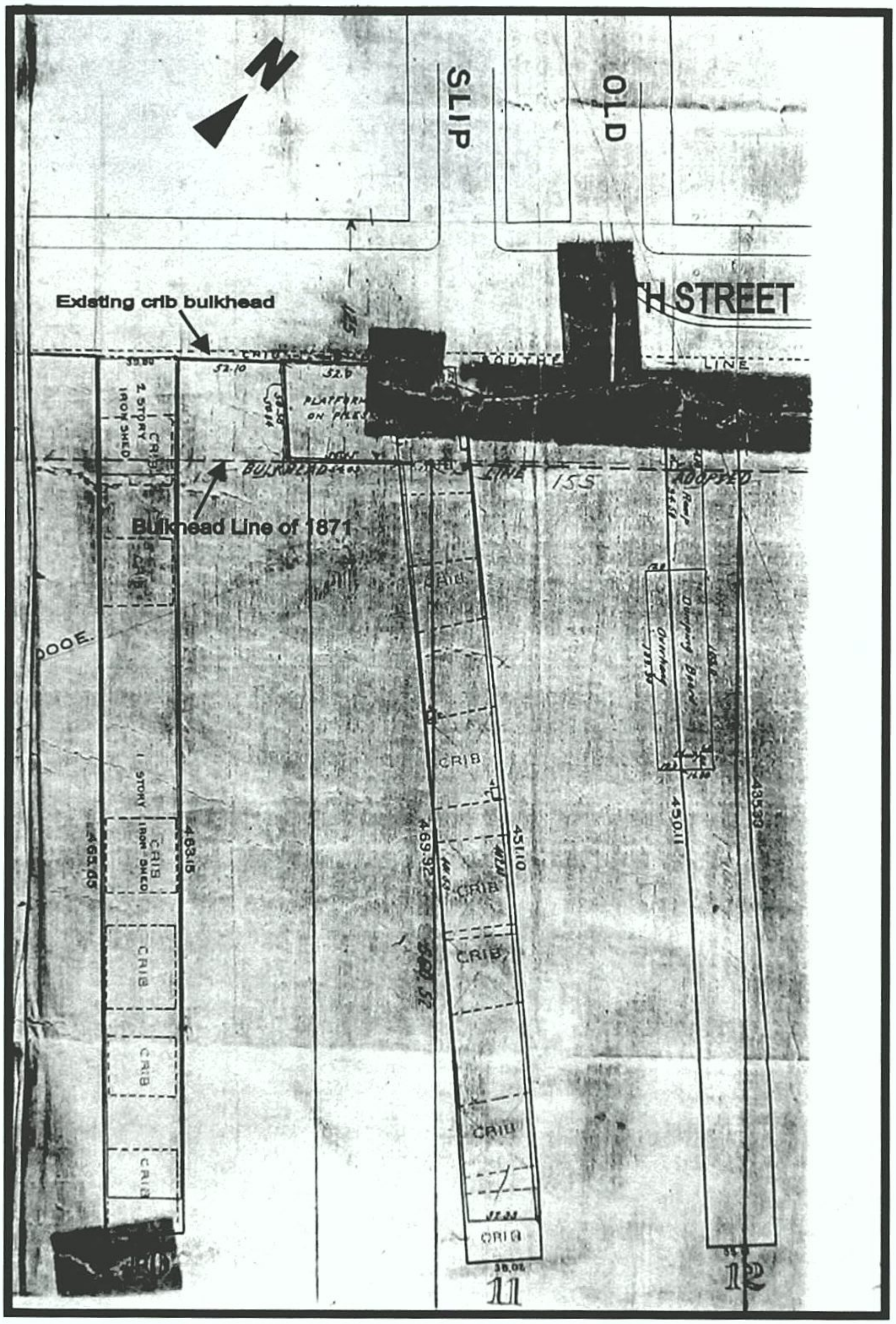
LEGEND

Green - Manhattan Island at the time of Contact
Orange - Made land (17th to mid-19th centuries)

SOURCE: David Rumsey Historical Map Collection - www.davidrumsey.com

EAST RIVER Waterfront Esplanade and Piers

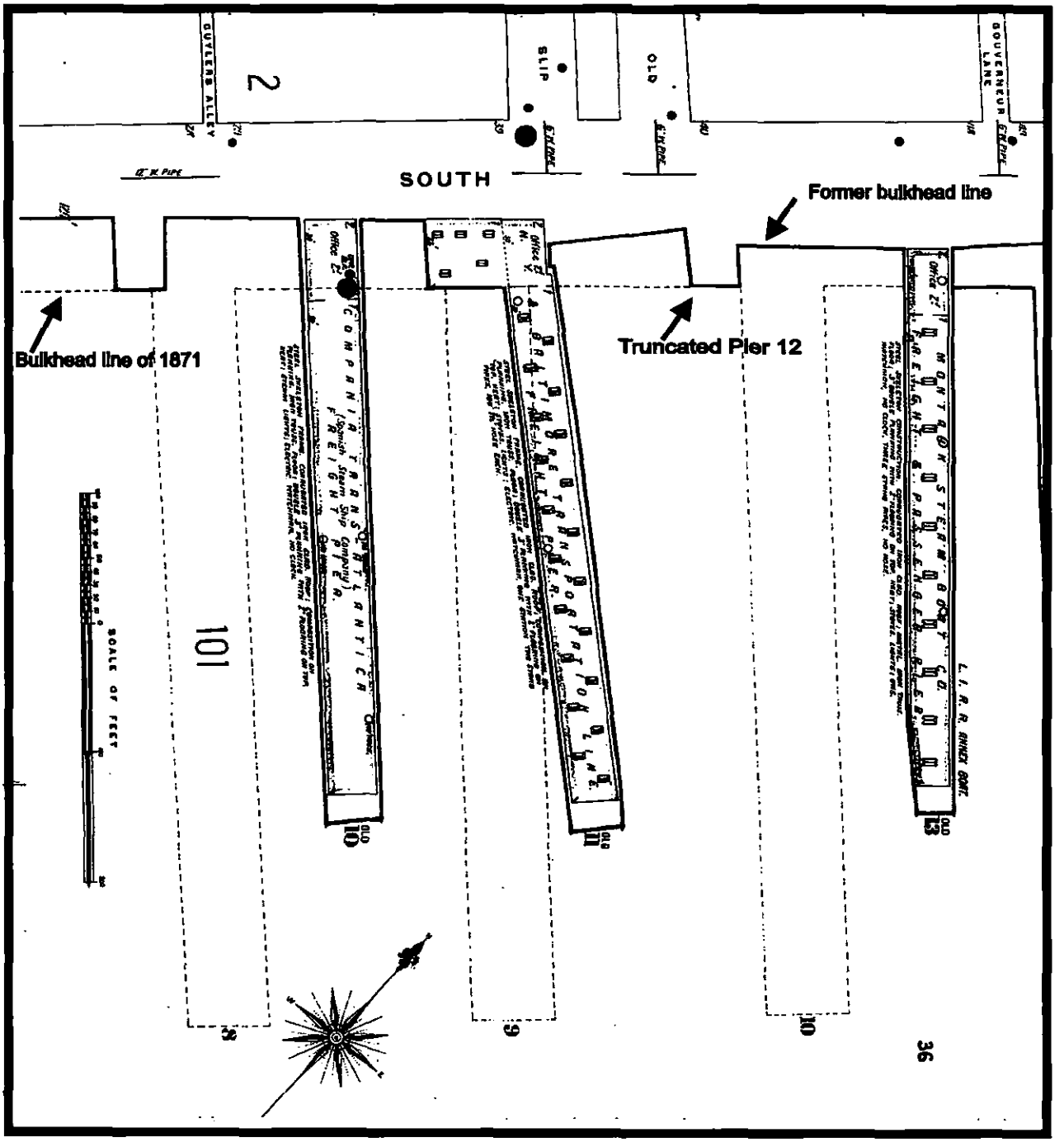
FIGURE 5: Viele, Topographic Map of the Island of New York, 1865
(Detail: Whitehall to Roosevelt Street)



SOURCE: Department of Docks Pier Maps (SSS 1903a). Collection: South Street Seaport Museum Library

EAST RIVER Waterfront Esplanade and Piers

FIGURE 6: Dock Map, Old Slip to Fulton, ER., 1903



EAST RIVER Waterfront Esplanade and Piers

FIGURE 7: Sanborn, Atlas of the Borough of Manhattan, 1905
(Detail: Plate 102, South Street from Cuylers Alley to Gouverneur Lane, with Old Slip)

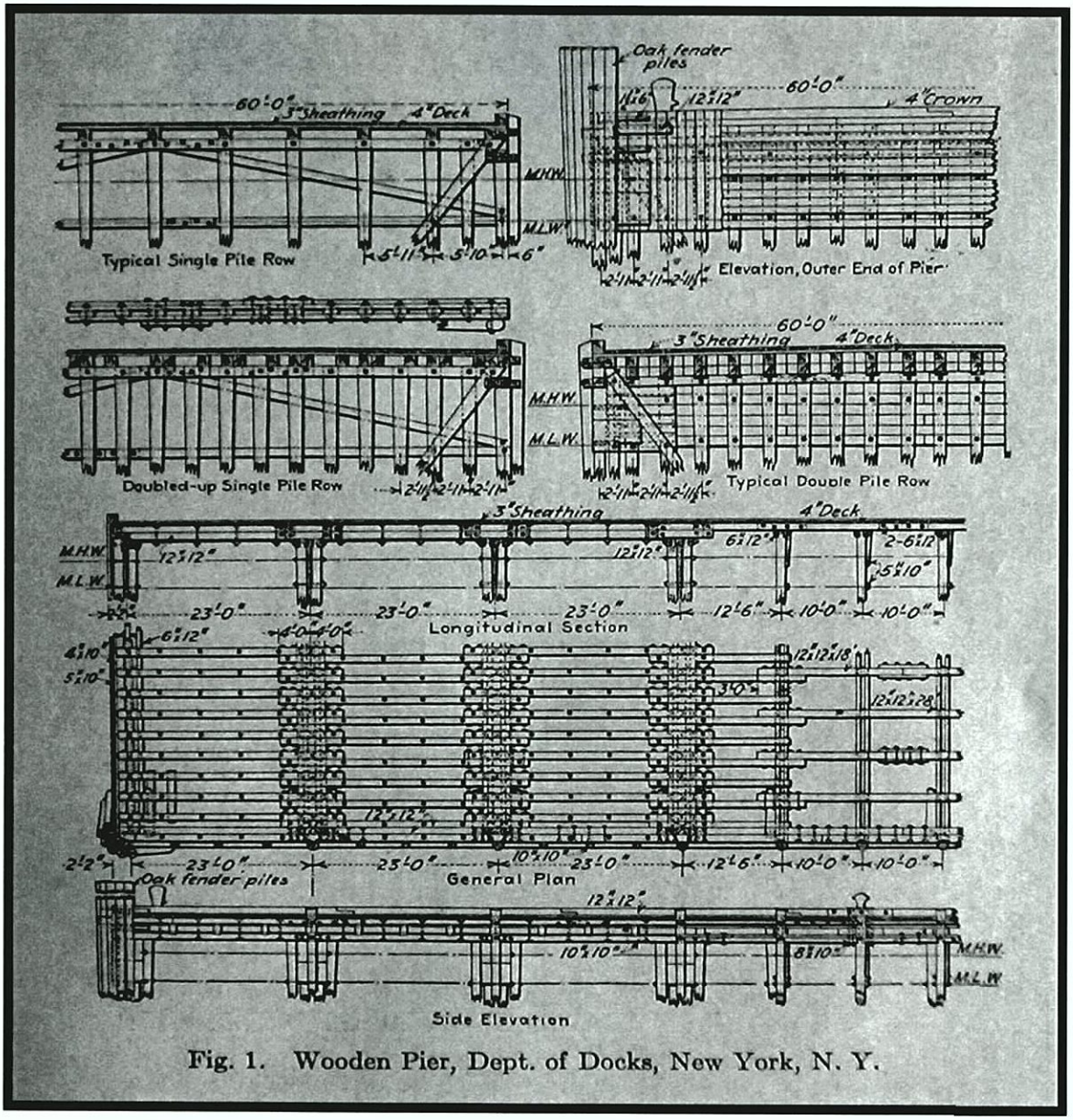


Fig. 1. Wooden Pier, Dept. of Docks, New York, N. Y.

SOURCE: Greene, *Wharves and Piers*, 1917

EAST RIVER Waterfront Esplanade and Piers

FIGURE 8: Wooden Pier, plan and elevations, 1917

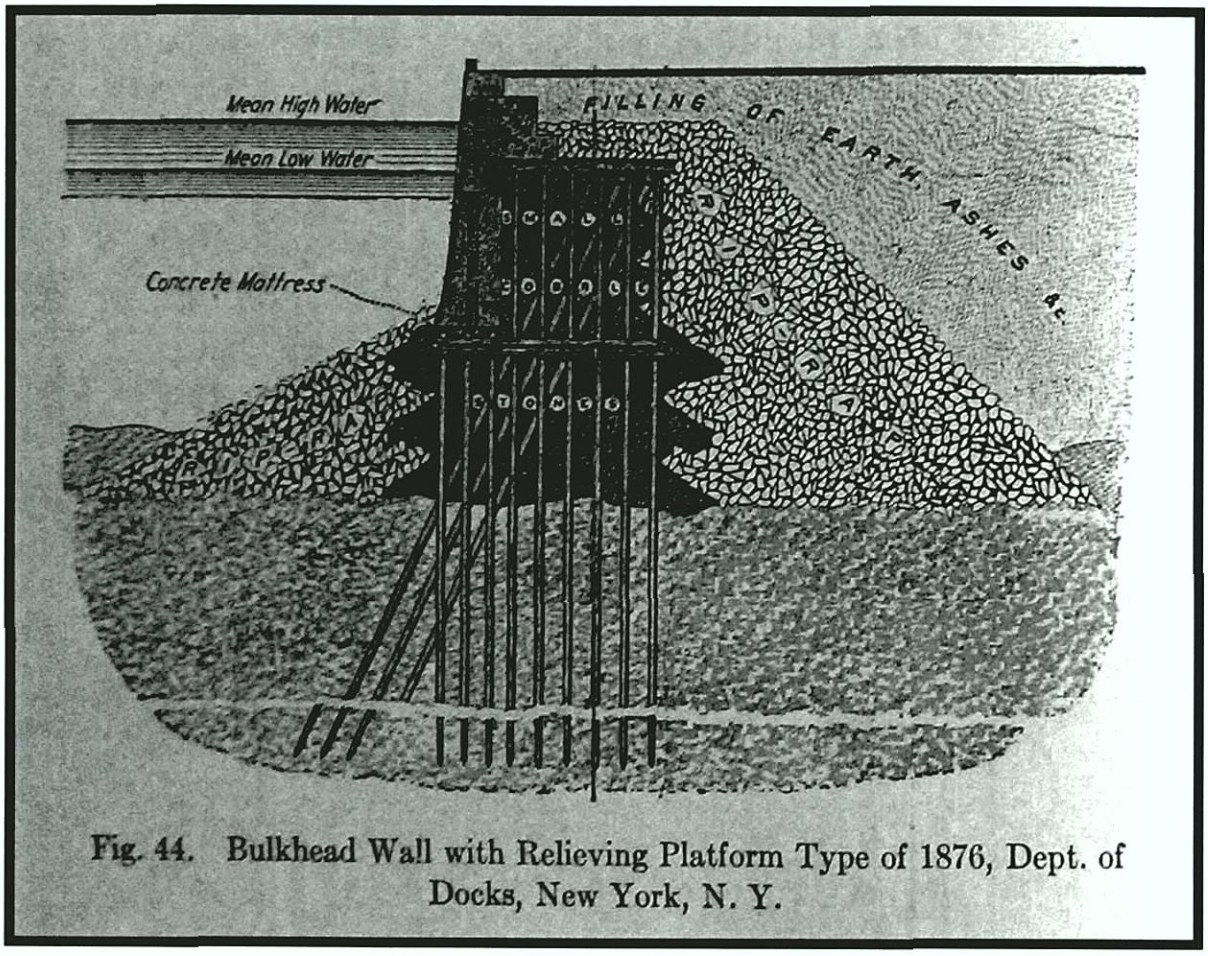


Fig. 44. Bulkhead Wall with Relieving Platform Type of 1876, Dept. of Docks, New York, N. Y.

SOURCE: Greene, *Wharves and Piers*, 1917

EAST RIVER Waterfront Esplanade and Piers

FIGURE 9: Bulkhead Wall, Type of 1876

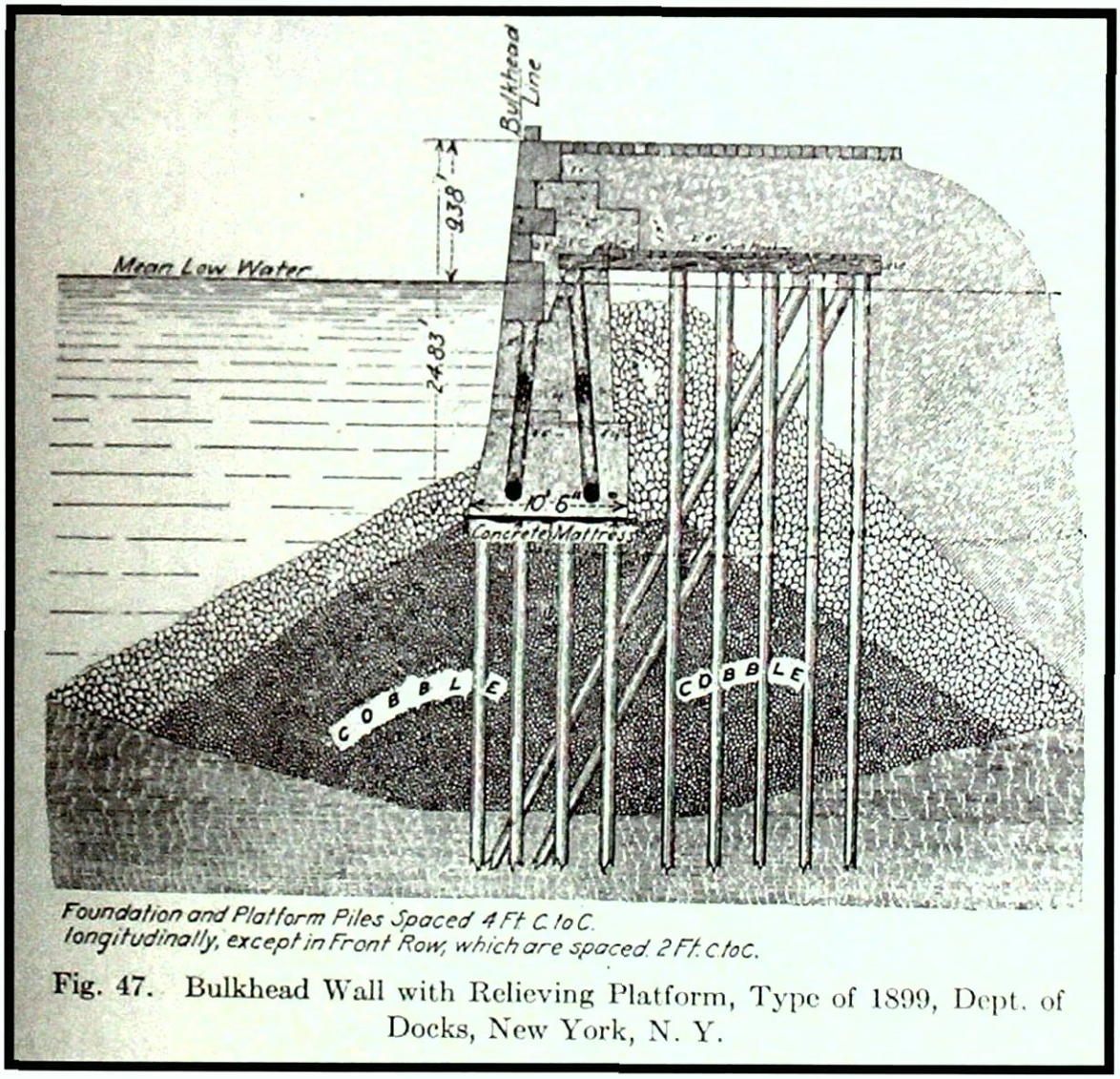
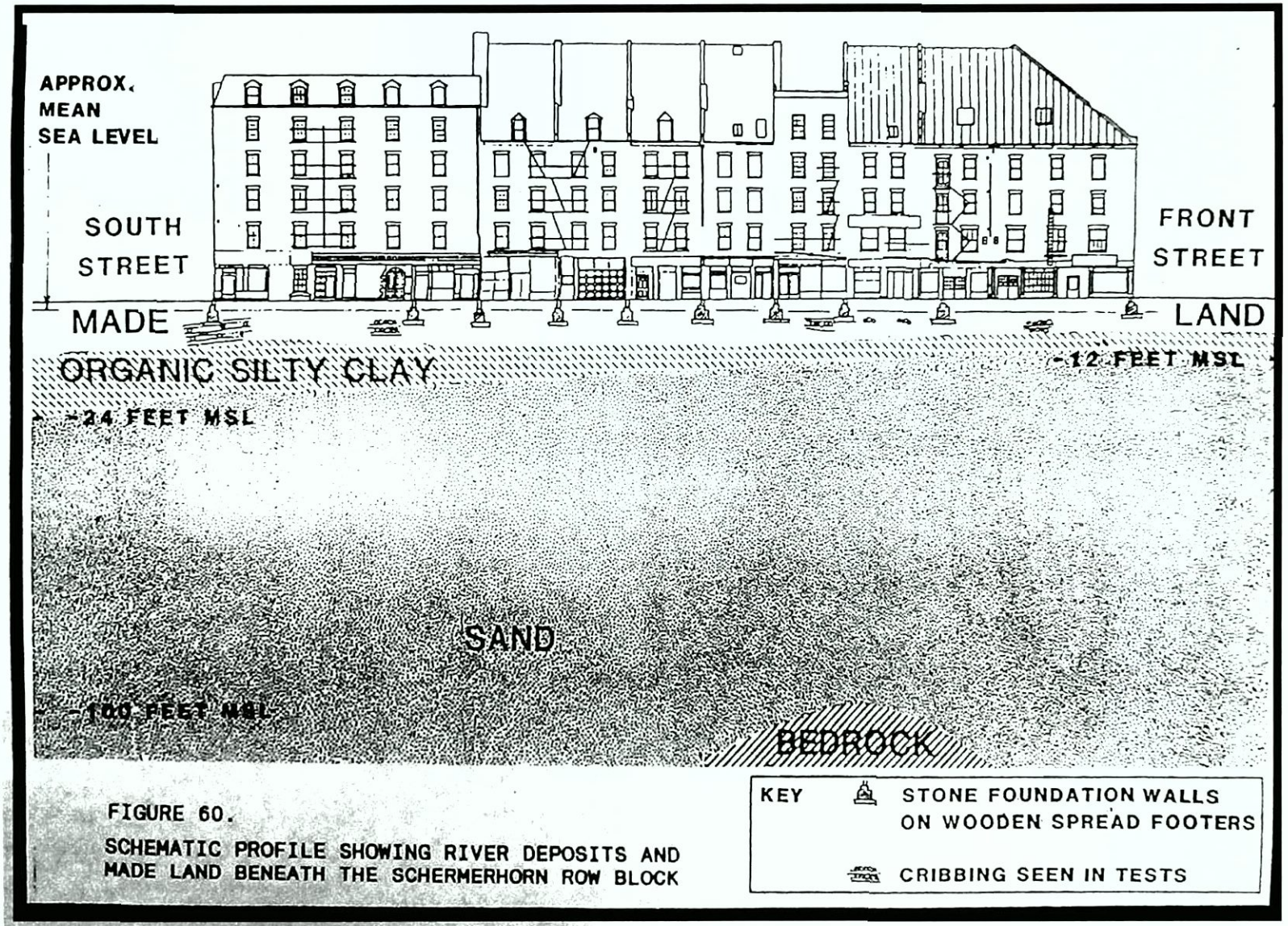


Fig. 47. Bulkhead Wall with Relieving Platform, Type of 1899, Dept. of Docks, New York, N. Y.

SOURCE: Greene, *Wharves and Piers*, 1917

EAST RIVER Waterfront Esplanade and Piers

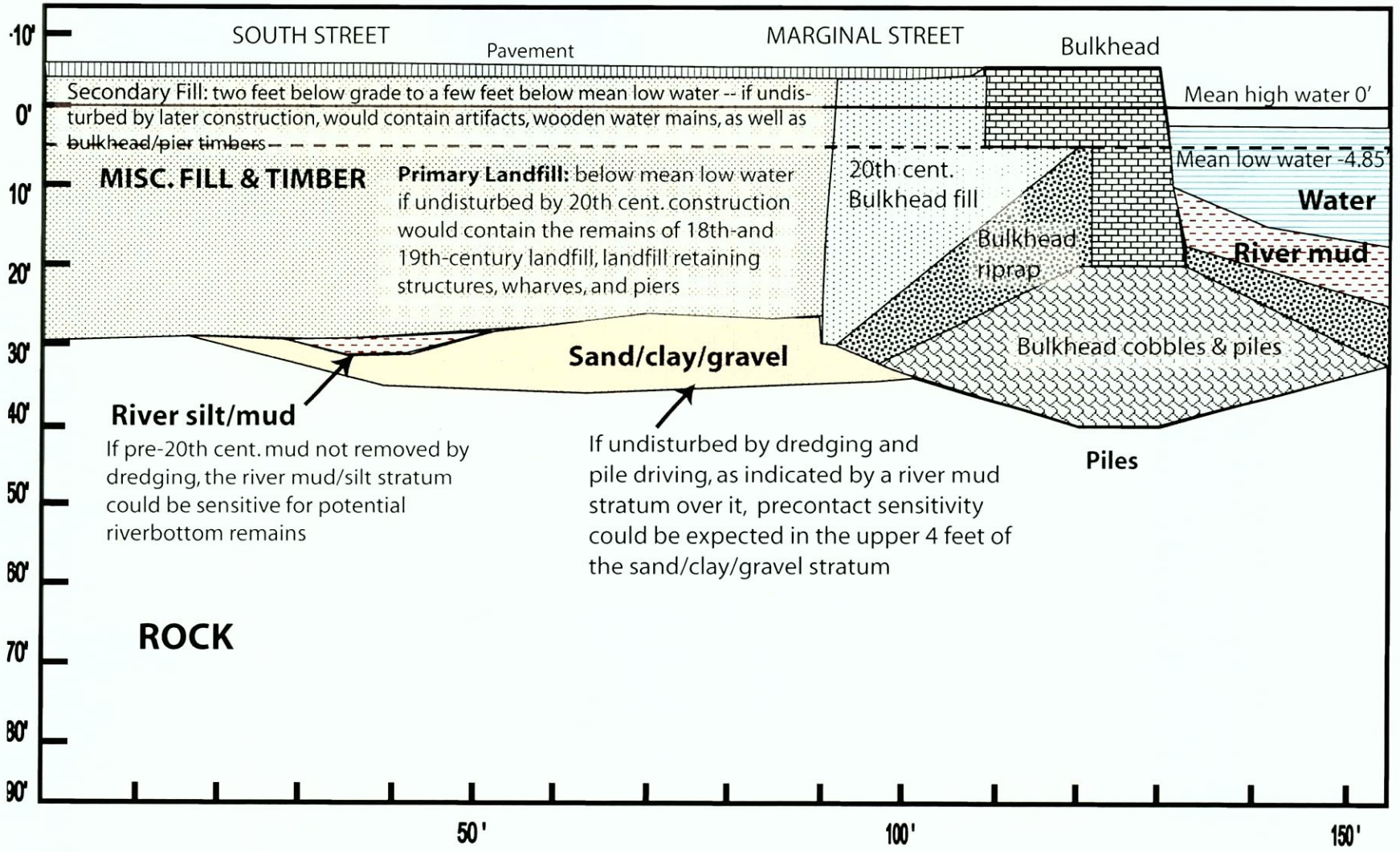
FIGURE 10: Bulkhead Wall, Type of 1899



SOURCE: Kardas and Larrabee 1991: Figure 60

EAST RIVER Waterfront Esplanade and Piers

FIGURE 11: Schematic Profile Showing River Deposits and Made Land Beneath the Schermerhorn Row Block

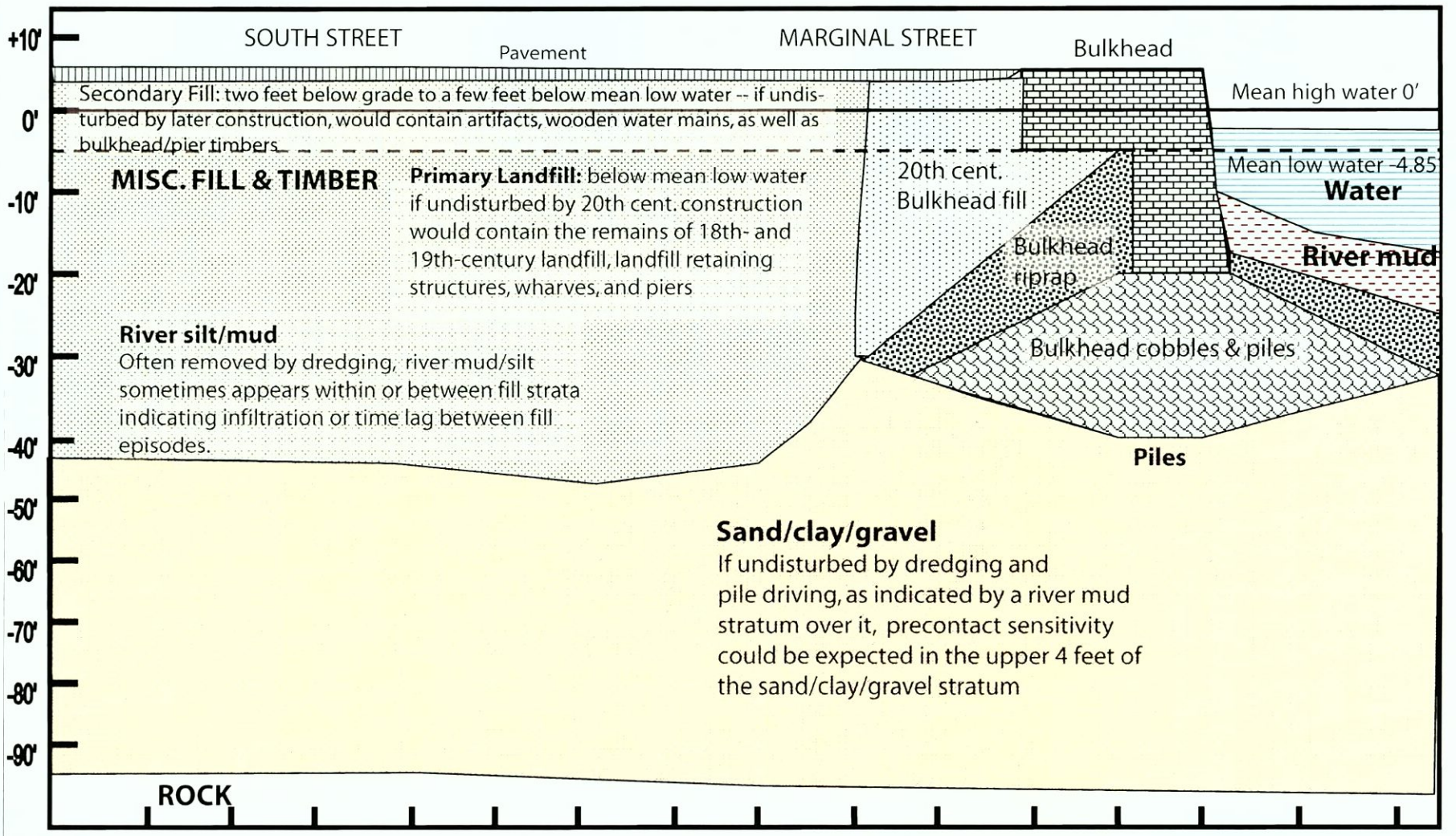


LEGEND

This profile is a ***generalized*** graphic depiction of the APE, from the north side of South Street to the modern bulkhead, showing potentially sensitive strata types in an area of shallow bedrock. It is based on sources cited in this report, in particular: soil boring logs at Wall Street West (WPA 1965: Sheet 1 #508, #509), bulkhead plans (Greene 1917 -- see Figure 10). Depths of strata vary among and within the East River Esplanade APE segments.

EAST RIVER Waterfront Esplanade and Piers

FIGURE 12: Generalized Profile of Potential Resource Depths -- Area of Shallow Bedrock

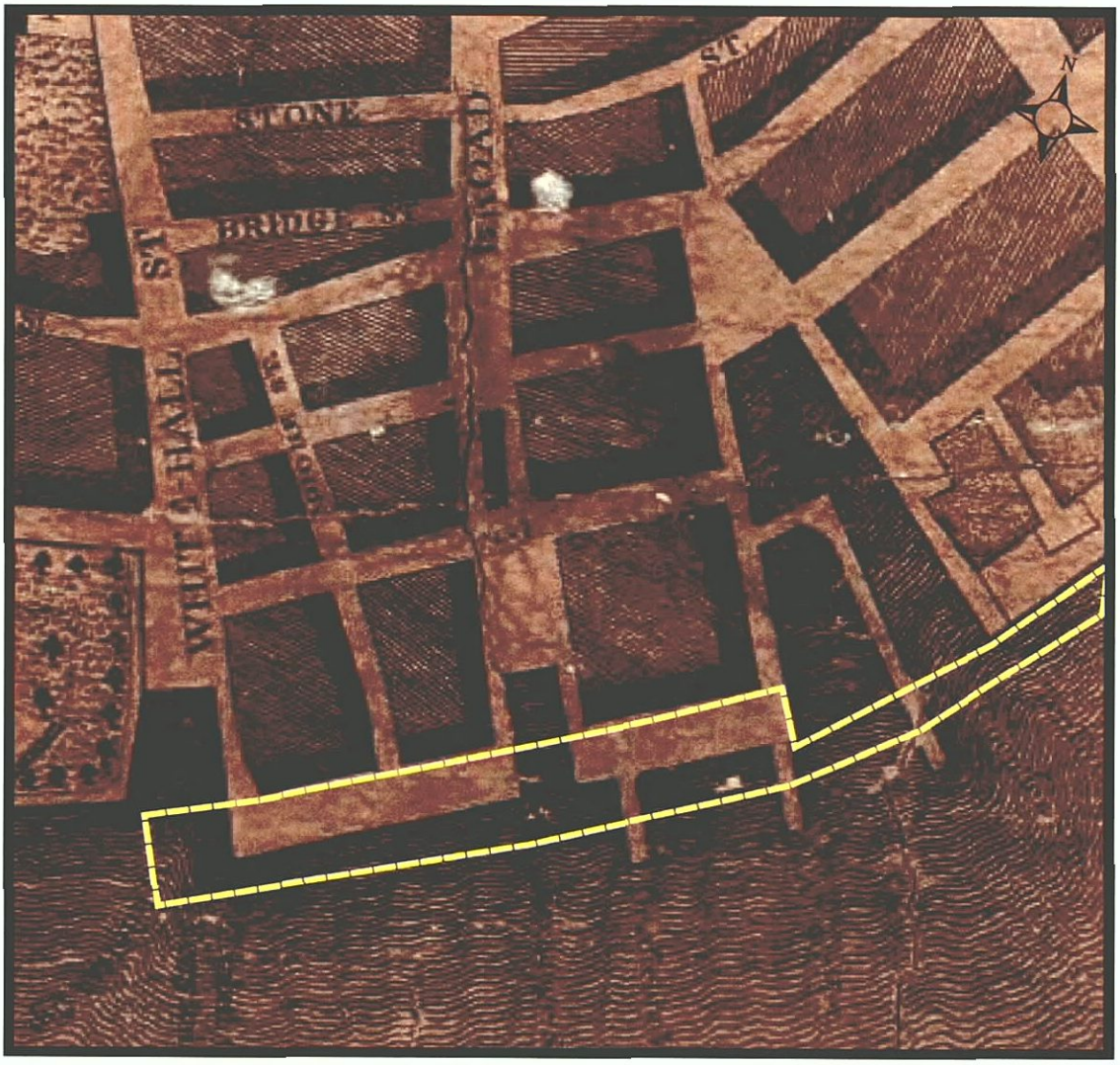


LEGEND

This profile is a ***generalized*** graphic depiction of the APE, from the north side of South Street to the modern bulkhead, showing potentially sensitive strata types in an area of deep bedrock. It is based on sources cited in this report, in particular: soil boring logs at Pine Street West (WPA 1965: Sheet 4 #335, #336), bulkhead plans (Greene 1917 -- see Figure 10). Depths of strata vary among and within the East River Esplanade APE segments.

EAST RIVER Waterfront Esplanade and Piers

FIGURE 13: Generalized Profile of Potential Resource Depths -- Area of Deep Bedrock



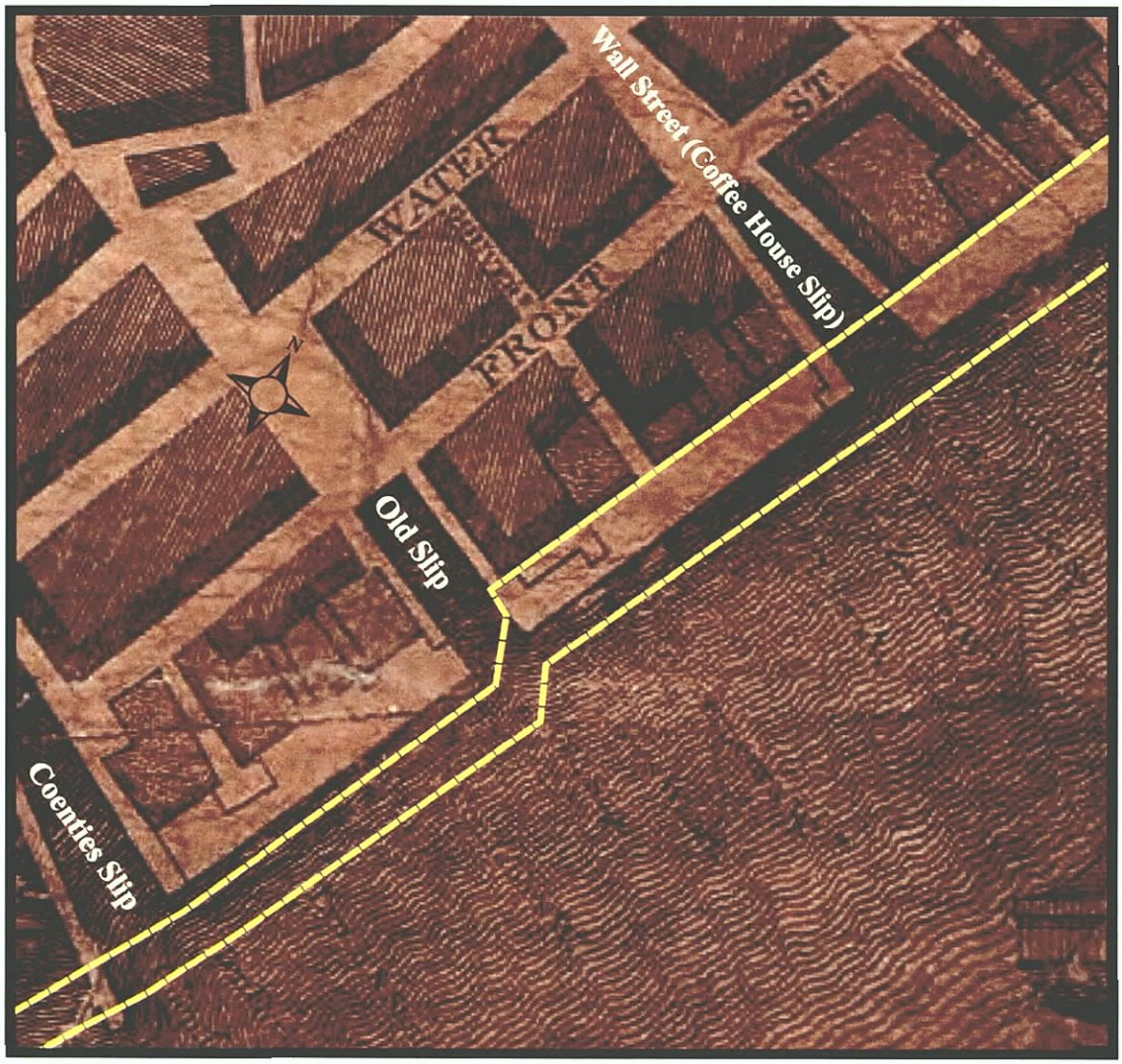
Legend

Area of Potential Effect

SOURCE: New York Public Library (www.nypl.org)

EAST RIVER Waterfront Esplanade and Piers

FIGURE 14: Mangin and Goerck, Plan of the City of New-York, 1803
(Detail: Whitehall Street to Coenties Slip)



Legend

Area of Potential Effect

SOURCE: New York Public Library (www.nypl.org)

EAST RIVER Waterfront Esplanade and Piers

FIGURE 15: Mangin and Goerck, Plan of the City of New-York, 1803
(Detail: Coenties Slip to Pine Street)

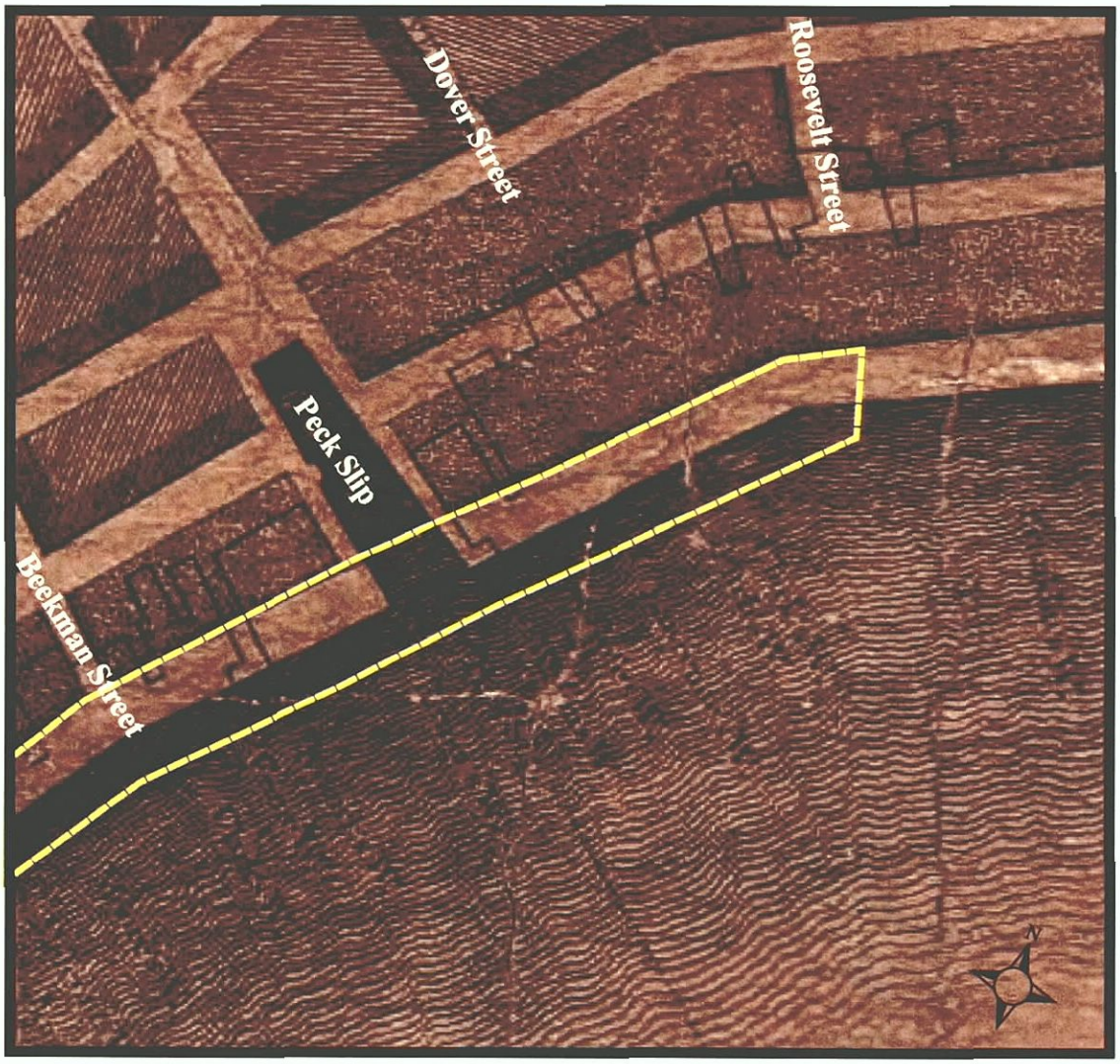
Legend

Area of Potential Effect

SOURCE: New York Public Library (www.nypl.org)

EAST RIVER Waterfront Esplanade and Piers

FIGURE 16: Mangin and Goerck, Plan of the City of New-York, 1803
(Detail: Pine Street to Beekman Street)



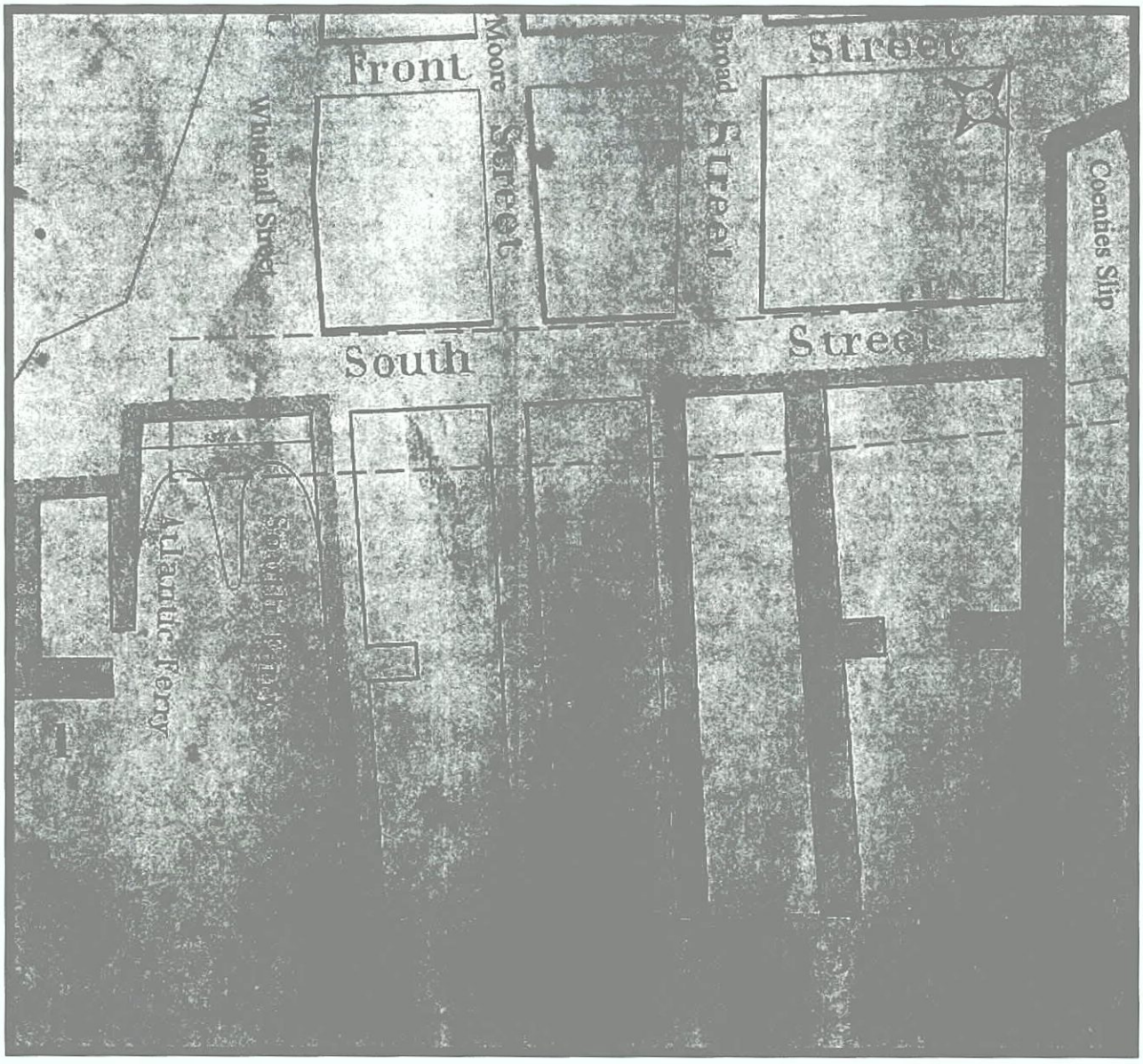
Legend

Area of Potential Effect

SOURCE: New York Public Library (www.nypl.org)

EAST RIVER Waterfront Esplanade and Piers

FIGURE 17: Mangin and Goerck, Plan of the City of New-York, 1803
(Detail: Beekman Street to Roosevelt Street)



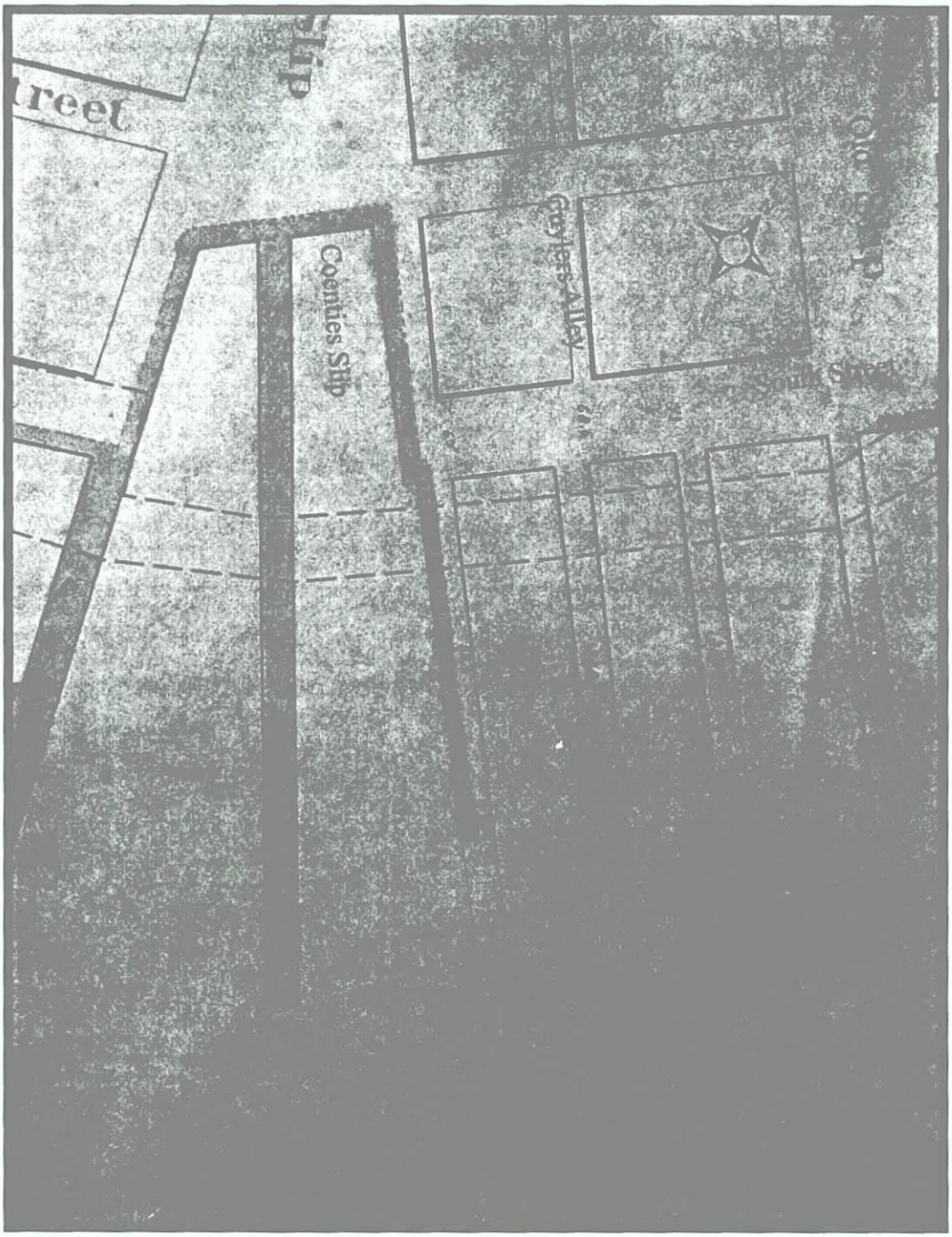
LEGEND

— — Area of Potential Effect

SOURCE: South Street Seaport Museum Library

EAST RIVER Waterfront Esplanade and Piers

FIGURE 18: Alvord, Maps of the Wharves and Piers of the East River, 1849 (Detail: Whitehall Street to Coenties Slip)



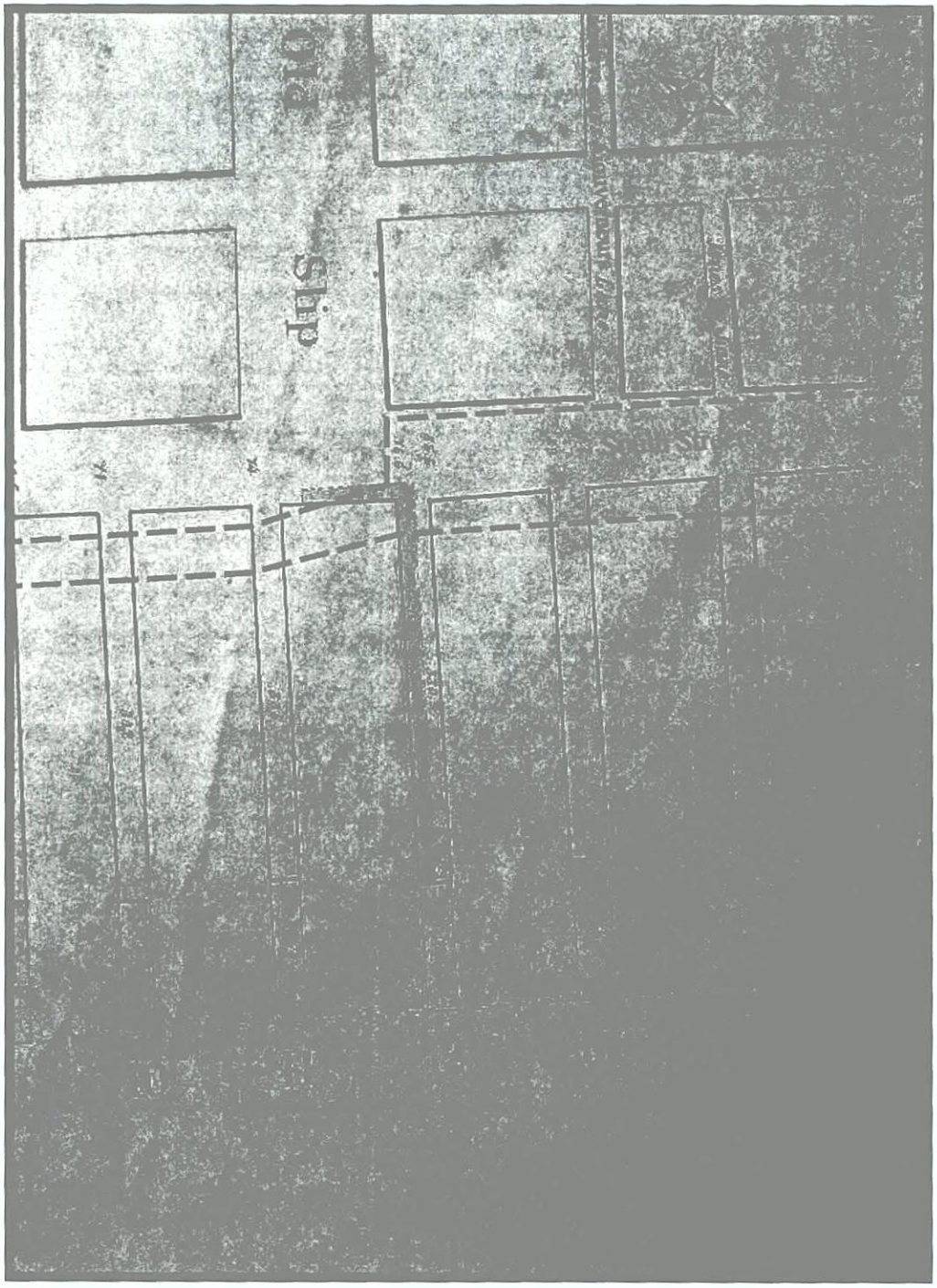
LEGEND

— — Area of Potential Effect

SOURCE: South Street Seaport Museum Library

EAST RIVER Waterfront Esplanade and Piers

FIGURE 19: Alvord, Maps of the Wharves and Piers of the East River, 1849 (Detail: Coenties Slip to Old Slip)



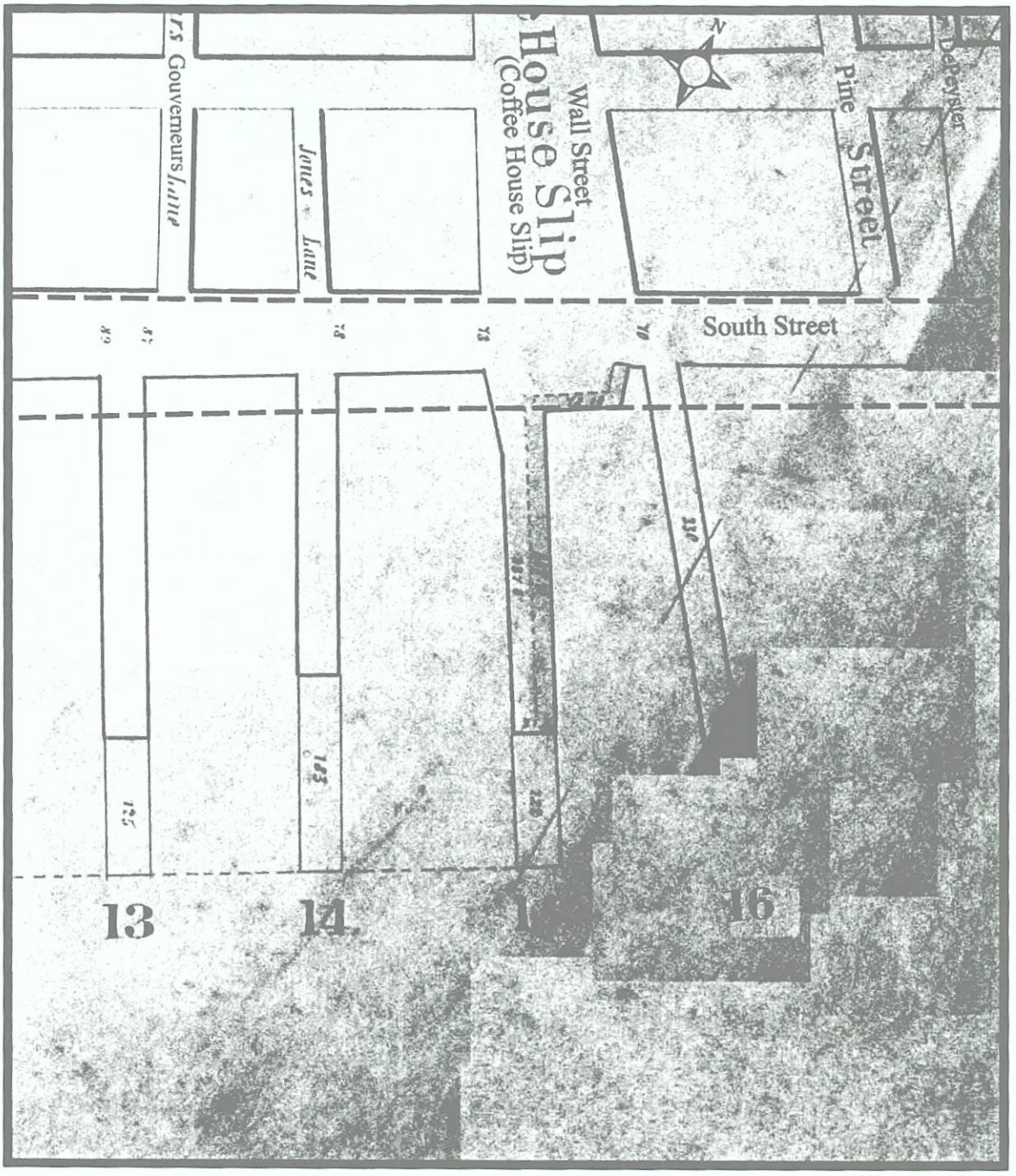
LEGEND

— — Area of Potential Effect

SOURCE: South Street Seaport Museum Library

EAST RIVER Waterfront Esplanade and Piers

FIGURE 20: Alvord, Maps of the Wharves and Piers of the East River, 1849 (Detail: Old Slip to Wall Street)



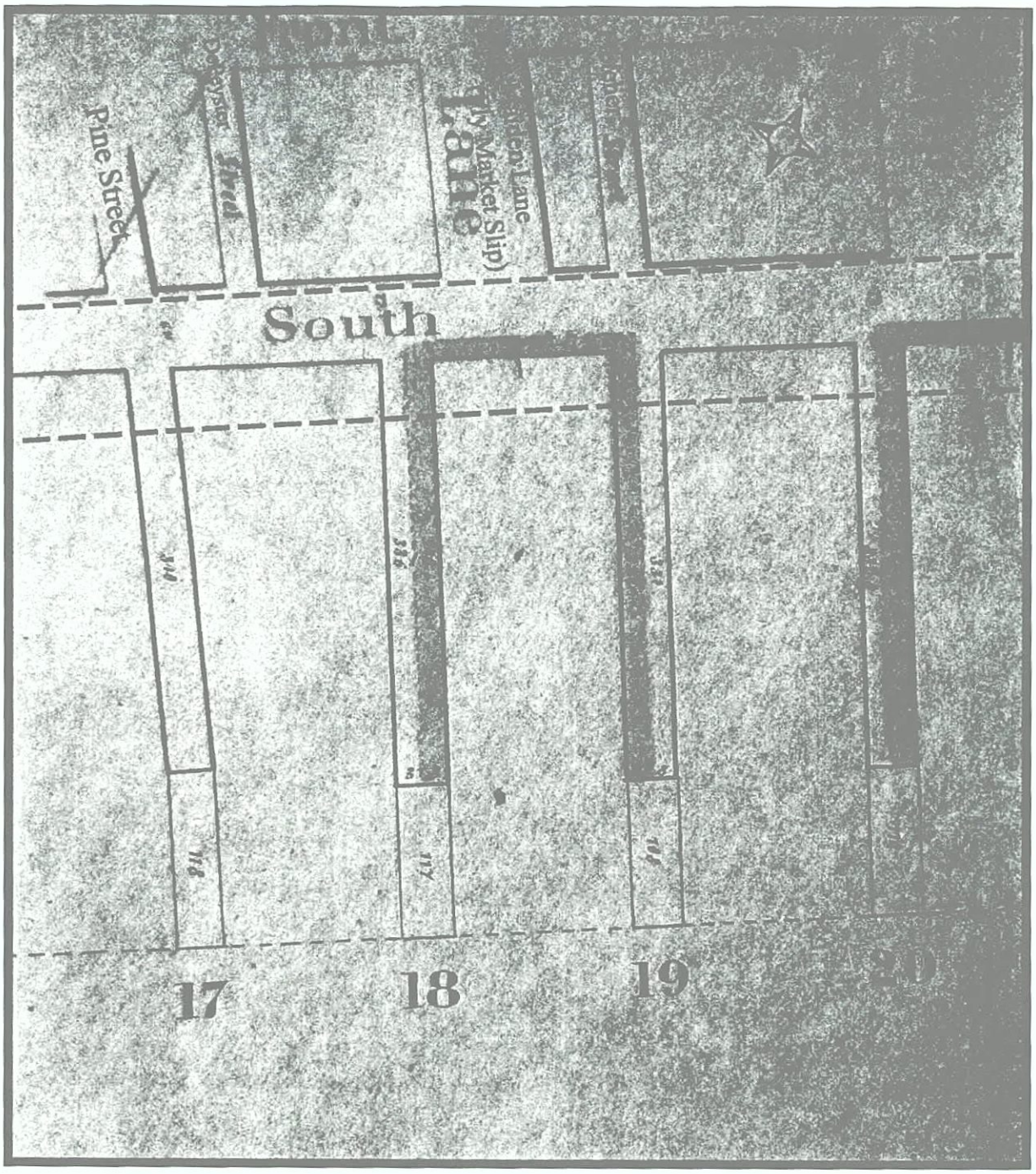
LEGEND

— — Area of Potential Effect

SOURCE: South Street Seaport Museum Library

EAST RIVER Waterfront Esplanade and Piers

FIGURE 21: Alvord, Maps of the Wharves and Piers of the East River, 1849 (Detail: Gouverneur Lane to Pine Street)



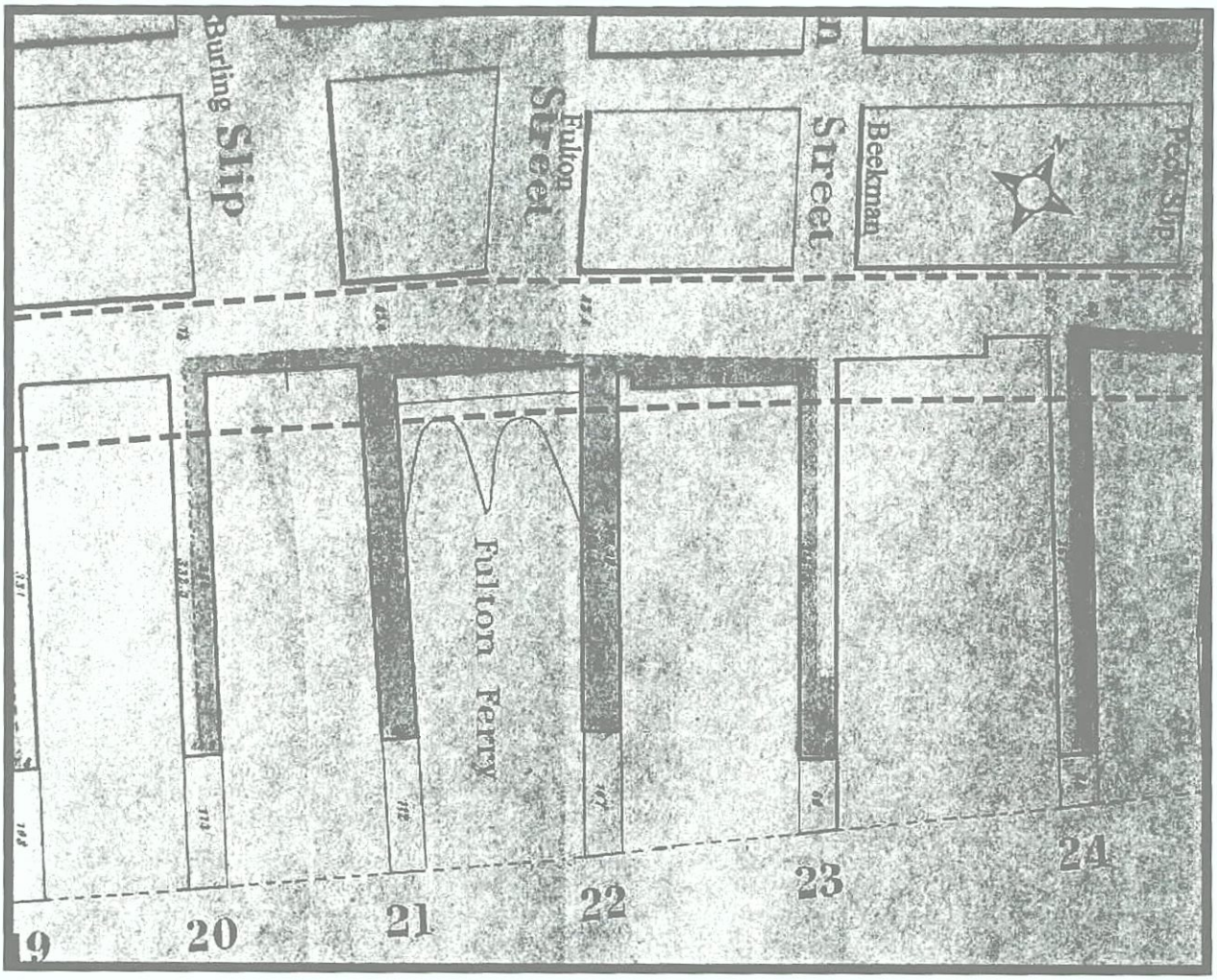
LEGEND

— — Area of Potential Effect

SOURCE: South Street Seaport Museum Library

EAST RIVER Waterfront Esplanade and Piers

FIGURE 22: Alvord, Maps of the Wharves and Piers of the East River, 1849 (Detail: Pine Street to Burling Slip)



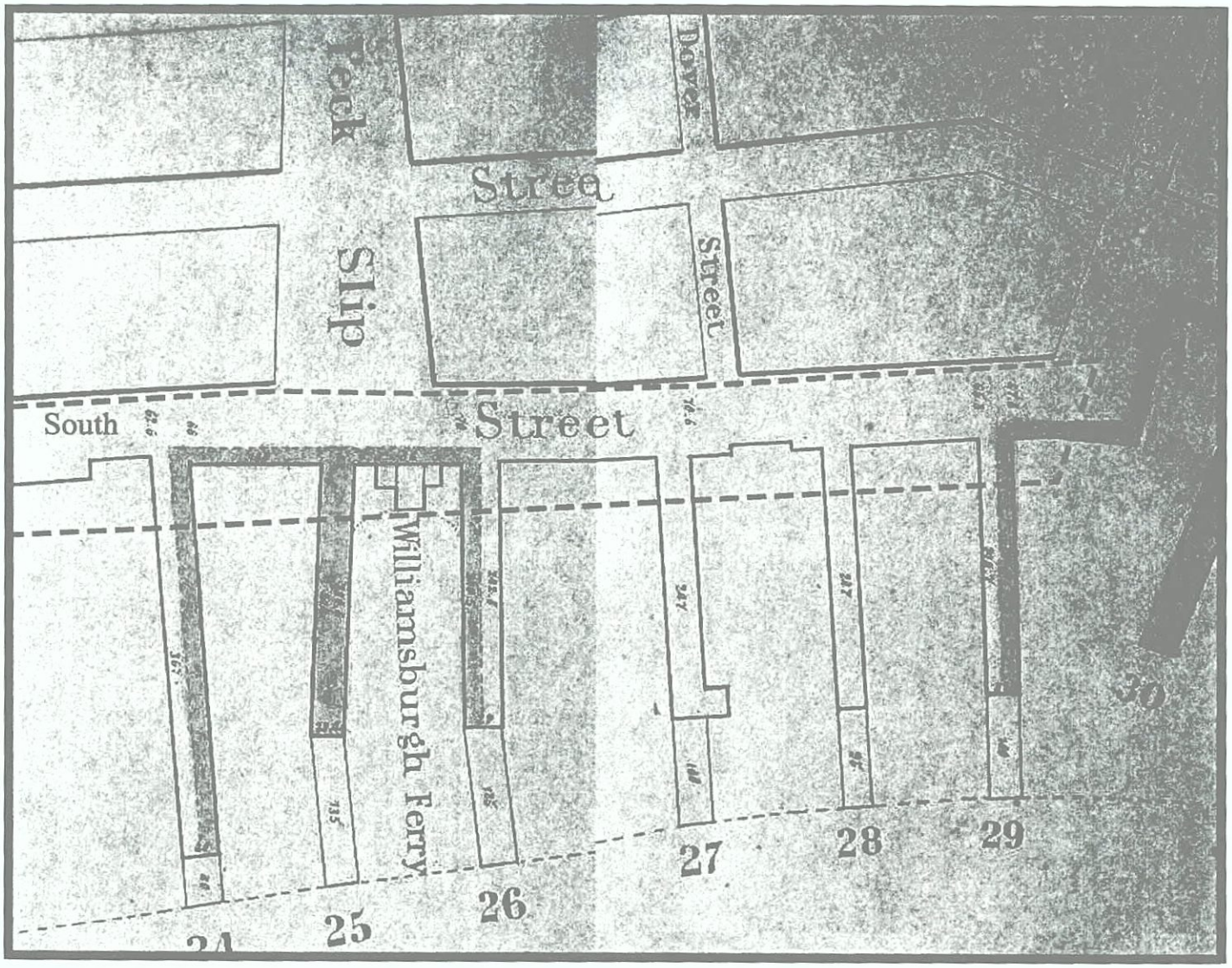
LEGEND

— — Area of Potential Effect

SOURCE: South Street Seaport Museum Library

EAST RIVER Waterfront Esplanade and Piers

FIGURE 23: Alvord, Maps of the Wharves and Piers of the East River, 1849 (Detail: Burling Slip to Peck Slip)



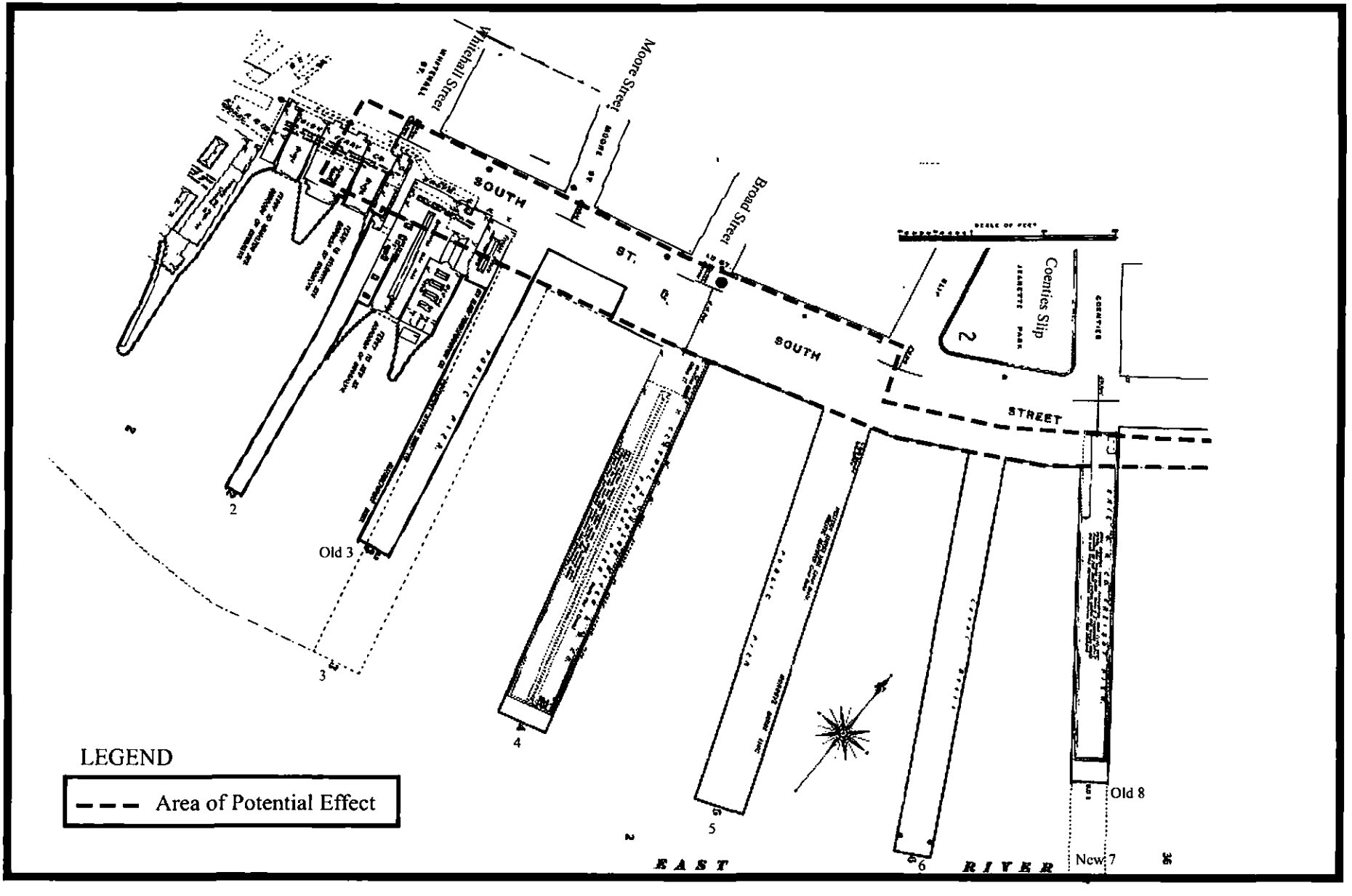
LEGEND

— — Area of Potential Effect

SOURCE: South Street Seaport Museum Library

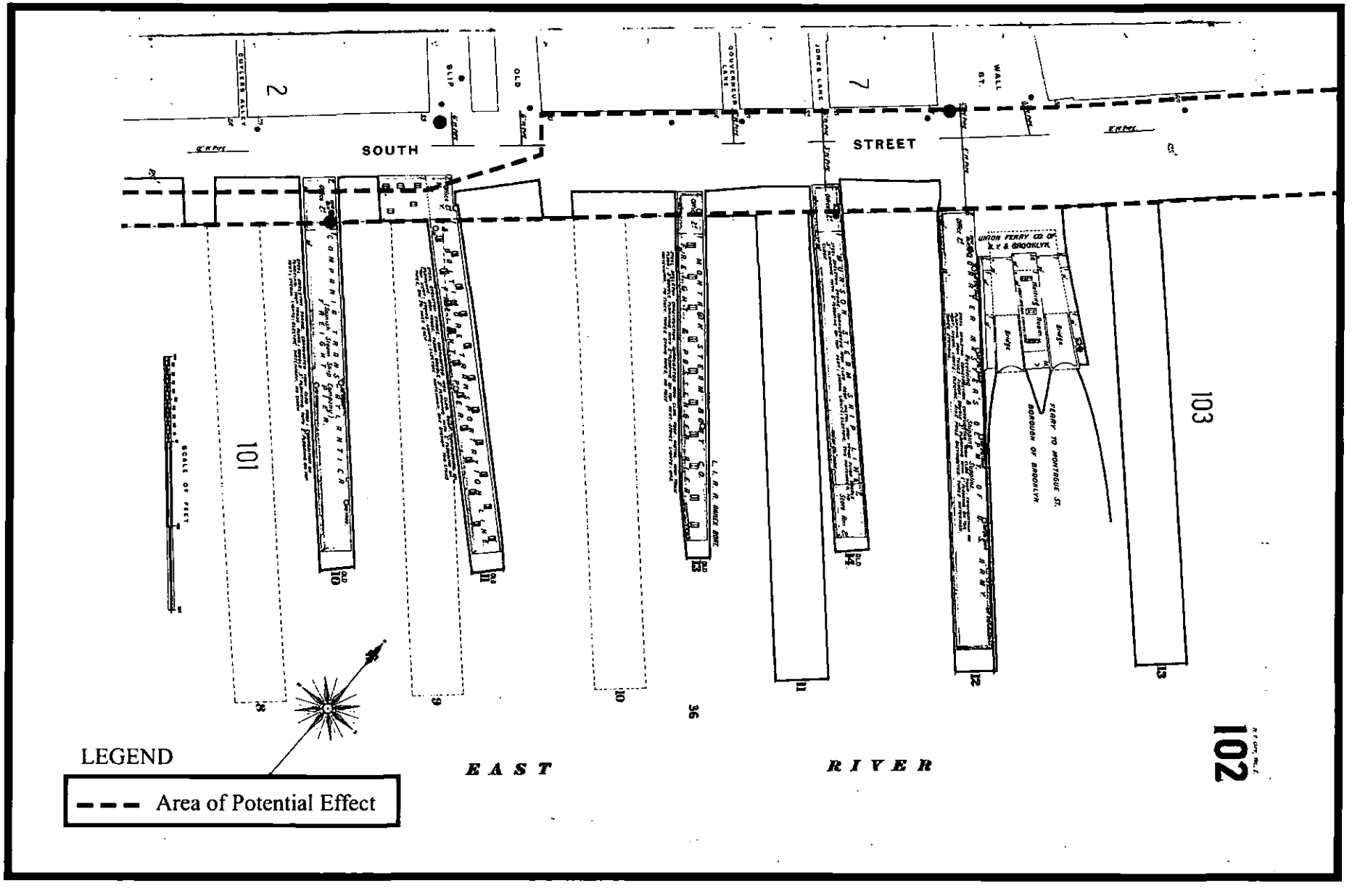
EAST RIVER Waterfront Esplanade and Piers

FIGURE 24: Alvord, Maps of the Wharves and Piers of the East River, 1849 (Detail: Peck Slip to Roosevelt Street)



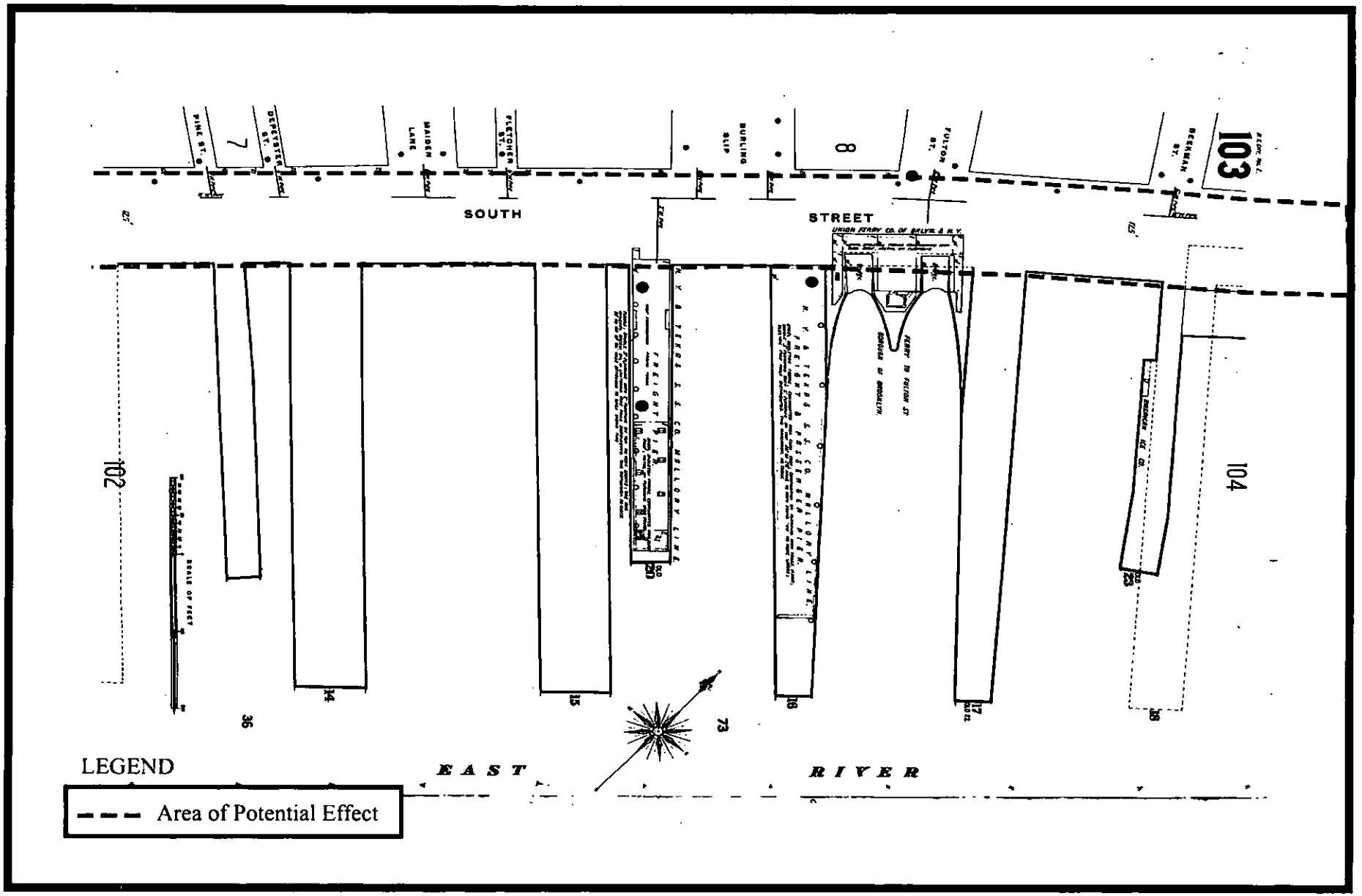
EAST RIVER Waterfront Esplanade and Piers

FIGURE 25: Sanborn, Atlas of the Borough of Manhattan, 1905
(Detail: Whitehall Street to Coenties Slip)



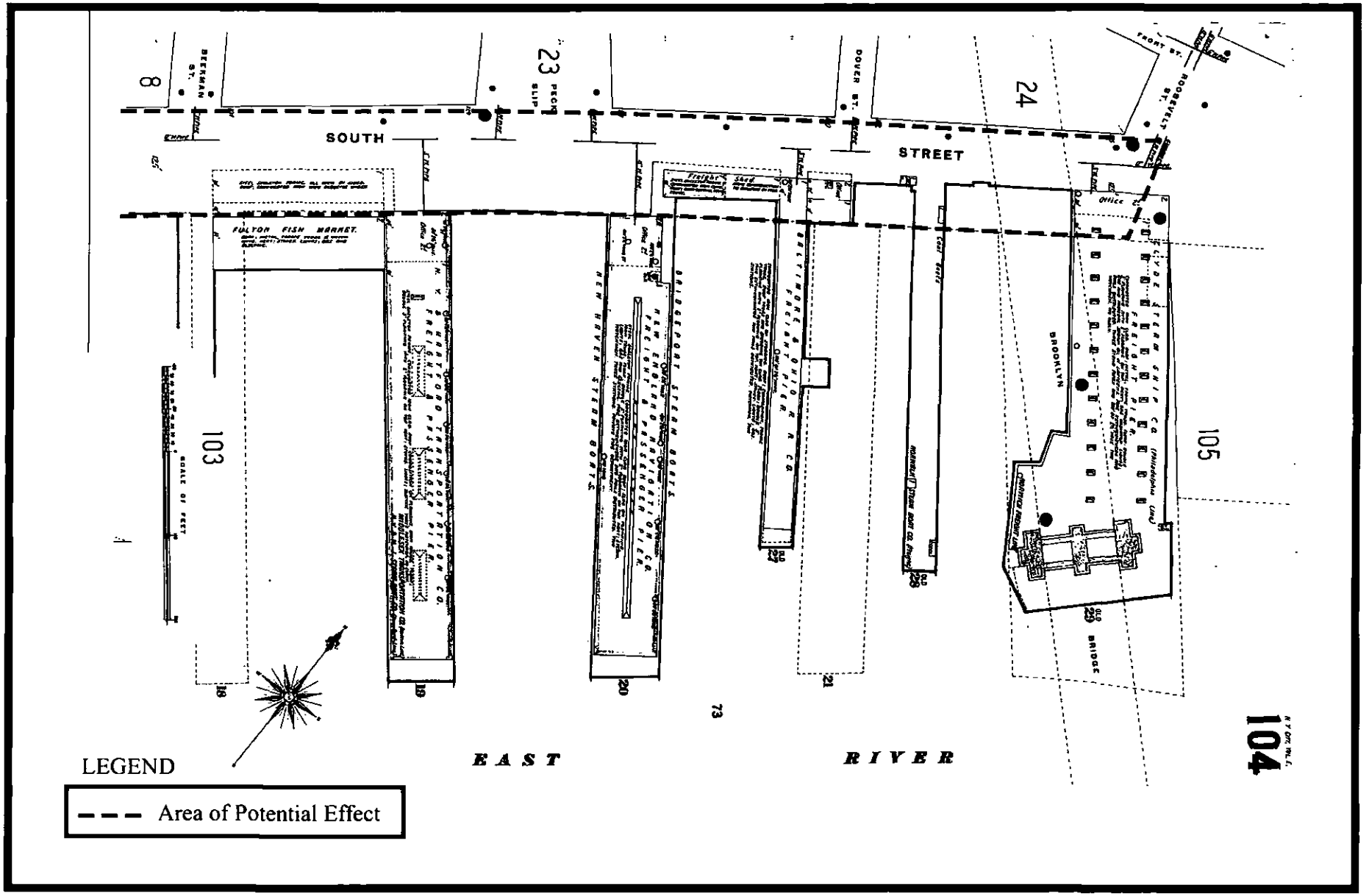
EAST RIVER Waterfront Esplanade and Piers

FIGURE 26: Sanborn, Atlas of the Borough of Manhattan, 1905
(Detail: Cuylers Alley to Wall Street)



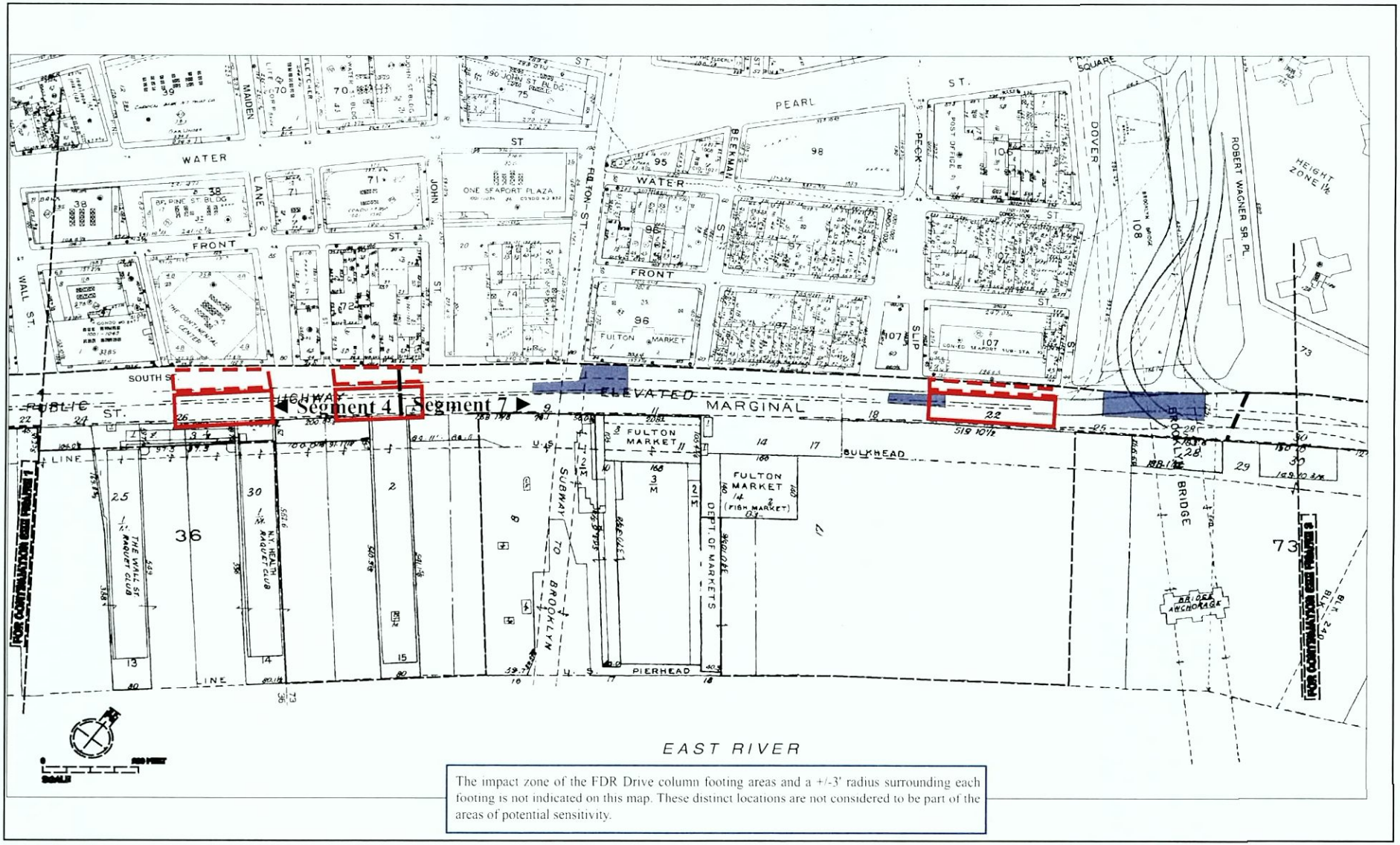
EAST RIVER Waterfront Esplanade and Piers

FIGURE 27: Sanborn, Atlas of the Borough of Manhattan, 1905
(Detail: Pine Street to Beekman Street)



EAST RIVER Waterfront Esplanade and Piers

FIGURE 28: Sanborn, Atlas of the Borough of Manhattan, 1905
(Detail: Beekman Street to Roosevelt Street)

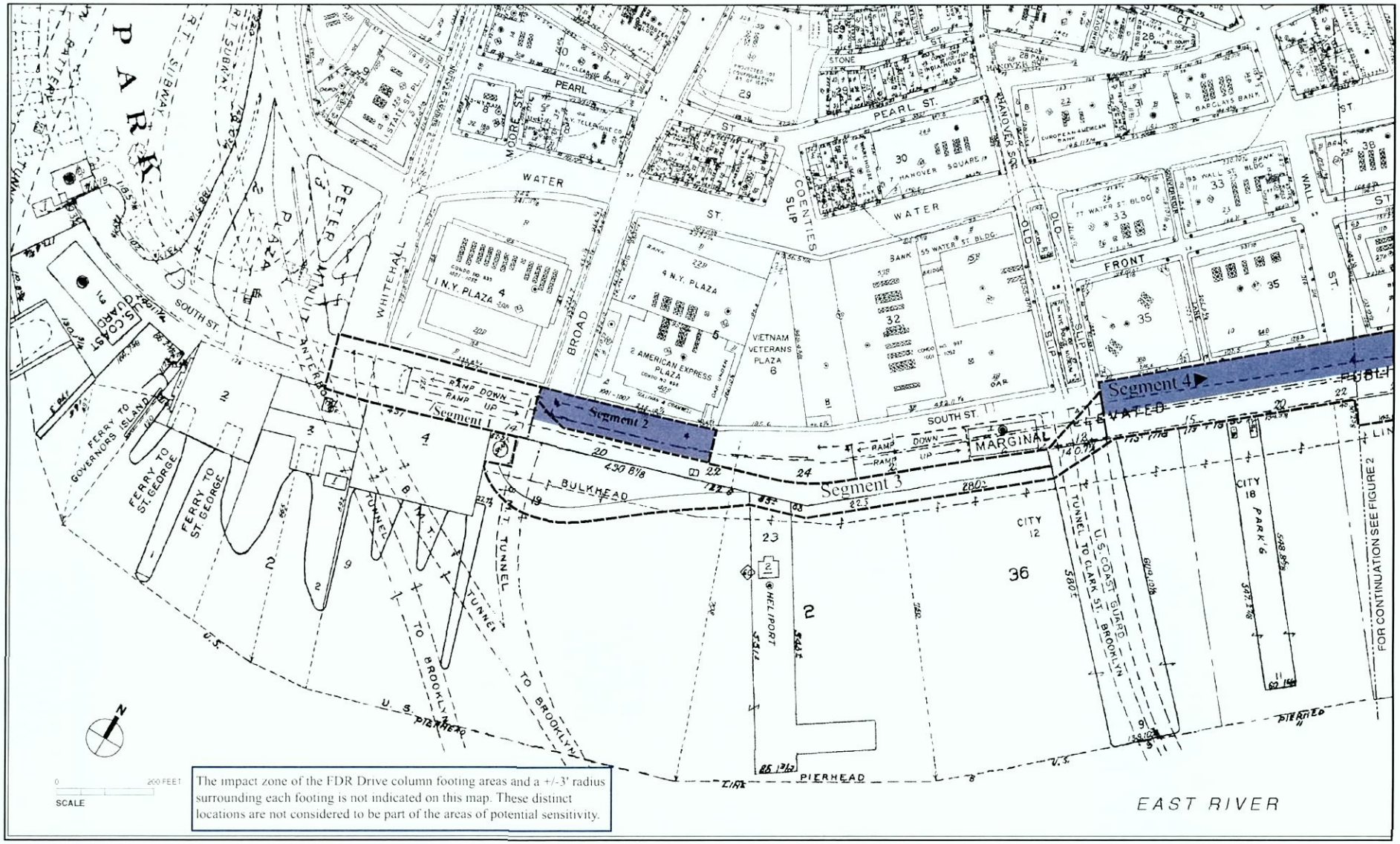


LEGEND

Area of Potential Effect | Areas of Potential Archaeological Sensitivity | Proposed Pavilion Location | Potential Pavilion Utility Connection Area

EAST RIVER Waterfront Esplanade and Piers

FIGURE 29: Areas of Potential Archaeological Sensitivity: Precontact Resources and Riverbottom Remains



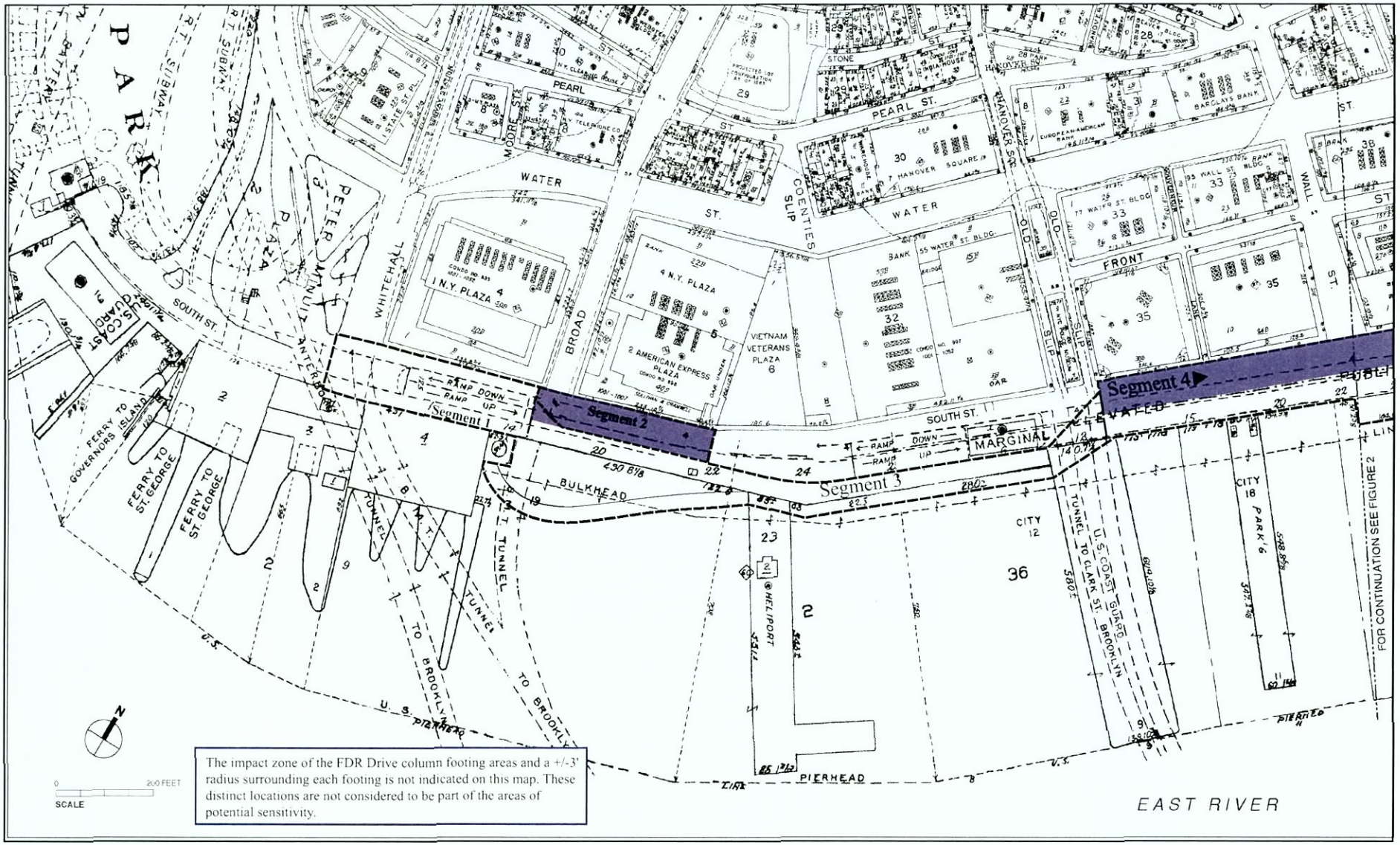
LEGEND

Area of Potential Effect

Areas of Potential Archaeological Sensitivity

EAST RIVER Waterfront Esplanade and Piers

FIGURE 30: Areas of Potential Archaeological Sensitivity: Sunken Vessels (Segments 2 and 3 only) and Wooden Water Mains (Segments 2, 3, and 4)



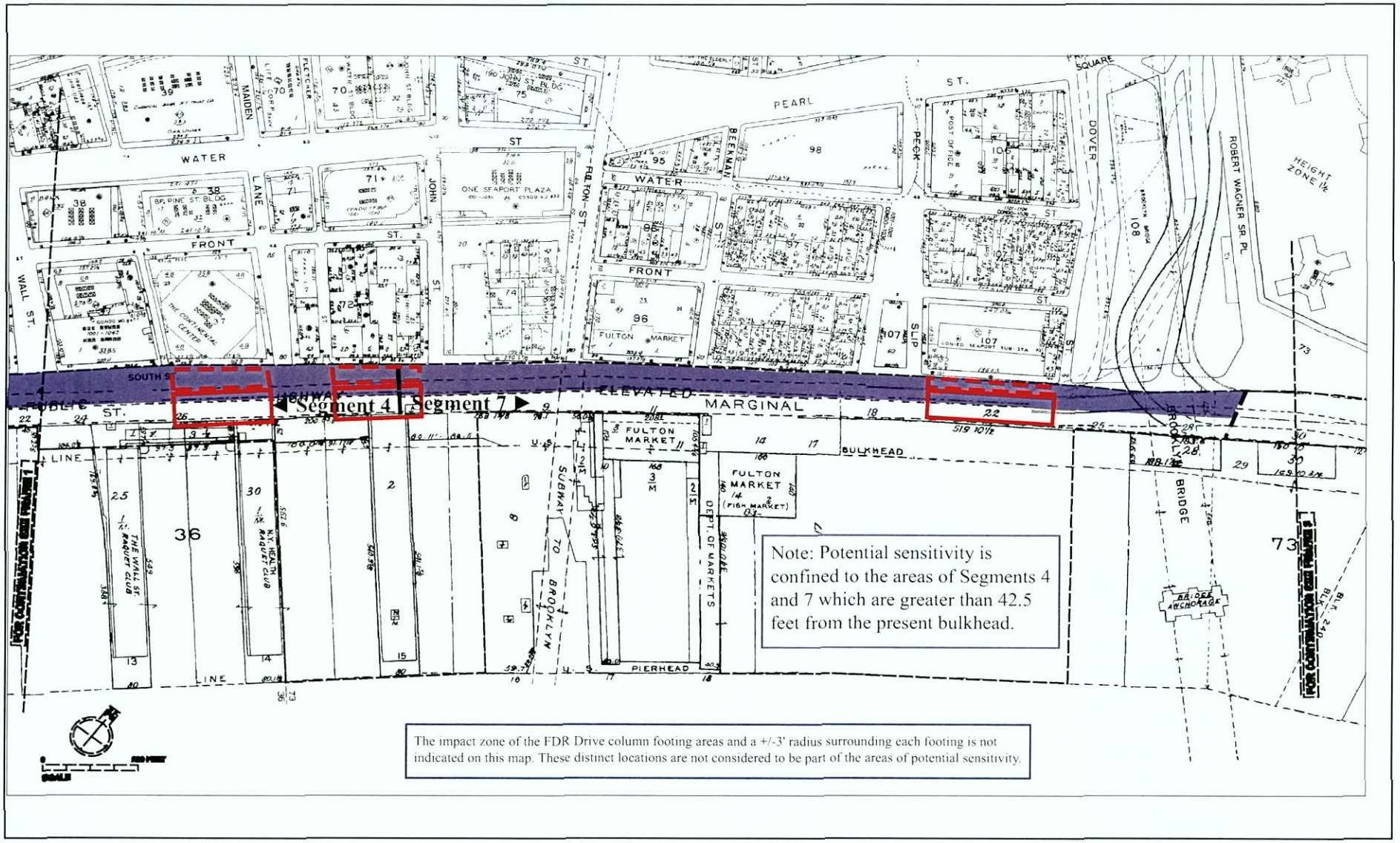
LEGEND

Area of Potential Effect

Areas of Potential Archaeological Sensitivity

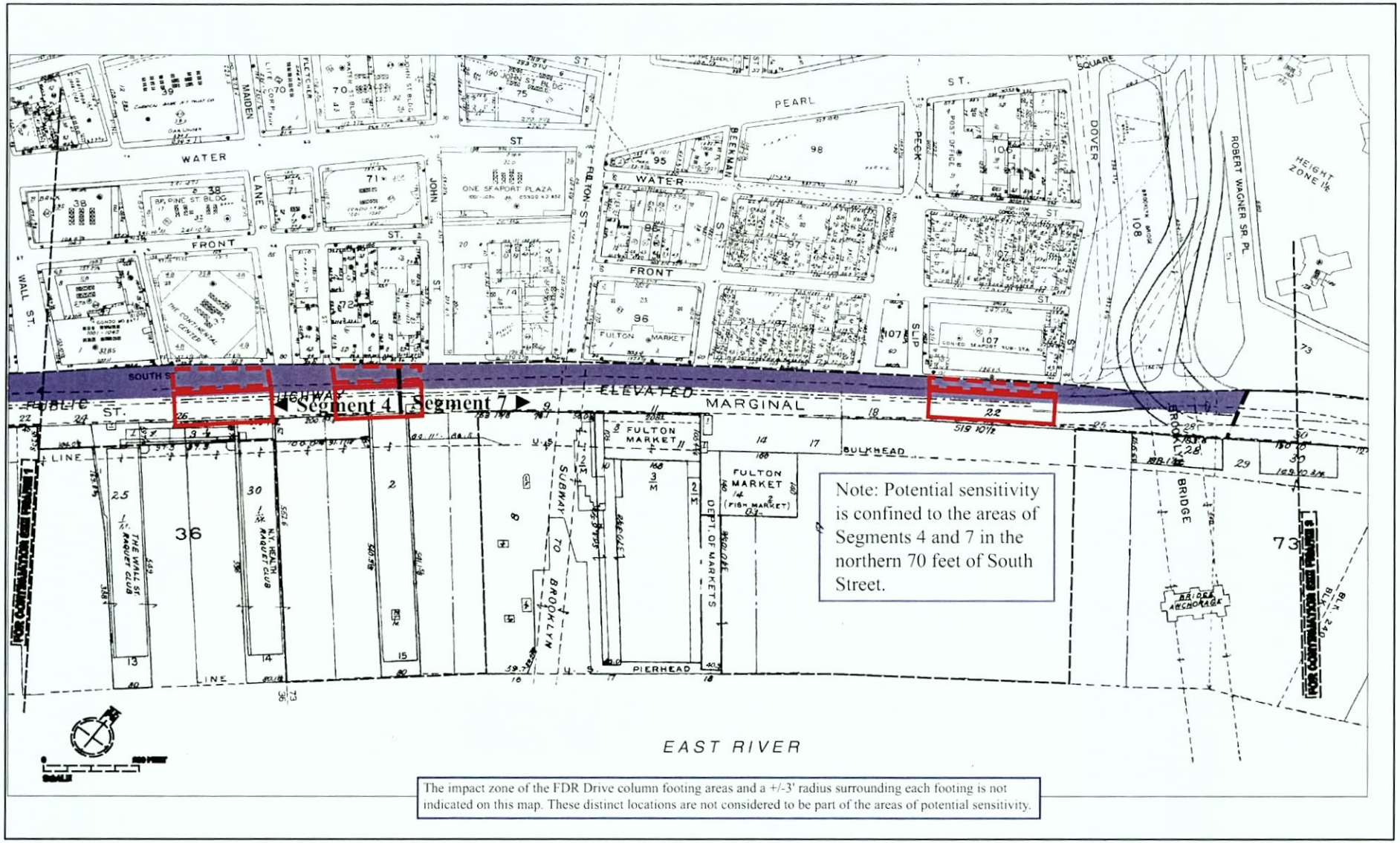
EAST RIVER Waterfront Esplanade and Piers

FIGURE 31: Areas of Potential Archaeological Sensitivity: Landfill Retaining Structures, Wharves, and Piers and Landfill Deposits (Segments 2, 3, and 4)



EAST RIVER Waterfront Esplanade and Piers

FIGURE 32: Areas of Potential Archaeological Sensitivity: Landfill Retaining Structures, Wharves, and Piers and Landfill Deposits (Segments 4 and 7)



LEGEND

Area of Potential Effect | Areas of Potential Archaeological Sensitivity | Proposed Pavilion Location | Potential Pavilion Utility Connection Area

EAST RIVER Waterfront Esplanade and Piers

FIGURE 33: Areas of Potential Archaeological Sensitivity: Wooden Water Mains (Segments 4 and 7)

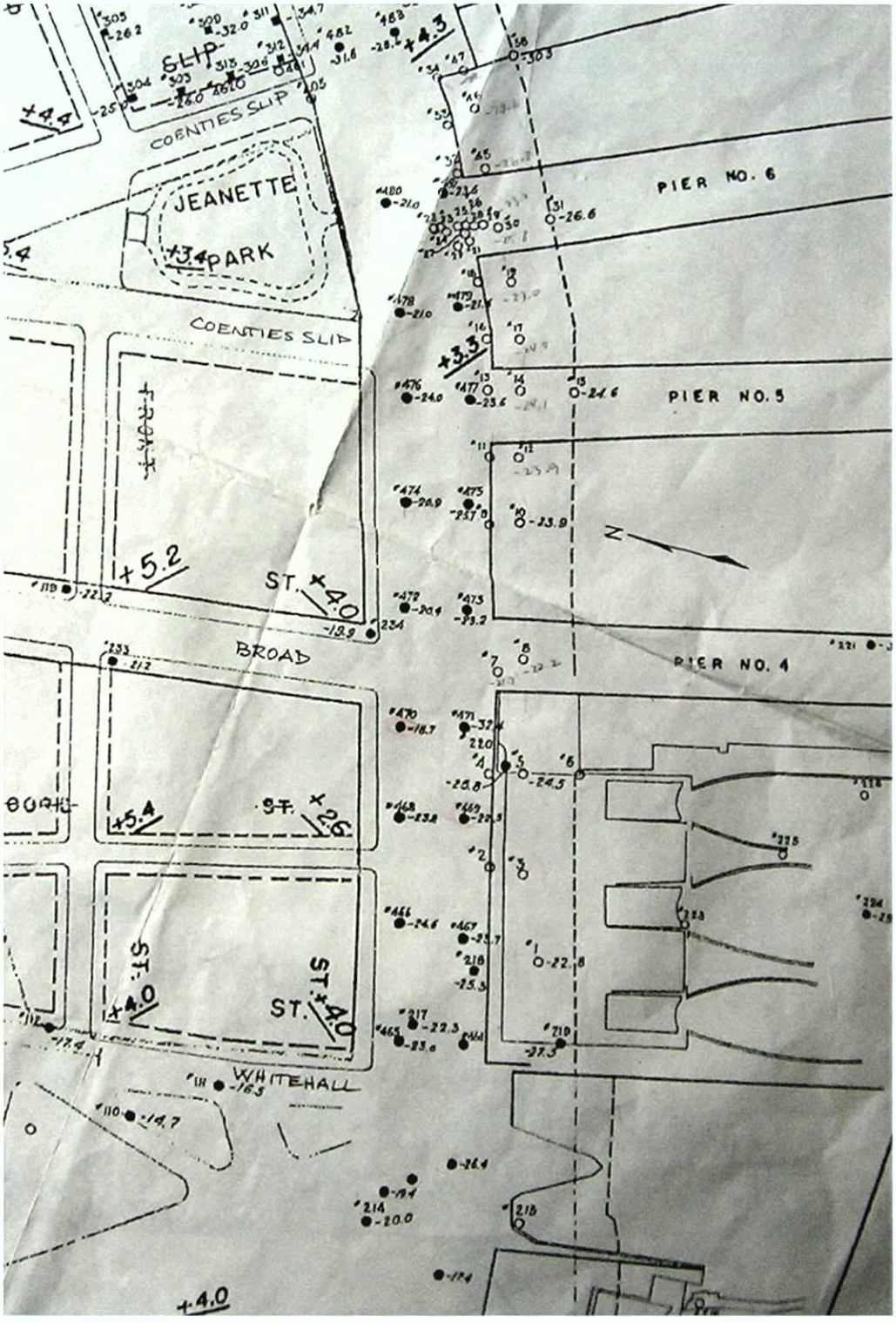
East River Waterfront Esplanade and Piers

Task 2 Phase 1A

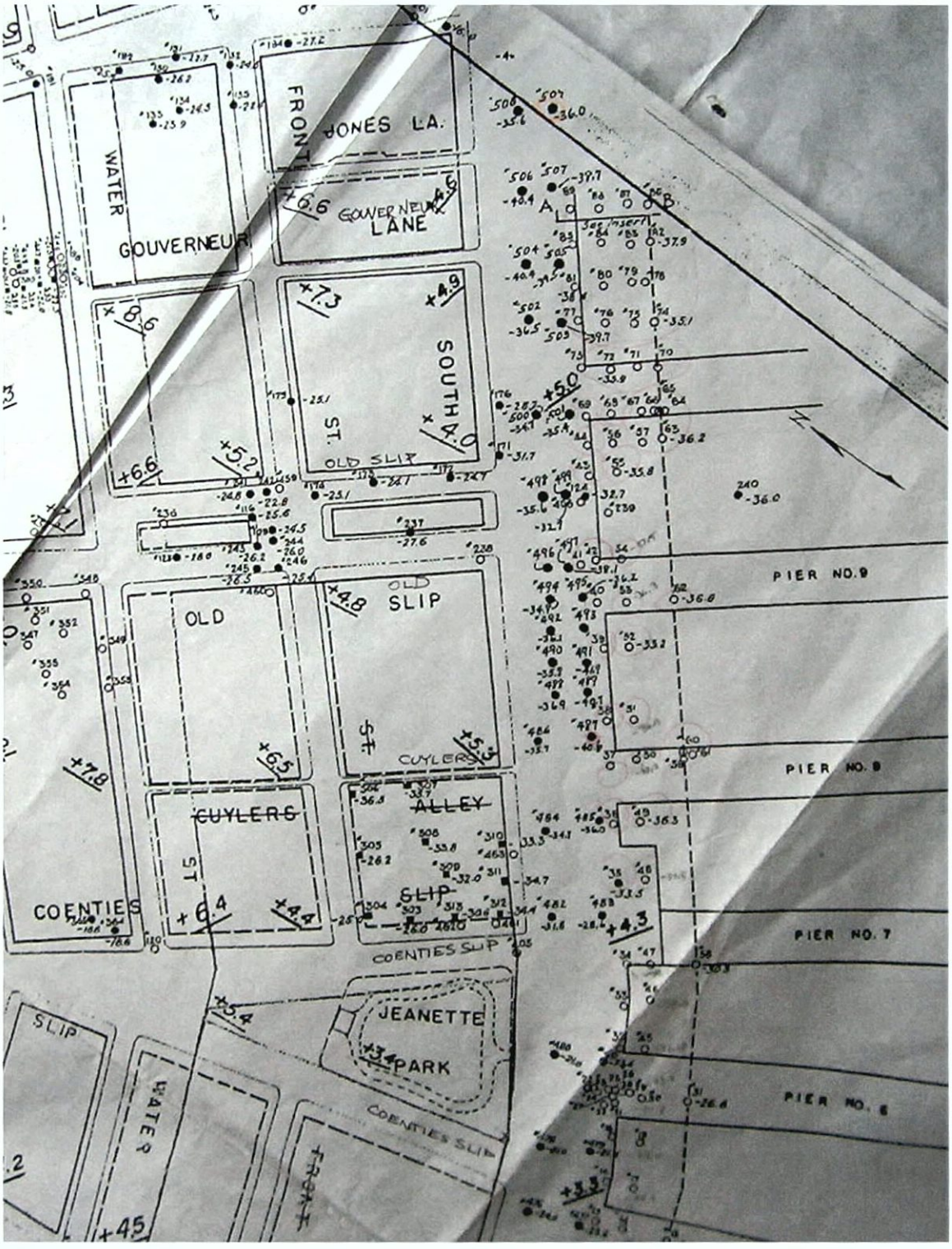
Whitehall Street to North of the Brooklyn Bridge

APPENDIX

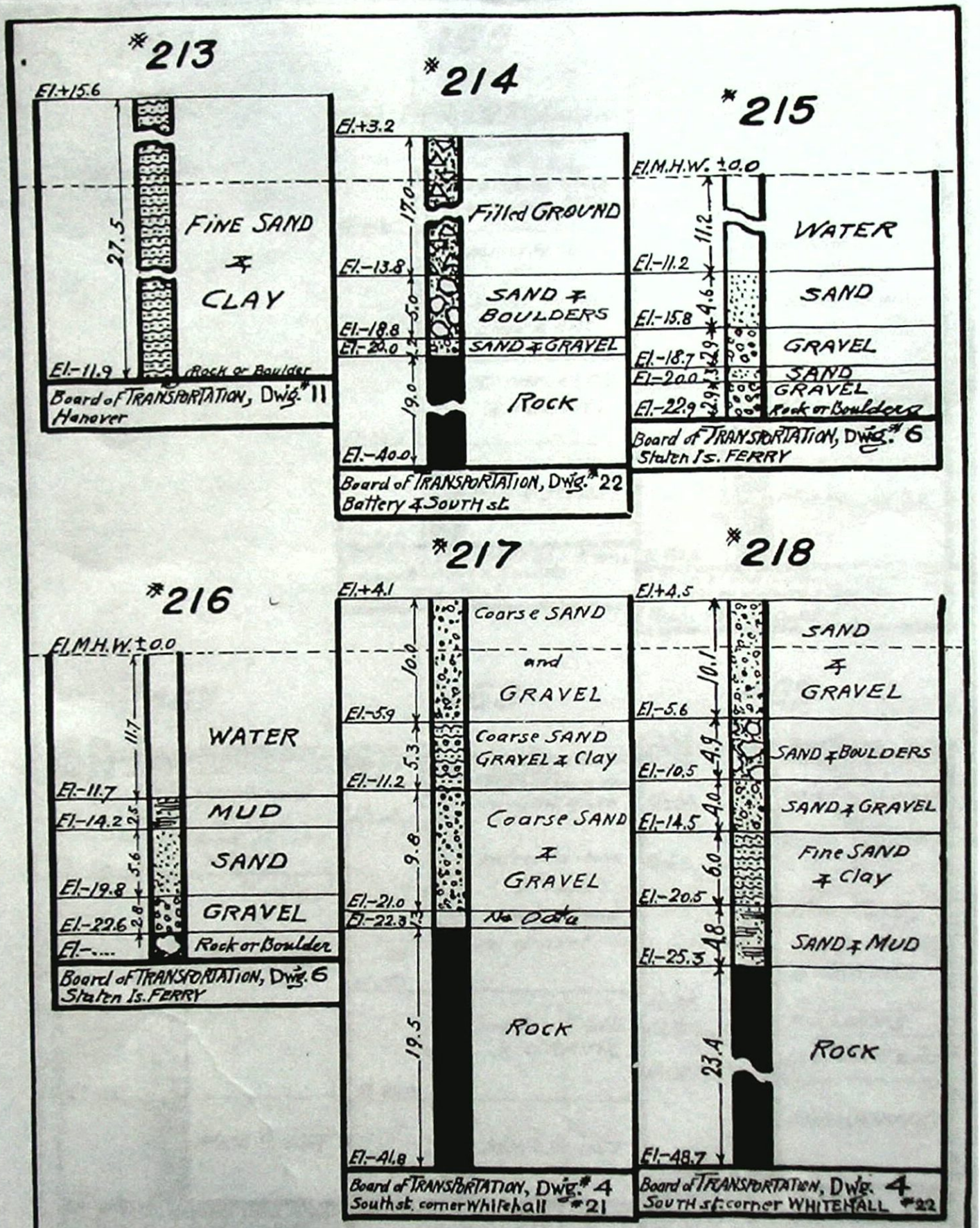
Soil Boring Logs
and
Locational Maps



WPA Rock Data – Map Sheet 1
(Volume 1, Sheet 1. Borough of Manhattan, Office of the President, 1937, revised)



WPA Rock Data – Map Sheet 2
(Volume 1, Sheet 1. Borough of Manhattan, Office of the President, 1937, revised)

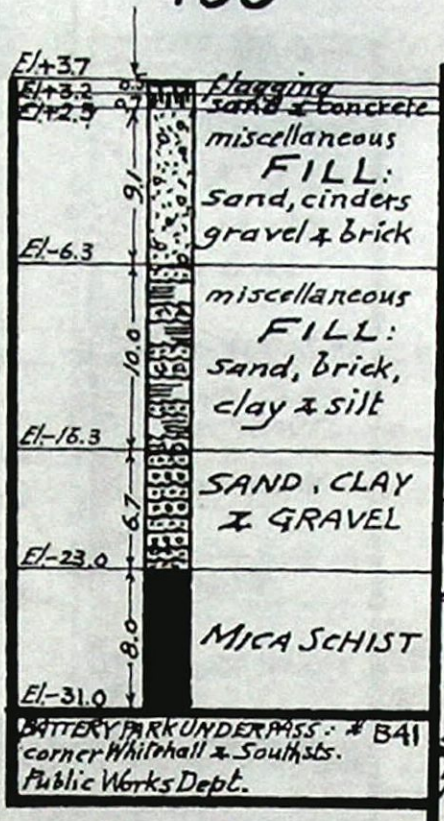


ROCK DATA VOL. 1, SHEET 1

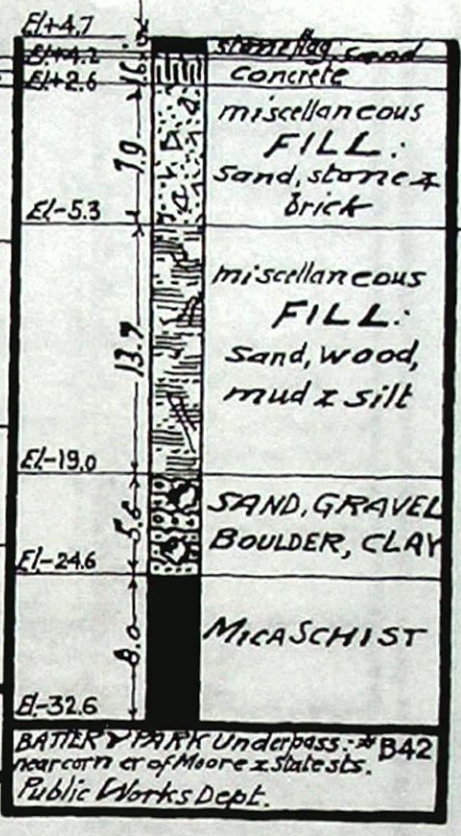
*464

*B40, no record

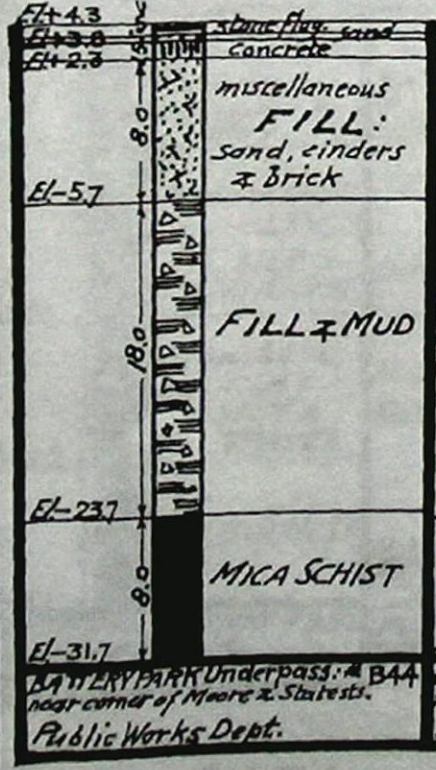
*465



*466



*467



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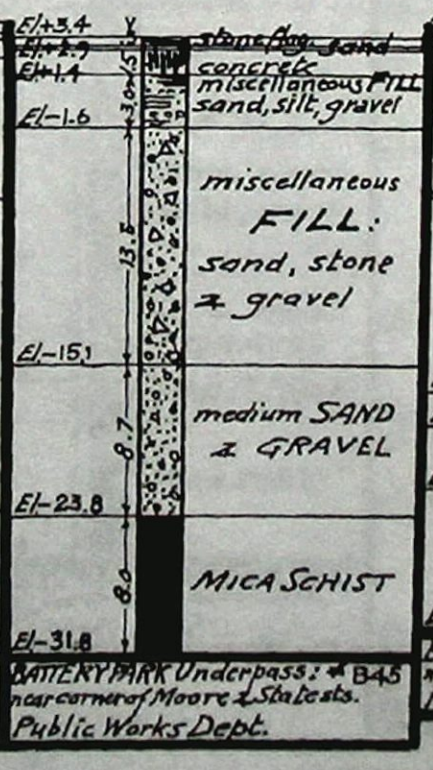
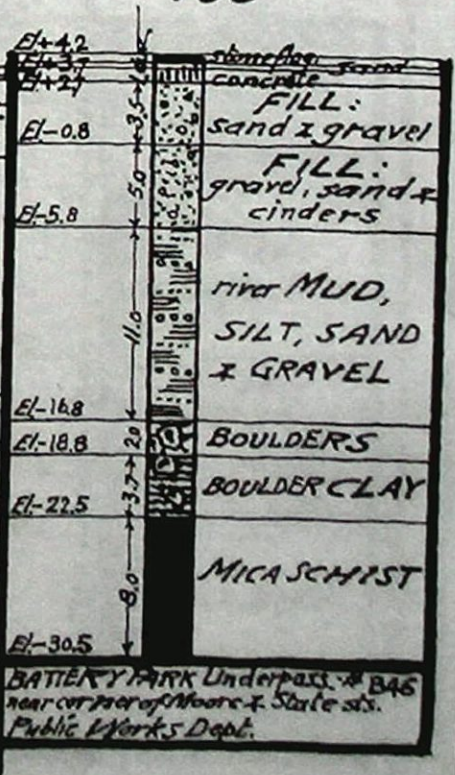
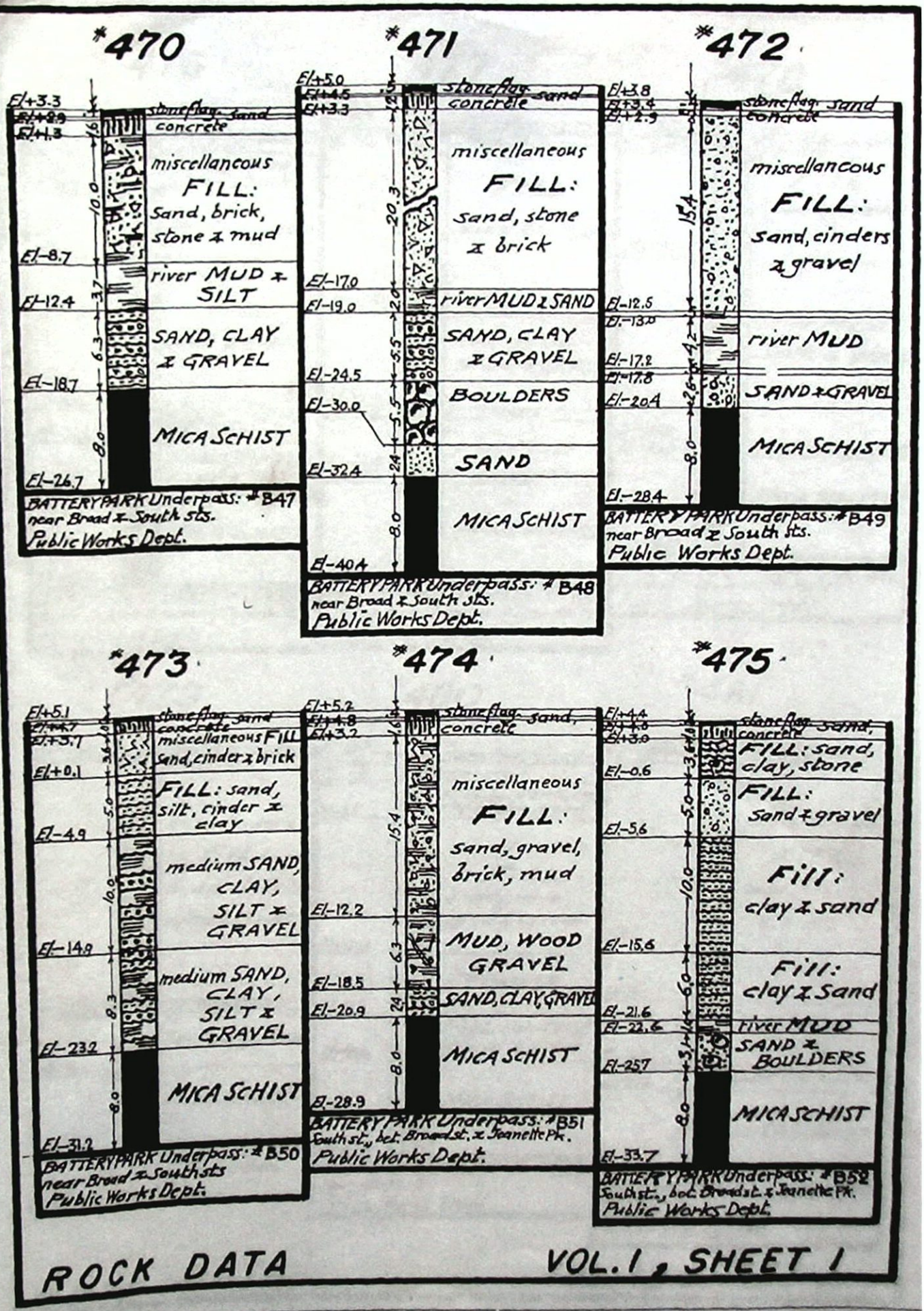


*469



ROCK DATA VOL. I, SHEET 1


*470
El+3.3
El+2.9
El+1.3
stoneflag sand concrete
miscellaneous FILL: sand, brick, stone & mud
El-8.7
river MUD & SILT
El-12.4
SAND, CLAY & GRAVEL
El-18.7
MICA SCHIST
El-26.7
BATTERY PARK Underpass: # B47 near Broad & South sts. Public Works Dept.
*471
El+5.0
El+4.5
El+3.3
stoneflag sand concrete
miscellaneous FILL: sand, stone & brick
El-17.0
river MUD & SAND
El-19.0
SAND, CLAY & GRAVEL
El-24.5
BOULDERS
El-30.0
SAND
El-32.4
MICA SCHIST
El-40.4
BATTERY PARK Underpass: # B48 near Broad & South sts. Public Works Dept.
*472
El+3.8
El+3.4
El+2.9
stoneflag sand concrete
miscellaneous FILL: sand, cinders & gravel
El-12.5
El-13.0
river MUD
El-17.2
El-17.8
SAND & GRAVEL
El-20.4
MICA SCHIST
El-28.4
BATTERY PARK Underpass: # B49 near Broad & South sts. Public Works Dept.
*473
El+5.1
El+4.7
El+3.7
stoneflag sand concrete
miscellaneous FILL sand, cinder & brick
El+0.1
FILL: sand, silt, cinder & clay
El-4.9
medium SAND, CLAY, SILT & GRAVEL
El-14.9
medium SAND, CLAY, SILT & GRAVEL
El-23.2
MICA SCHIST
El-31.2
BATTERY PARK Underpass: # B50 near Broad & South sts Public Works Dept.
*474
El+5.2
El+4.8
El+3.2
stoneflag sand, concrete
miscellaneous FILL: sand, gravel, brick, mud
El-12.2
MUD, WOOD GRAVEL
El-18.5
SAND, CLAY, GRAVEL
El-20.9
MICA SCHIST
El-28.9
BATTERY PARK Underpass: # B51 South st., bet. Broad st. & Jeanette Pk. Public Works Dept.
*475
El+4.4
El+3.8
El+3.0
stoneflag sand, concrete
FILL: sand, clay, stone
El-0.6
FILL: sand & gravel
El-5.6
Fill: clay & sand
El-15.6
Fill: clay & Sand
El-21.6
El-22.6
river MUD
SAND & BOULDERS
El-25.7
MICA SCHIST
El-33.7
BATTERY PARK Underpass: # B52 South st., bet. Broad st. & Jeanette Pk. Public Works Dept.
ROCK DATA
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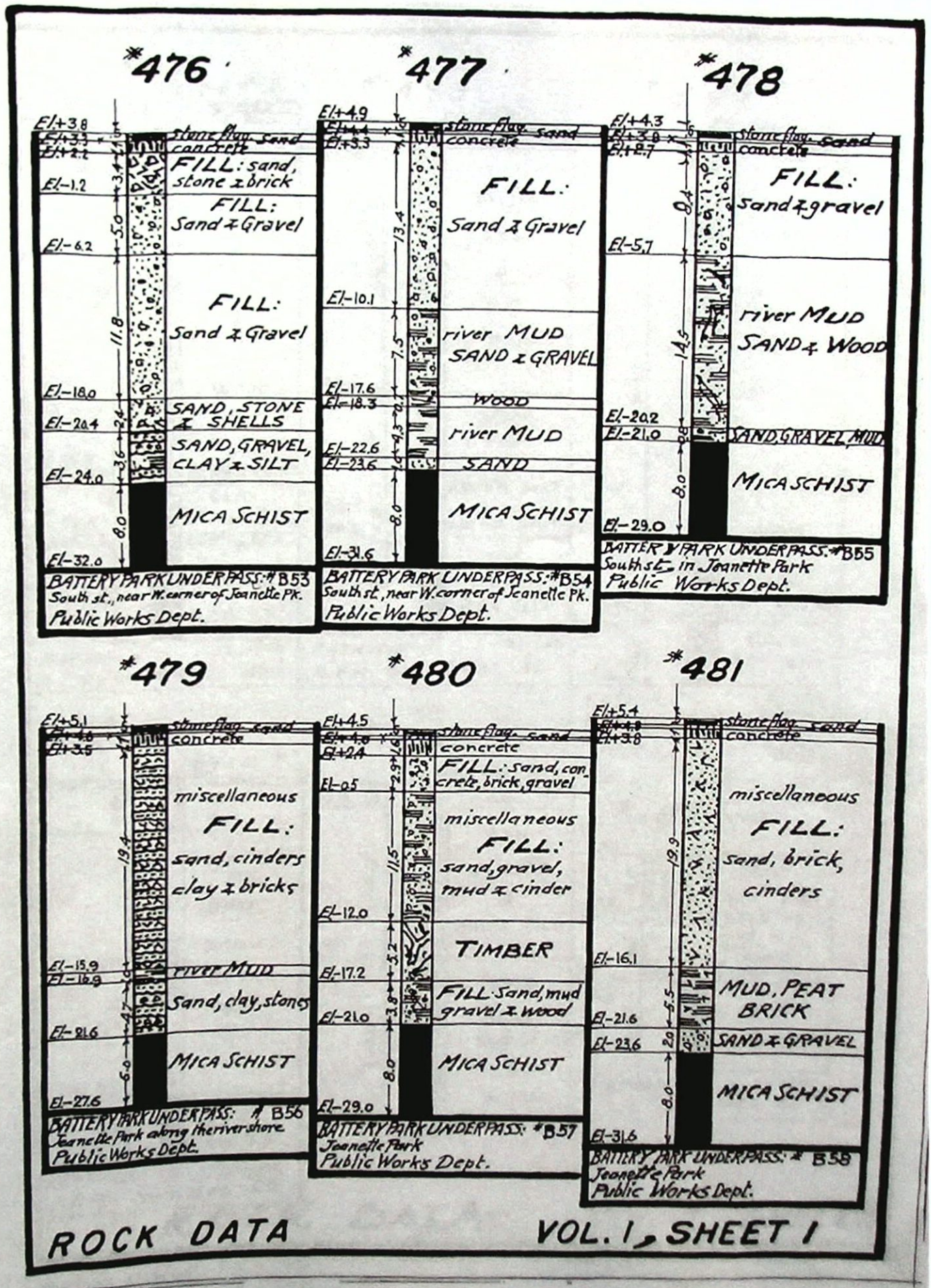
*476
El+3.8
El+3.3
El+2.2
Stone flag. Sand concrete
FILL: sand, stone & brick
3.4
El-1.2
FILL: Sand & Gravel
5.0
El-6.2
FILL: Sand & Gravel
11.8
El-18.0
SAND, STONE & SHELLS
2.4
El-20.4
SAND, GRAVEL, CLAY & SILT
3.6
El-24.0
MICA SCHIST
8.0
El-32.0
BATTERY PARK UNDERPASS: # B53
South st., near W. corner of Jeanette Pk.
Public Works Dept.
*477
El+4.9
El+4.4
El+3.3
Stone flag. Sand concrete
FILL: Sand & Gravel
1.6
13.4
El-10.1
river MUD SAND & GRAVEL
7.5
El-17.6
WOOD
0.1
El-18.3
river MUD
4.3
El-22.6
SAND
1.4
El-23.6
MICA SCHIST
8.0
El-31.6
BATTERY PARK UNDERPASS: #B54
South st., near W. corner of Jeanette Pk.
Public Works Dept.
*478
El+4.3
El+3.8
El+2.7
Stone flag. Sand concrete
FILL: sand & gravel
1.6
1.0
0.4
El-5.7
river MUD SAND & WOOD
14.5
El-20.2
SAND, GRAVEL, MUD
0.8
El-21.0
MICA SCHIST
8.0
El-29.0
BATTERY PARK UNDERPASS: #B55
South st. in Jeanette Park
Public Works Dept.
*479
El+5.1
El+4.6
El+3.5
Stone flag. Sand concrete
miscellaneous FILL: sand, cinders clay & bricks
1.1
19.4
El-15.9
river MUD
1.0
El-16.9
Sand, clay, stones
4.7
El-21.6
MICA SCHIST
6.0
El-27.6
BATTERY PARK UNDERPASS: # B56
Jeanette Park along the river shore.
Public Works Dept.
*480
El+4.5
El+4.0
El+2.4
Stone flag. Sand concrete
FILL: sand, concrete, brick, gravel
1.4
2.9
El-0.5
miscellaneous FILL: sand, gravel, mud & cinder
3.3
11.5
El-12.0
TIMBER
5.2
El-17.2
FILL Sand, mud gravel & wood
3.8
El-21.0
MICA SCHIST
8.0
El-29.0
BATTERY PARK UNDERPASS: #B57
Jeanette Park
Public Works Dept.
*481
El+5.4
El+4.8
El+3.8
Stone flag. Sand concrete
miscellaneous FILL: sand, brick, cinders
1.6
19.9
El-16.1
MUD, PEAT BRICK
5.5
El-21.6
SAND & GRAVEL
2.0
El-23.6
MICA SCHIST
8.0
El-31.6
BATTERY PARK UNDERPASS: # B58
Jeanette Park
Public Works Dept.
ROCK DATA
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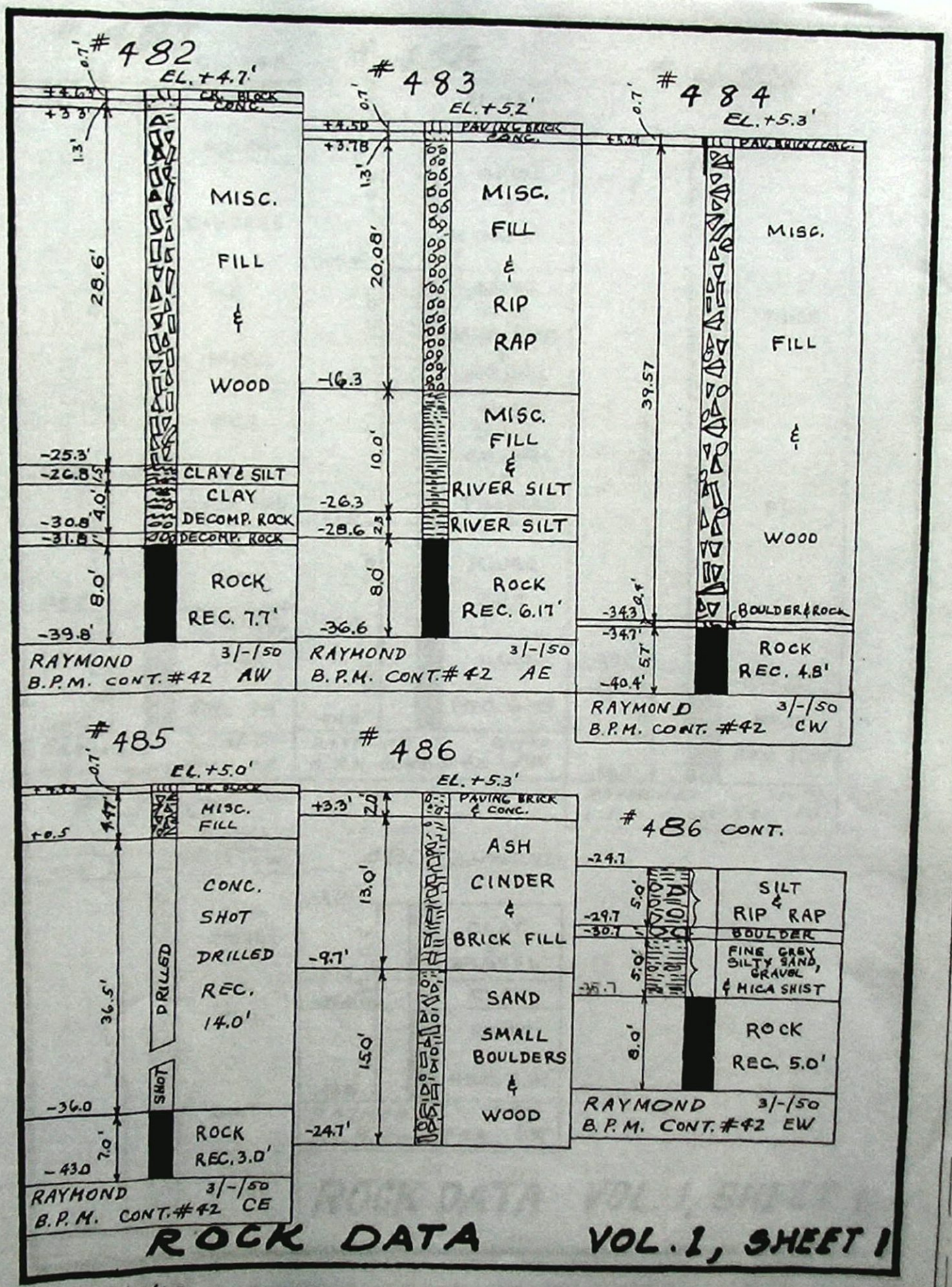
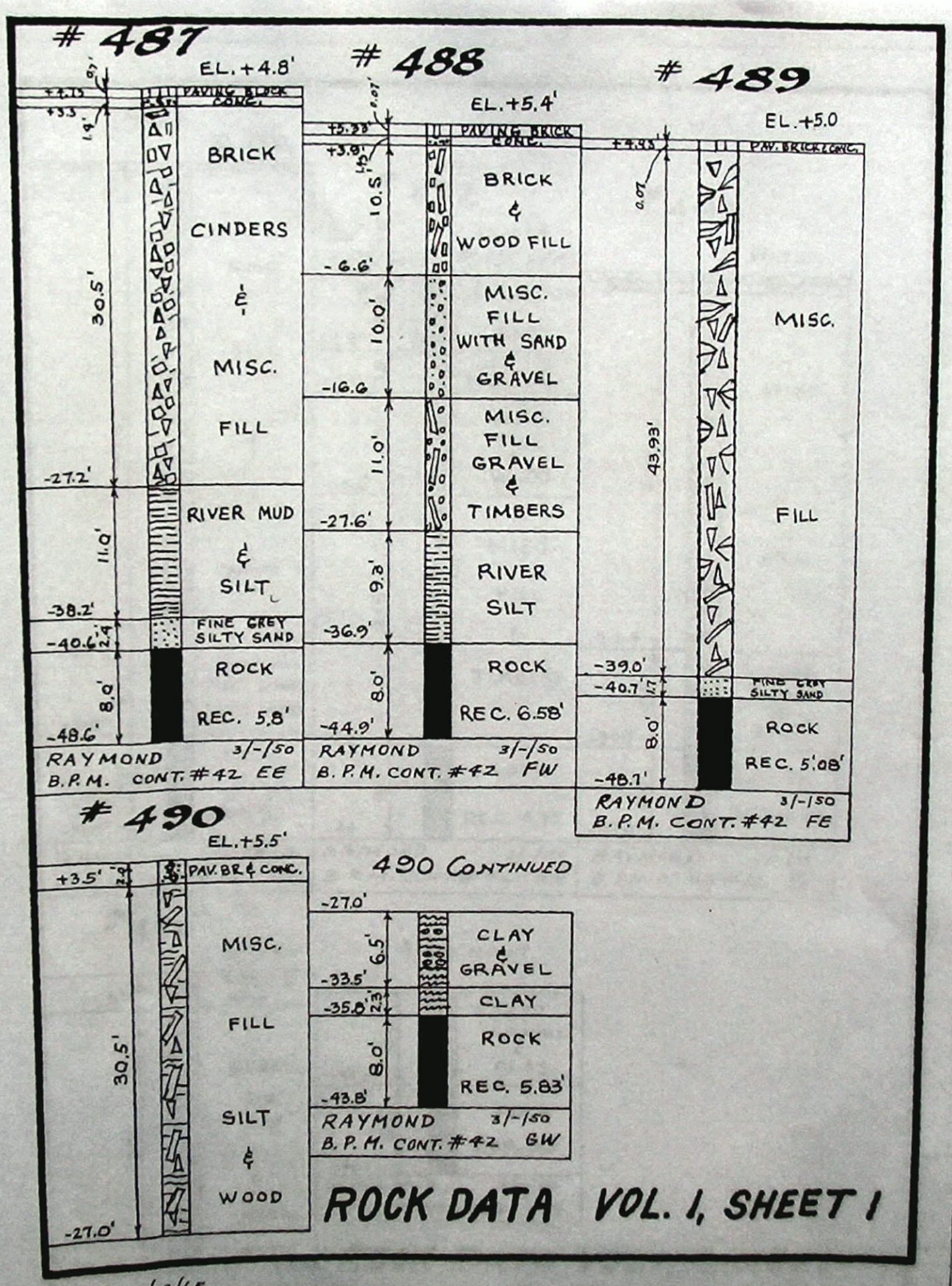
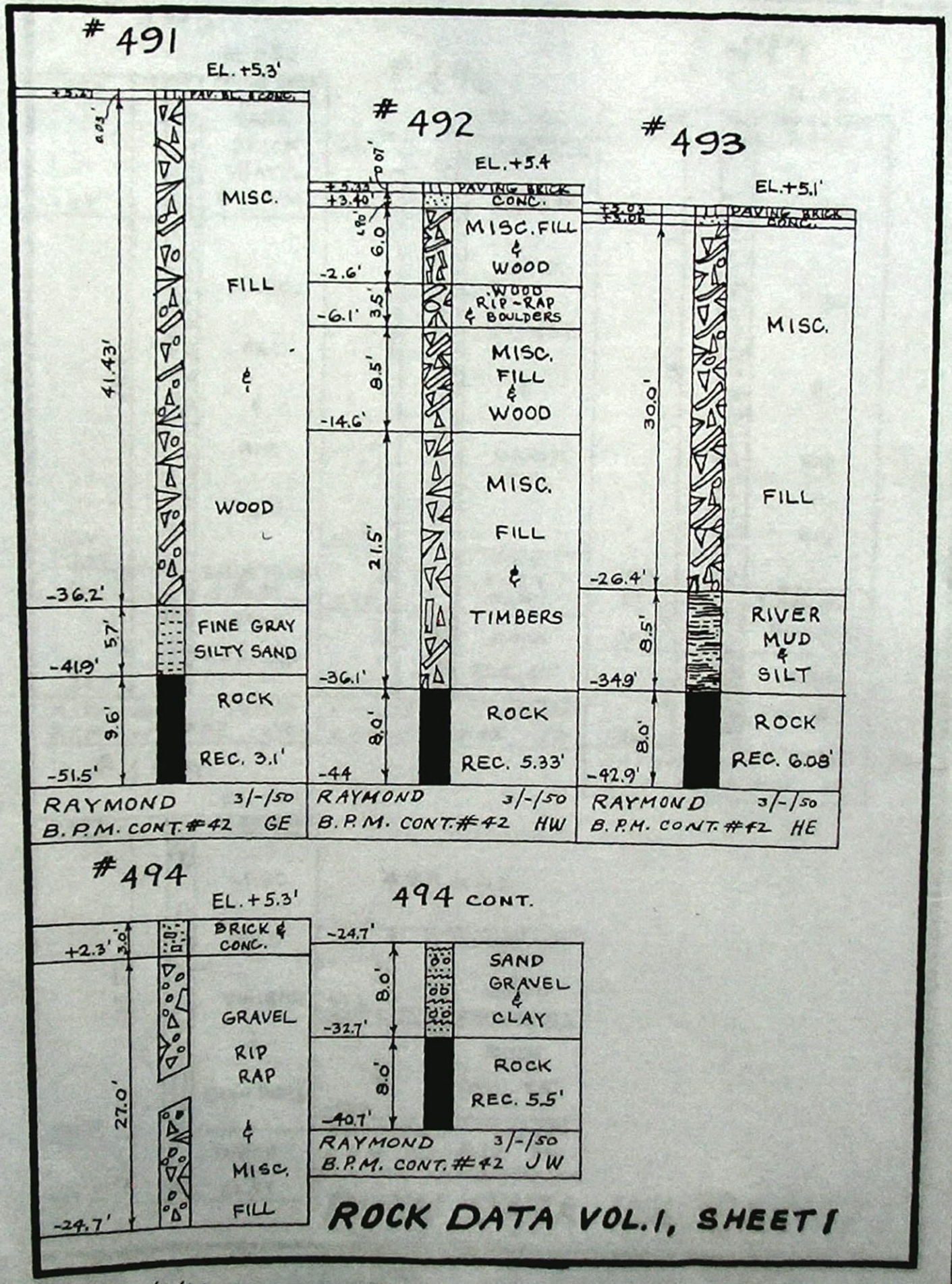


ROCK DATA VOL. 1, SHEET 1

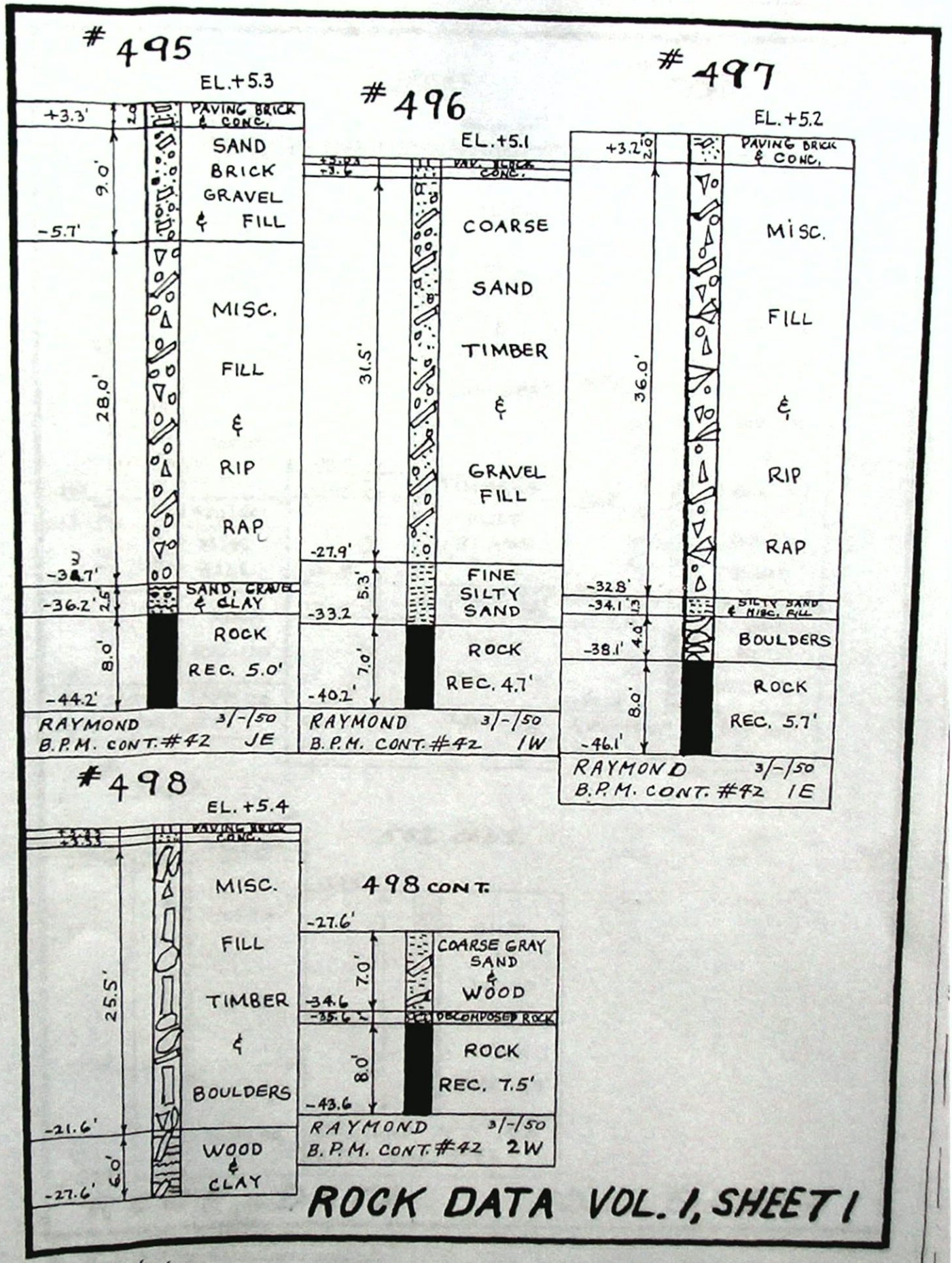
Martins 1/29/65.

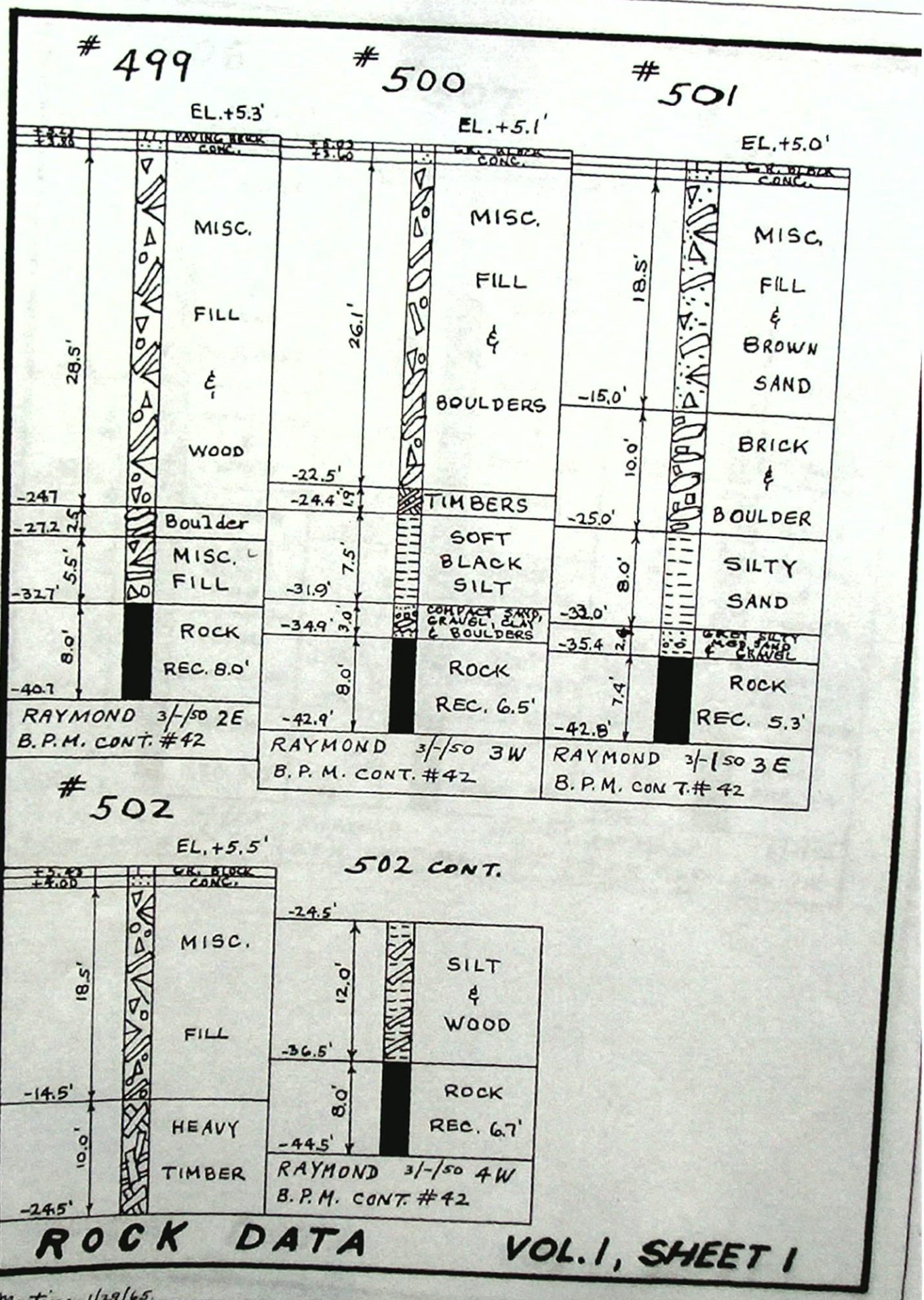


Martins 1/29/65.

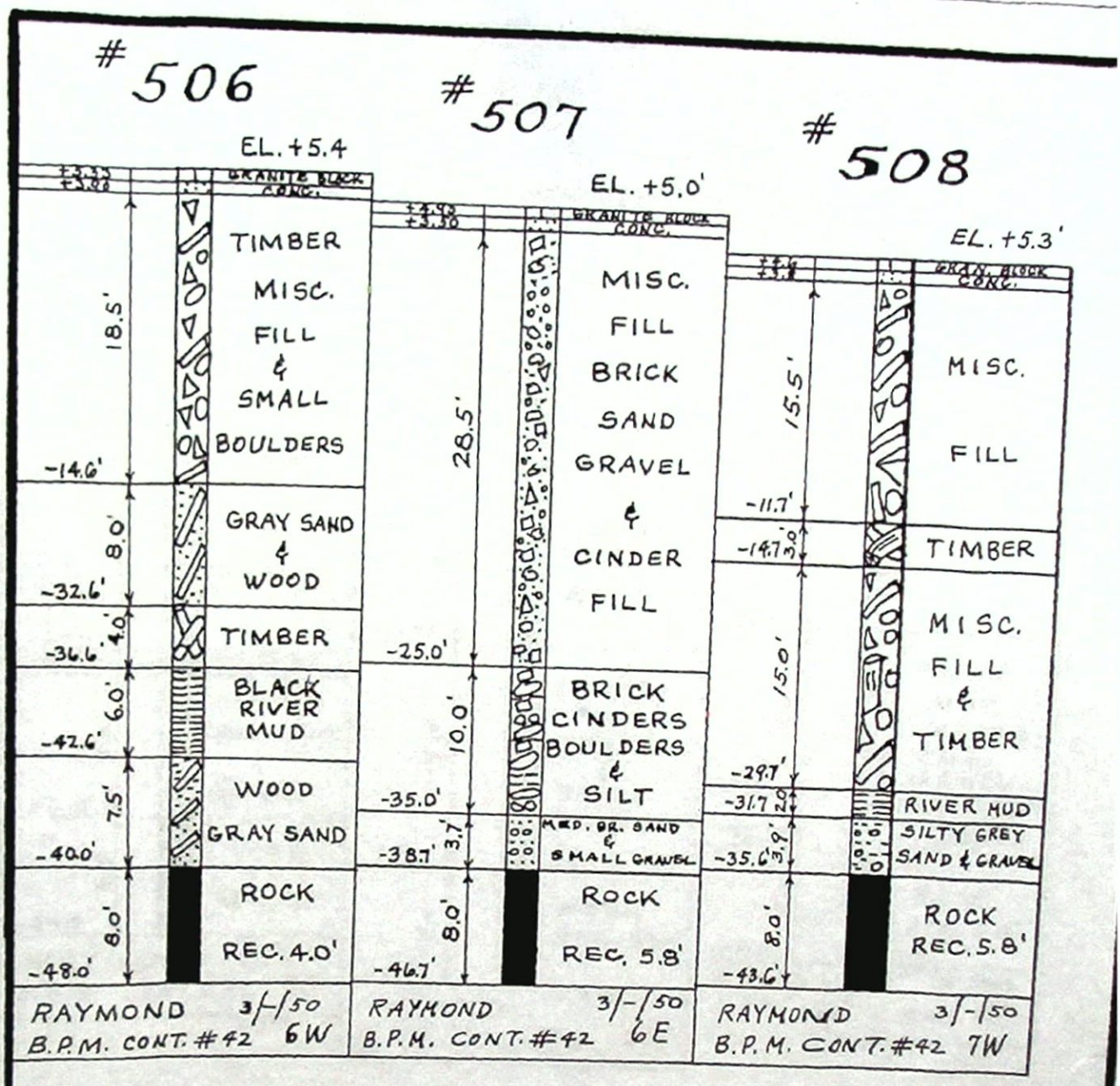


Martins 1/29/65


#495
EL.+5.3
+3.3'
2.0
PAVING BRICK & CONC.
9.0'
SAND BRICK GRAVEL & FILL
-5.7'
28.0'
MISC. FILL & RIP RAP
-33.7'
-36.2'
2.5
SAND, GRAVEL & CLAY
8.0'
ROCK REC. 5.0'
-44.2'
RAYMOND 3/-/50
B.P.M. CONT. #42 JE
#496
EL.+5.1
+3.6
PAV. BRICK CONC.
31.5'
COARSE SAND TIMBER & GRAVEL FILL
-27.9'
5.3'
FINE SILTY SAND
-33.2
7.0'
ROCK REC. 4.7'
-40.2'
RAYMOND 3/-/50
B.P.M. CONT. #42 IW
#497
EL.+5.2
+3.2'
2.0
PAVING BRICK & CONC.
36.0'
MISC. FILL & RIP RAP
-32.8'
-34.1'
1.3
SILTY SAND & MISC. FILL
4.0'
BOULDERS
-38.1'
8.0'
ROCK REC. 5.7'
-46.1'
RAYMOND 3/-/50
B.P.M. CONT. #42 IE
#498
EL.+5.4
PAVING BRICK CONC.
25.5'
MISC. FILL TIMBER & BOULDERS
-21.6'
6.0'
WOOD & CLAY
-27.6'
498 CONT.
-27.6'
7.0'
COARSE GRAY SAND & WOOD
-34.6
-35.6'
DECOMPOSED ROCK
8.0'
ROCK REC. 7.5'
-43.6
RAYMOND 3/-/50
B.P.M. CONT. #42 2W
ROCK DATA VOL. 1, SHEET 1
Martins 1/29/65.

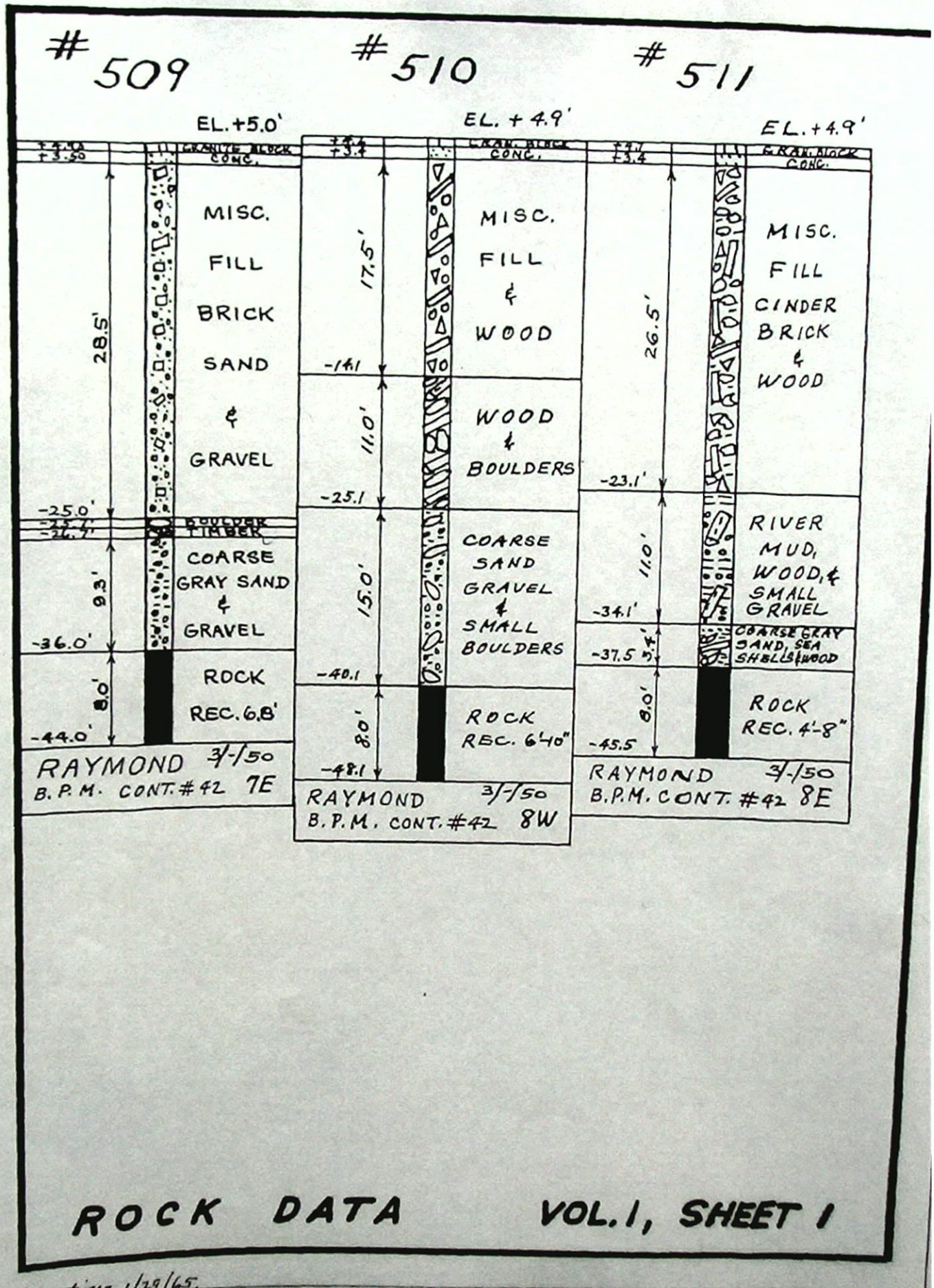


Martina 1/29/65



ROCK DATA VOL. I, SHEET I

Martins 1/29/65



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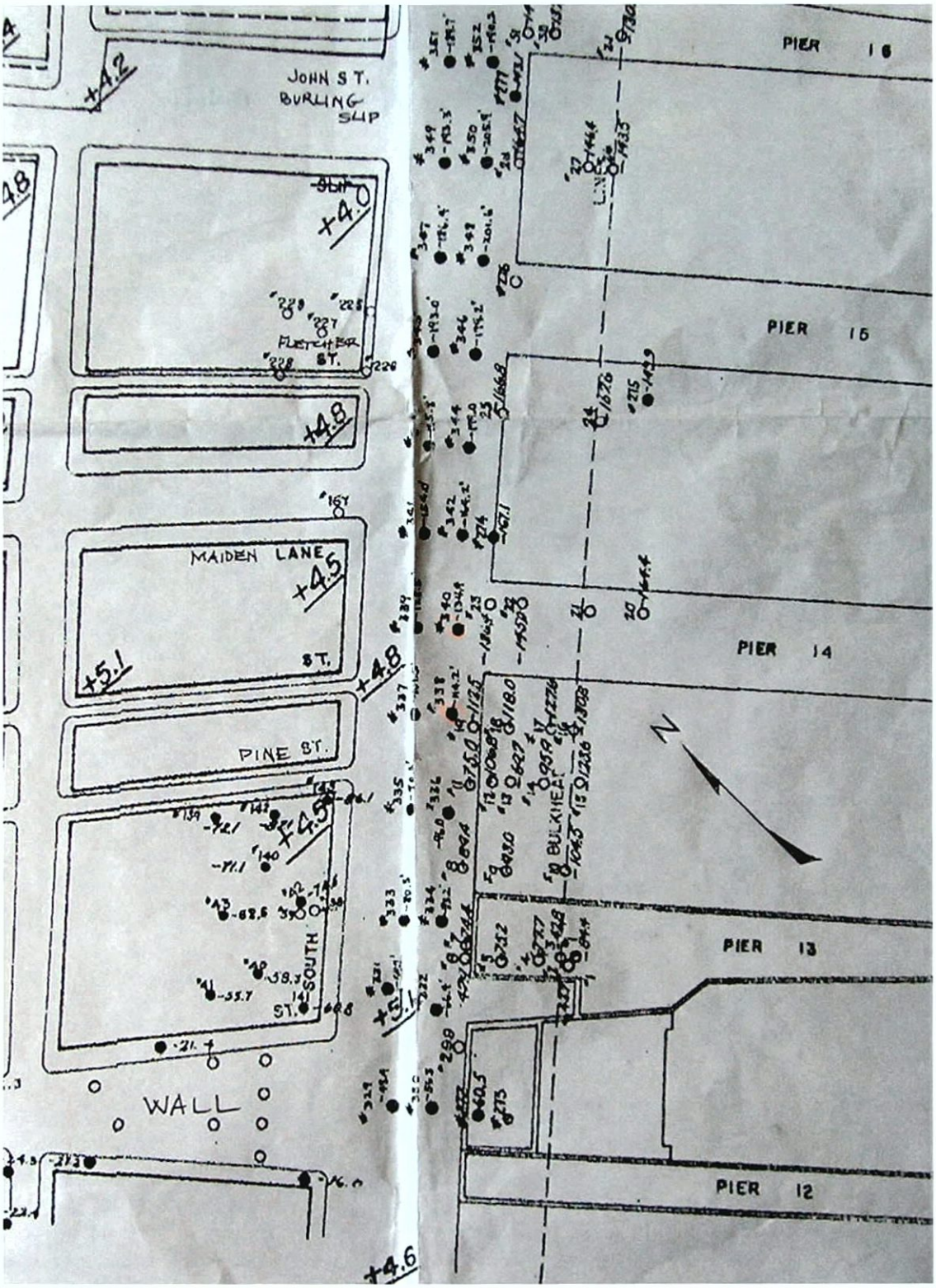
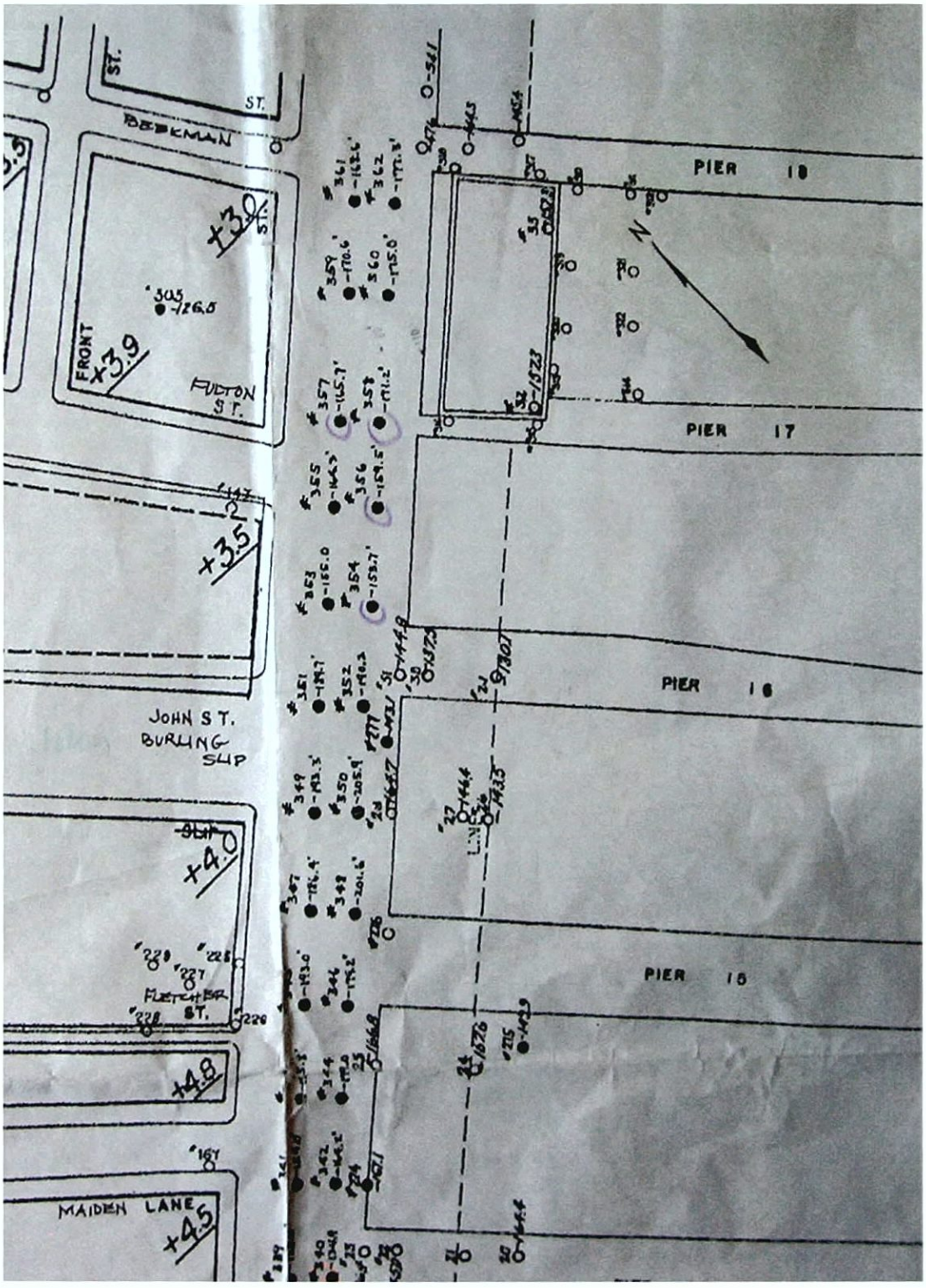
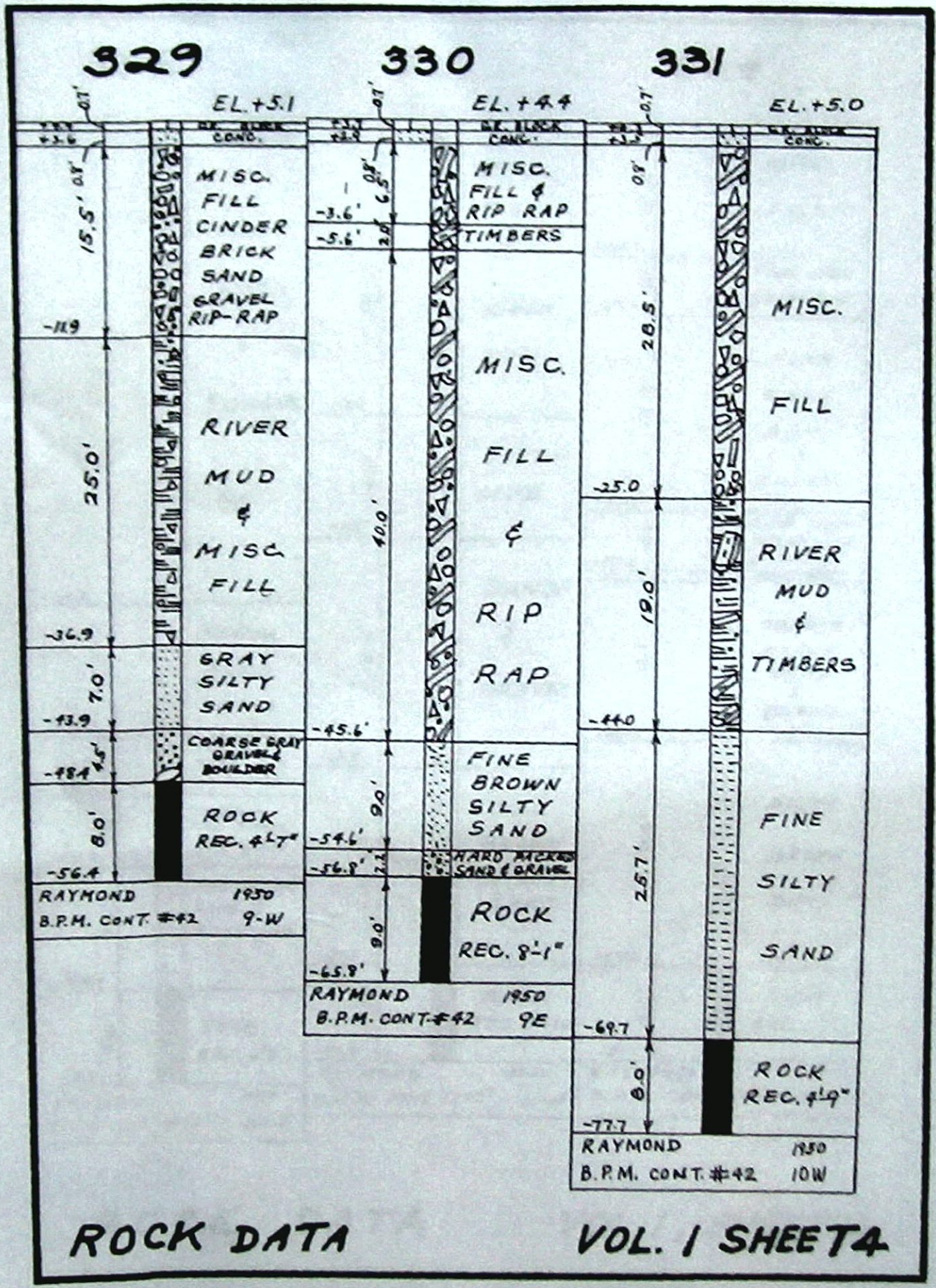


WPA Rock Data – Map 3
(Volume 1, Sheet 4. Borough of Manhattan, Office of the President, 1937, revised)

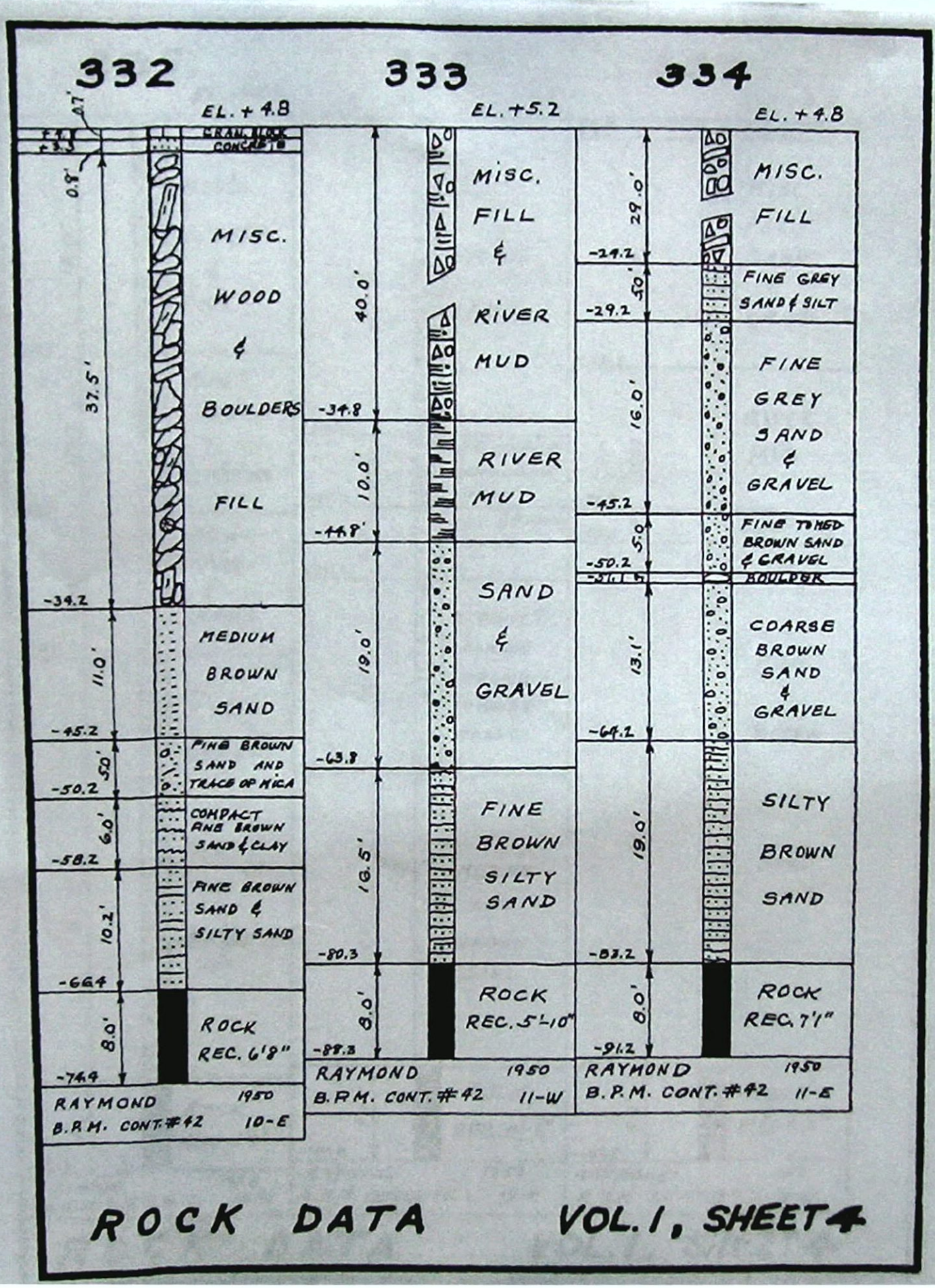


WPA Rock Data – Map 4
(Volume 1, Sheet 4. Borough of Manhattan, Office of the President, 1937, revised)

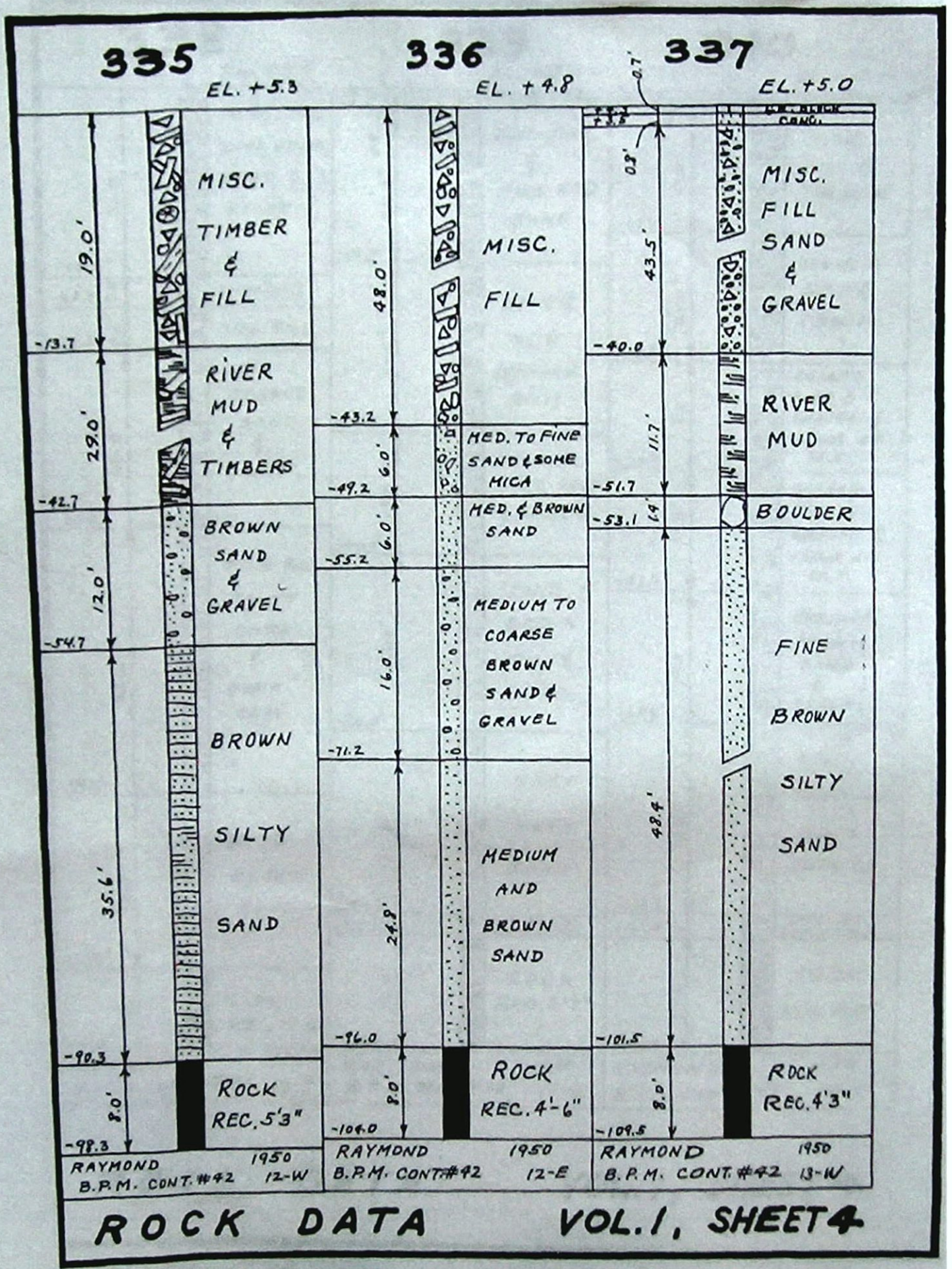


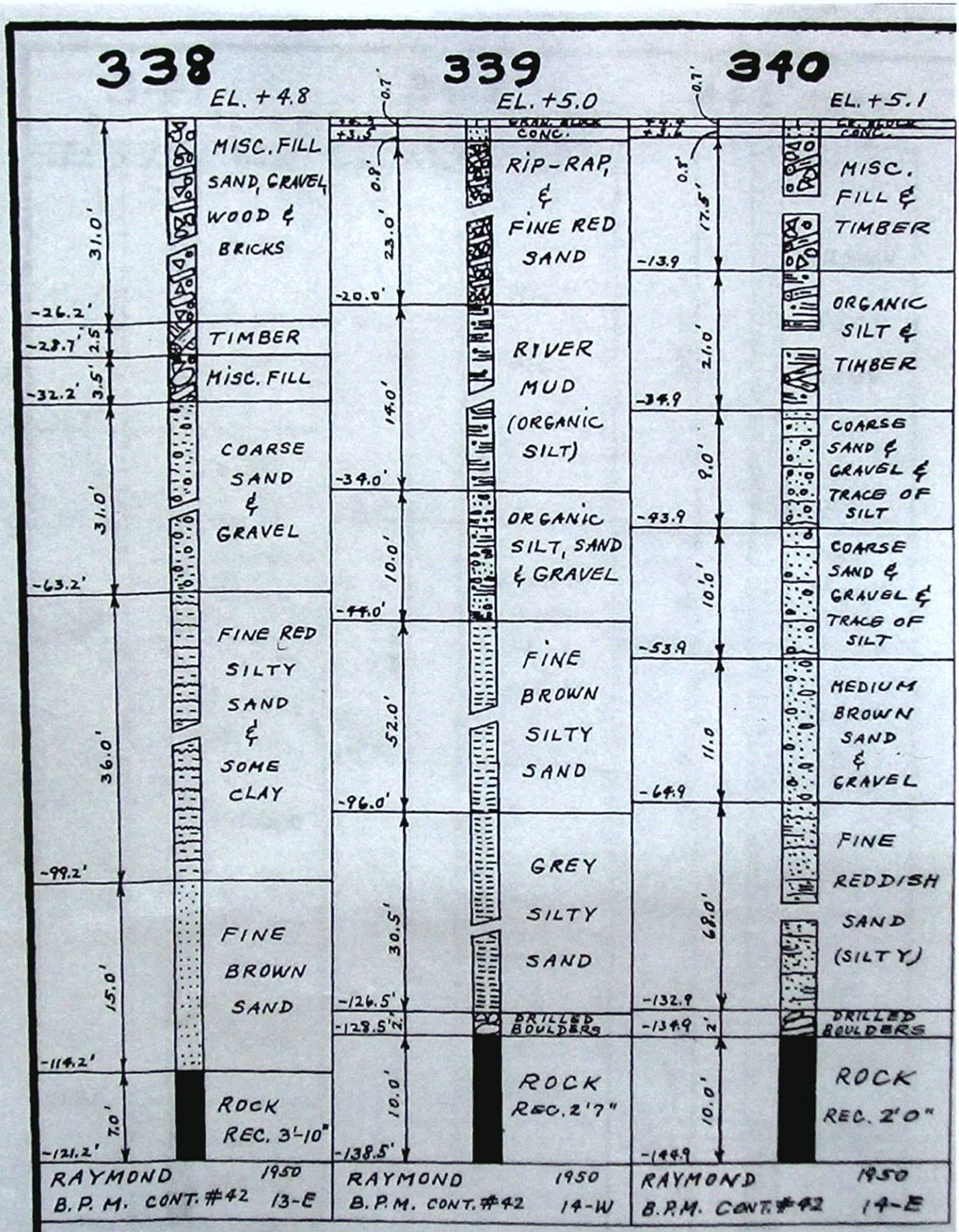
ROCK DATA VOL. 1 SHEET 4

Martins 2/2/65.

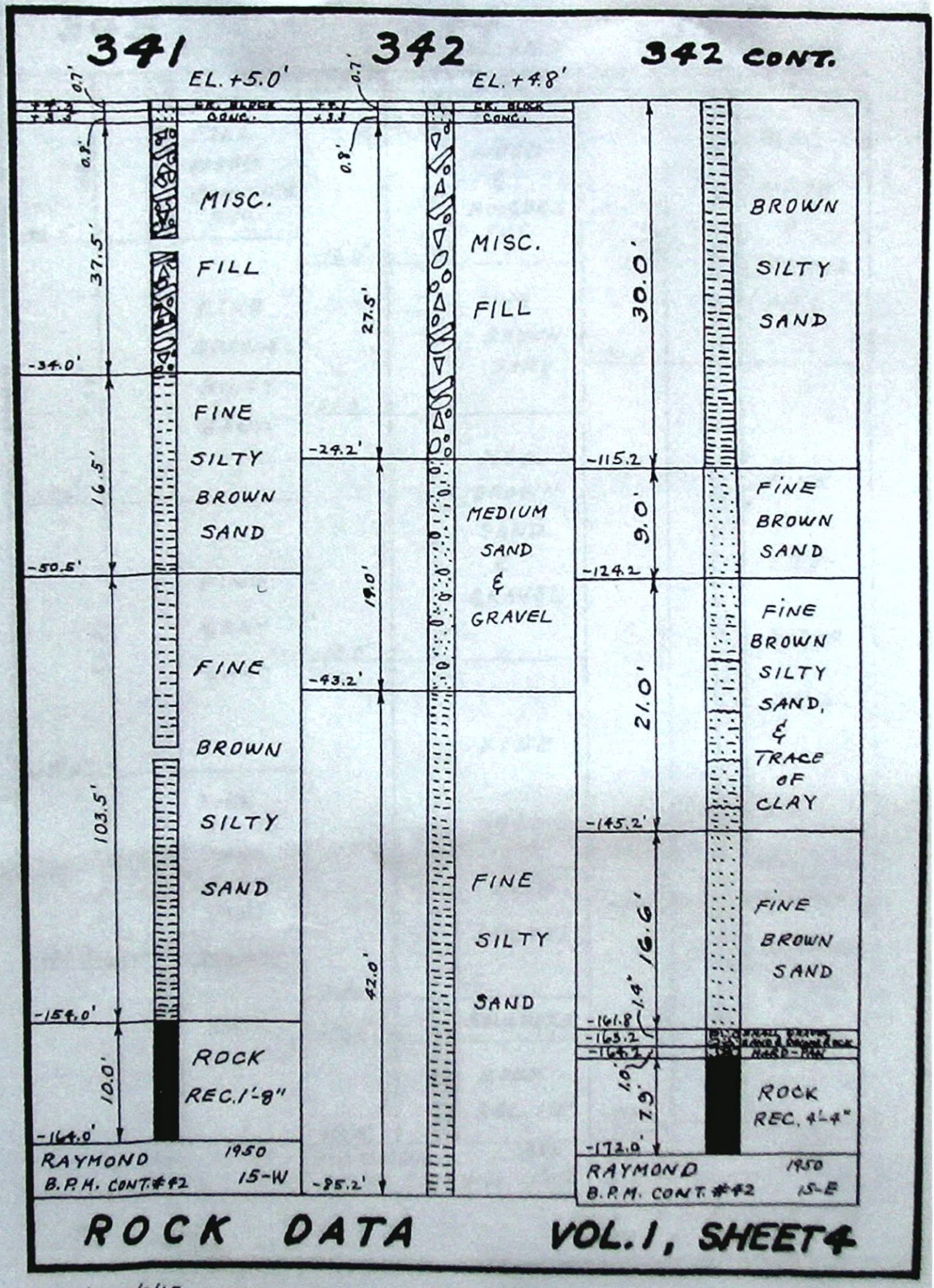


ROCK DATA VOL. 1, SHEET 4


335
EL. +5.3
19.0'
MISC. TIMBER & FILL
-13.7
29.0'
RIVER MUD & TIMBERS
-42.7
12.0'
BROWN SAND & GRAVEL
-54.7
35.6'
BROWN SILTY SAND
-90.3
8.0'
ROCK REC. 5'3"
-98.3
RAYMOND B.P.M. CONT. #42 1950 12-W
336
EL. +4.8
48.0'
MISC. FILL
-43.2
6.0'
MED. TO FINE SAND & SOME MICA
-49.2
6.0'
MED. & BROWN SAND
-55.2
16.0'
MEDIUM TO COARSE BROWN SAND & GRAVEL
-71.2
24.8'
MEDIUM AND BROWN SAND
-96.0
8.0'
ROCK REC. 4'-6"
-104.0
RAYMOND B.P.M. CONT. #42 1950 12-E
337
EL. +5.0
0.7'
0.8'
43.5'
MISC. FILL SAND & GRAVEL
-40.0
11.7'
RIVER MUD
-51.7
1.4'
BOULDER
-53.1
48.4'
FINE BROWN SILTY SAND
-101.5
8.0'
ROCK REC. 4'3"
-109.5
RAYMOND B.P.M. CONT. #42 1950 13-W
ROCK DATA VOL. 1, SHEET 4

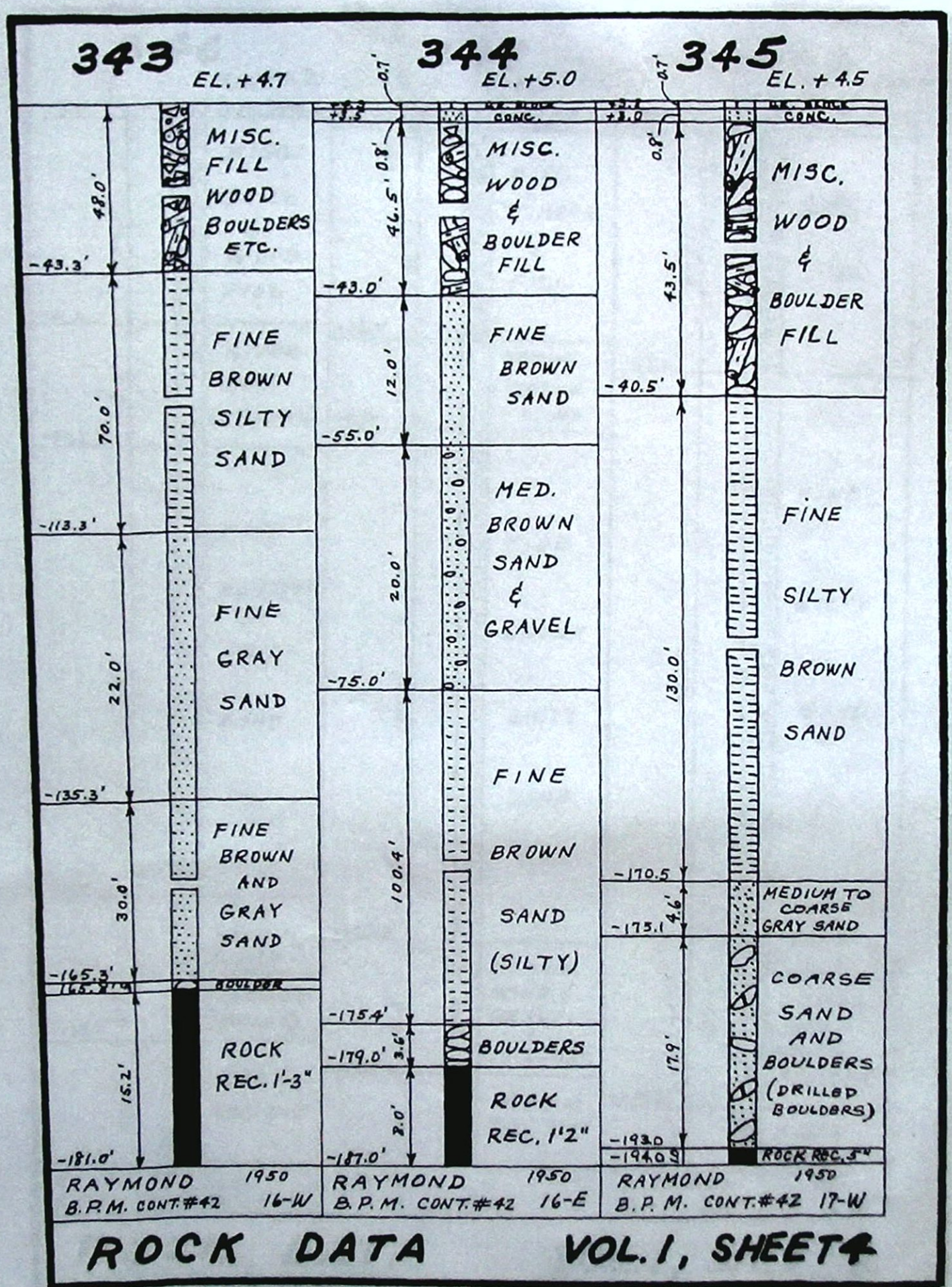


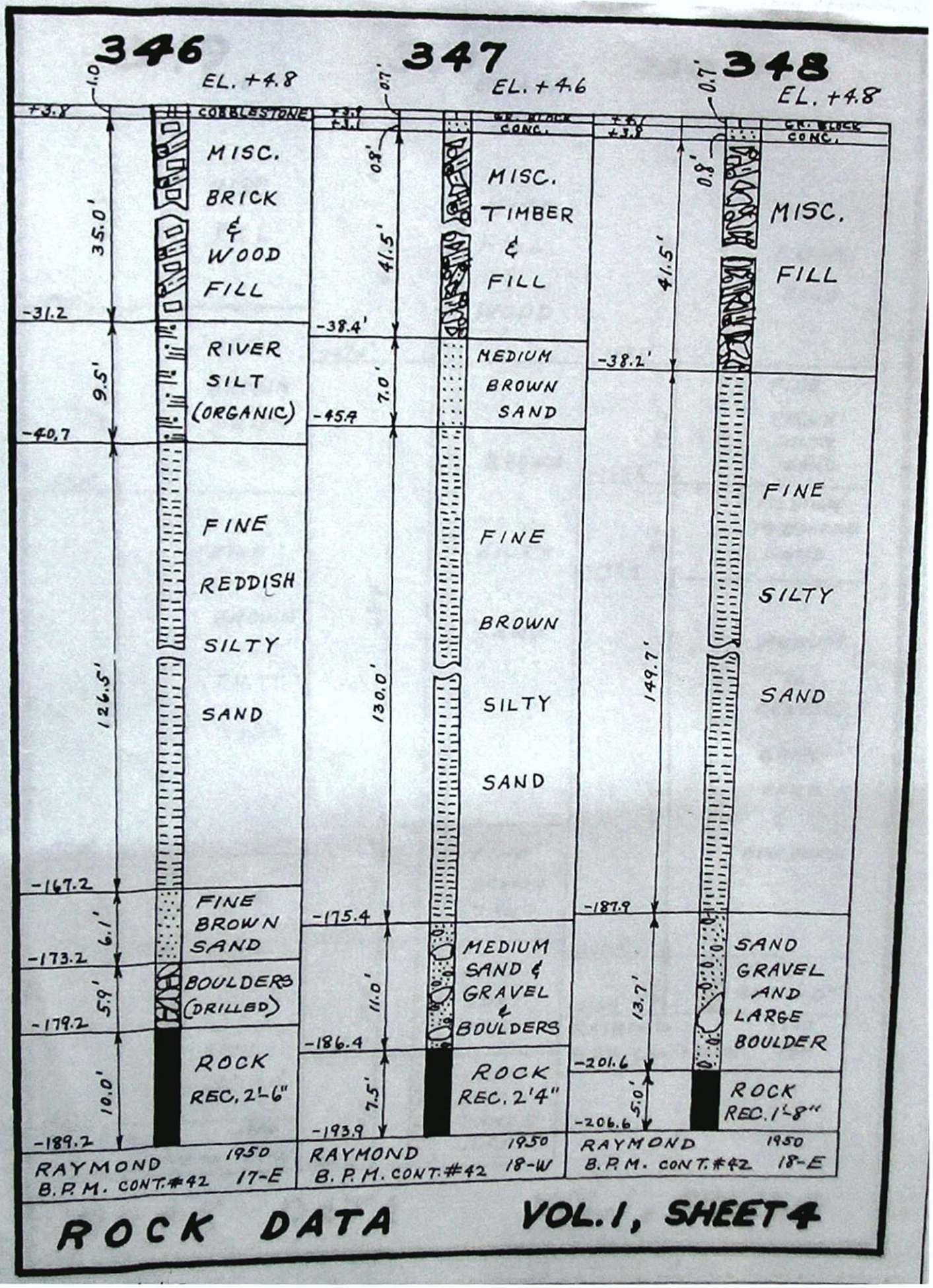
ROCK DATA VOL. 1, SHEET 4

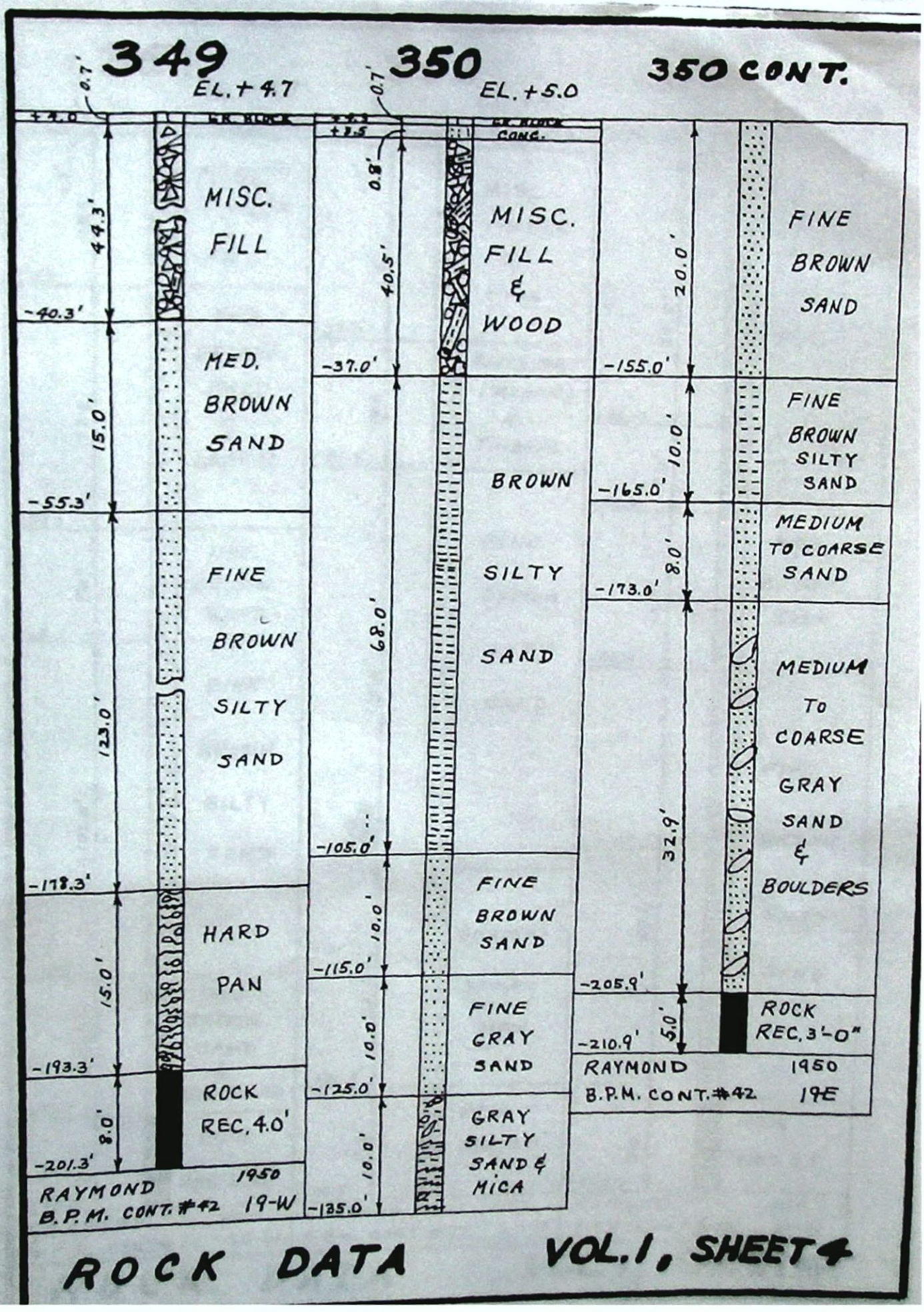


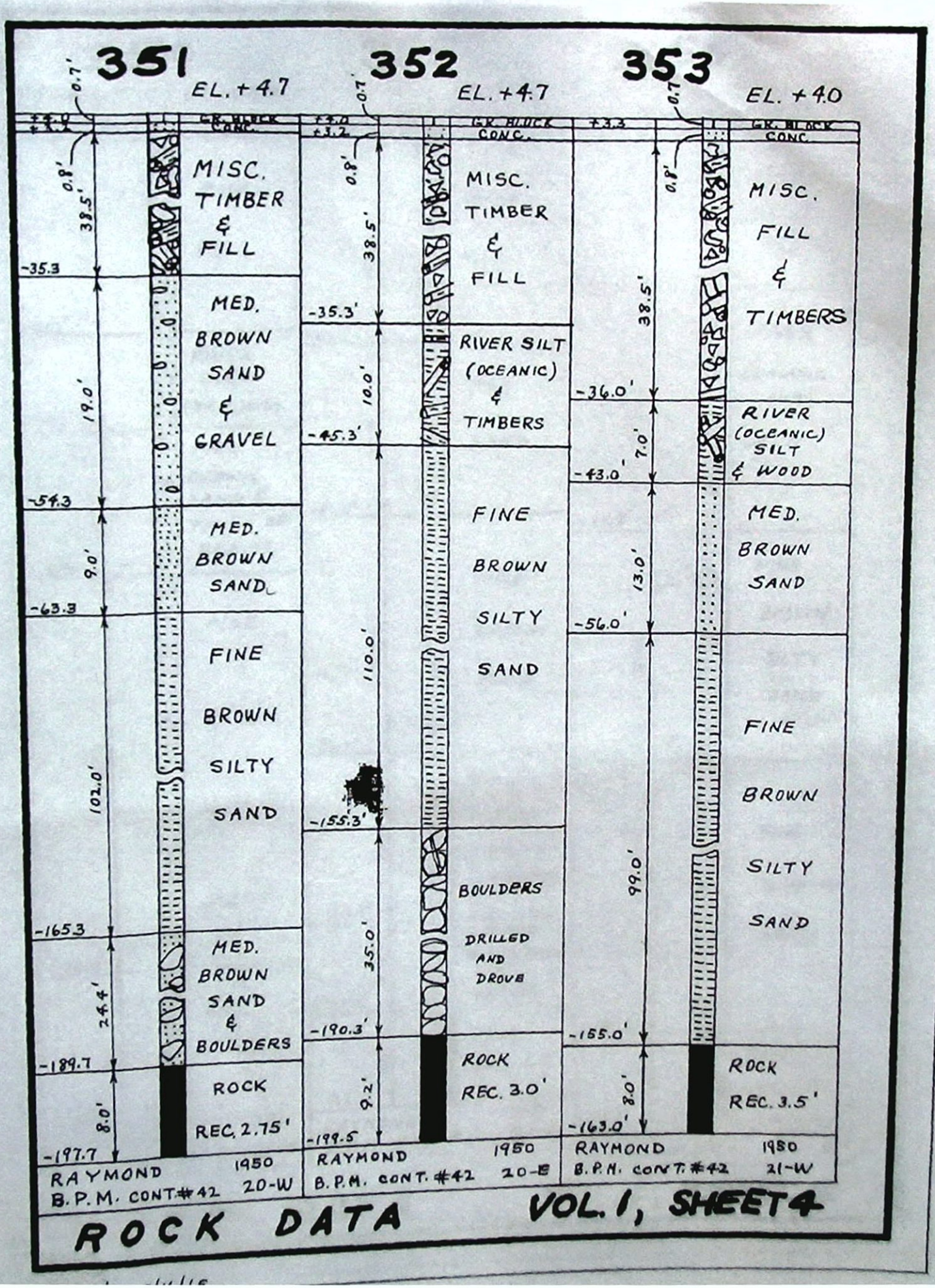
ROCK DATA VOL. 1, SHEET 4

Martino 2/9/65.

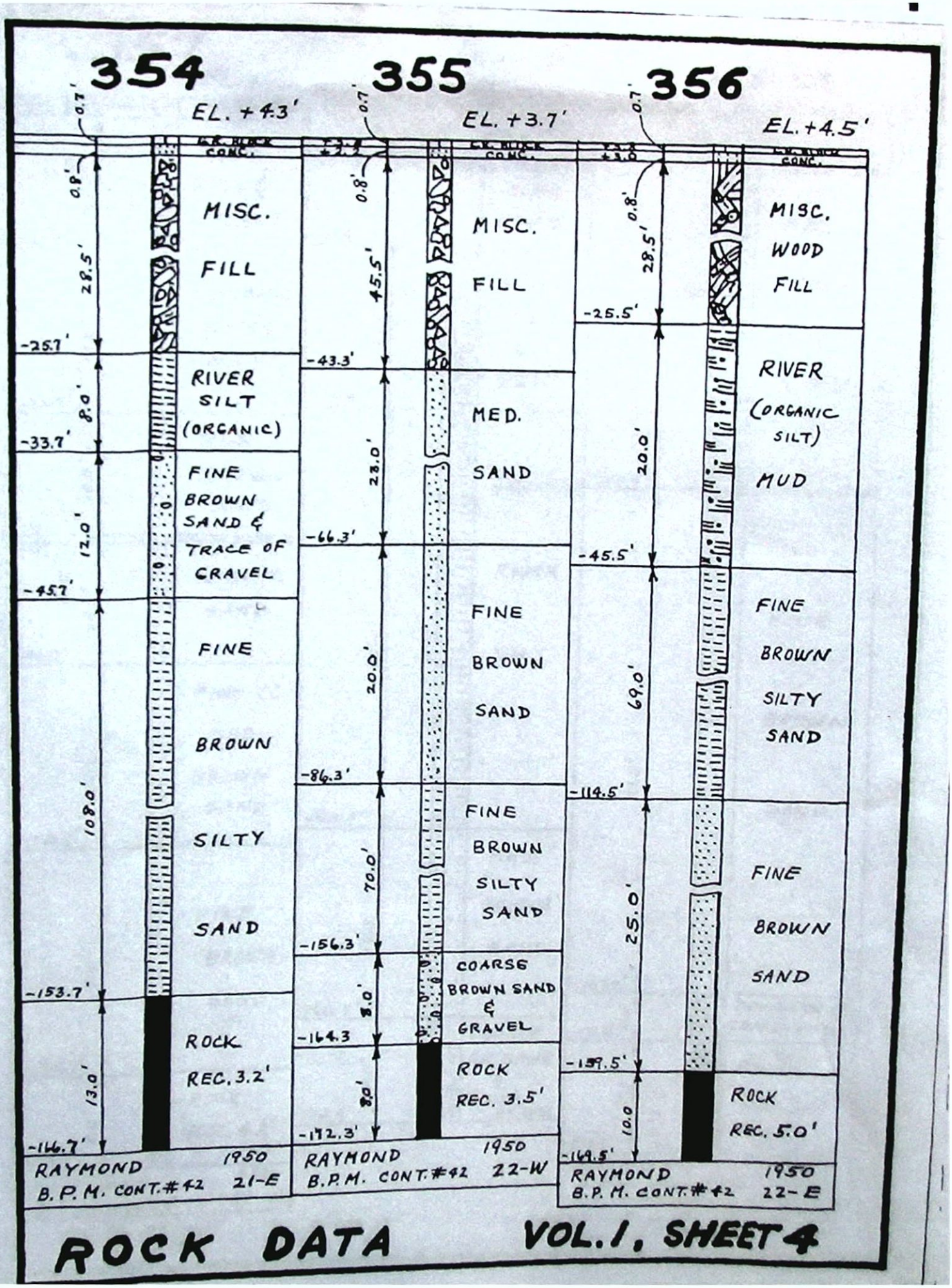

343
EL. +4.7
48.0'
-43.3'
MISC. FILL WOOD BOULDERS ETC.
70.0'
-113.3'
FINE BROWN SILTY SAND
22.0'
-135.3'
FINE GRAY SAND
30.0'
-165.3'
FINE BROWN AND GRAY SAND
BOULDER
15.2'
-181.0'
ROCK REC. 1'-3"
RAYMOND B.P.M. CONT. #42 1950 16-W
344
EL. +5.0
0.7'
+5.3
CONC.
46.5'
0.8'
-43.0'
MISC. WOOD & BOULDER FILL
12.0'
-55.0'
FINE BROWN SAND
20.0'
-75.0'
MED. BROWN SAND & GRAVEL
100.4'
-175.4'
FINE BROWN SAND (SILTY)
3.6'
-179.0'
BOULDERS
2.0'
-181.0'
ROCK REC. 1'2"
RAYMOND B.P.M. CONT. #42 1950 16-E
345
EL. +4.5
0.7'
+3.8
CONC.
0.8'
43.5'
-40.5'
MISC. WOOD & BOULDER FILL
130.0'
-170.5
FINE SILTY BROWN SAND
4.6'
-175.1
MEDIUM TO COARSE GRAY SAND
17.9'
-193.0
-194.0
COARSE SAND AND BOULDERS (DRILLED BOULDERS)
ROCK REC. 5"
RAYMOND B.P.M. CONT. #42 1950 17-W
ROCK DATA VOL. 1, SHEET 4

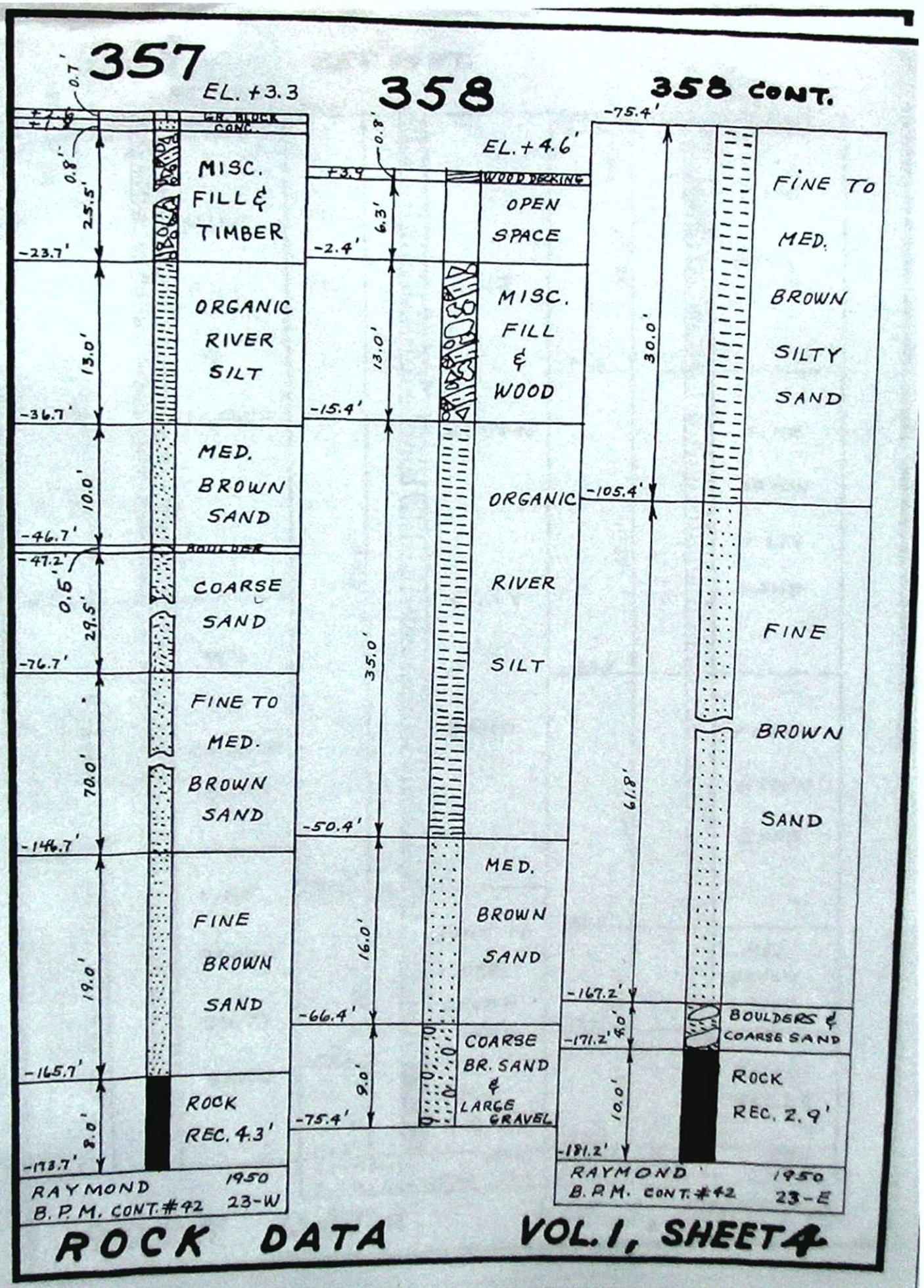

346
EL. +4.8
+3.8
1.0
COBBLESTONE
MISC. BRICK & WOOD FILL
35.0'
-31.2
RIVER SILT (ORGANIC)
9.5'
-40.7
FINE REDDISH SILTY SAND
126.5'
-167.2
FINE BROWN SAND
6.1'
-173.2
BOULDERS (DRILLED)
5.9'
-179.2
ROCK REC. 2'-6"
10.0'
-189.2
RAYMOND B.P.M. CONT. #42 1950 17-E
347
EL. +4.6
+3.9
+3.1
0.7'
0.8'
CONC.
MISC. TIMBER & FILL
41.5'
-38.4'
MEDIUM BROWN SAND
7.0'
-45.4
FINE BROWN SILTY SAND
130.0'
-175.4
MEDIUM SAND & GRAVEL & BOULDERS
11.0'
-186.4
ROCK REC. 2'4"
7.5'
-193.9
RAYMOND B.P.M. CONT. #42 1950 18-W
348
EL. +4.8
+3.9
0.7'
0.8'
CONC. BLOCK CONC.
MISC. FILL
41.5'
-38.2'
FINE SILTY SAND
149.7'
-187.9
SAND GRAVEL AND LARGE BOULDER
13.7'
-201.6
ROCK REC. 1'-8"
5.0'
-206.6
RAYMOND B.P.M. CONT. #42 1950 18-E
ROCK DATA
VOL. I, SHEET 4

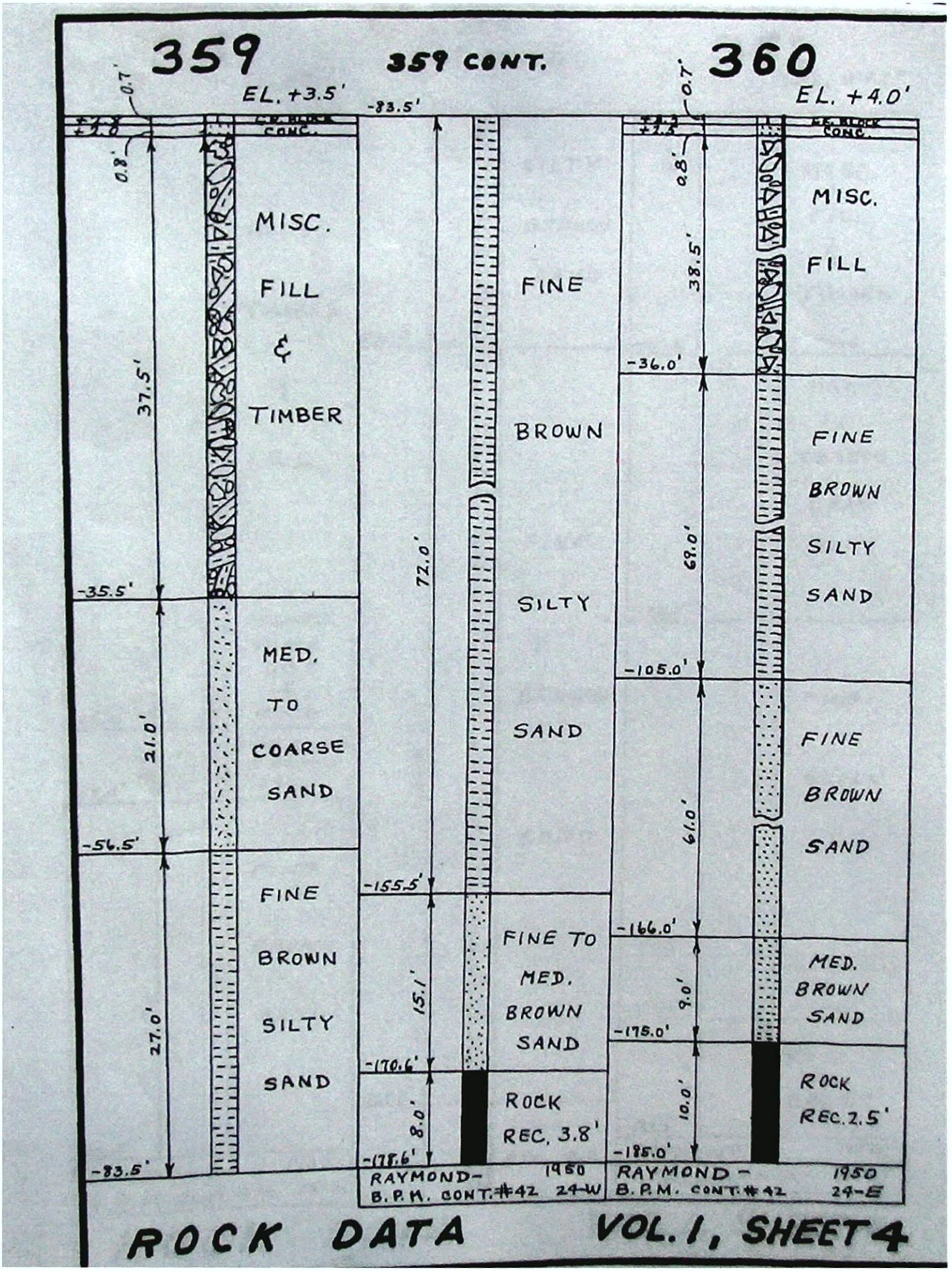

349
EL. +4.7
0.7'
+4.0
44.3'
-40.3'
MISC. FILL
15.0'
-55.3'
MED. BROWN SAND
123.0'
FINE BROWN SILTY SAND
-178.3'
15.0'
HARD PAN
-193.3'
8.0'
ROCK REC. 4.0'
-201.3'
RAYMOND B.P.M. CONT. #42
1950
19-W
350
EL. +5.0
0.7'
+5.0
+4.2
+3.5
0.8'
40.5'
-37.0'
MISC. FILL & WOOD
68.0'
BROWN SILTY SAND
-105.0'
10.0'
-115.0'
FINE BROWN SAND
10.0'
-125.0'
FINE GRAY SAND
10.0'
-135.0'
GRAY SILTY SAND & MICA
350 CONT.
20.0'
-155.0'
FINE BROWN SAND
10.0'
-165.0'
FINE BROWN SILTY SAND
8.0'
-173.0'
MEDIUM TO COARSE SAND
32.9'
MEDIUM TO COARSE GRAY SAND & BOULDERS
-205.9'
5.0'
-210.9'
ROCK REC. 3'-0"
RAYMOND B.P.M. CONT. #42
1950
19E
ROCK DATA
VOL. 1, SHEET 4

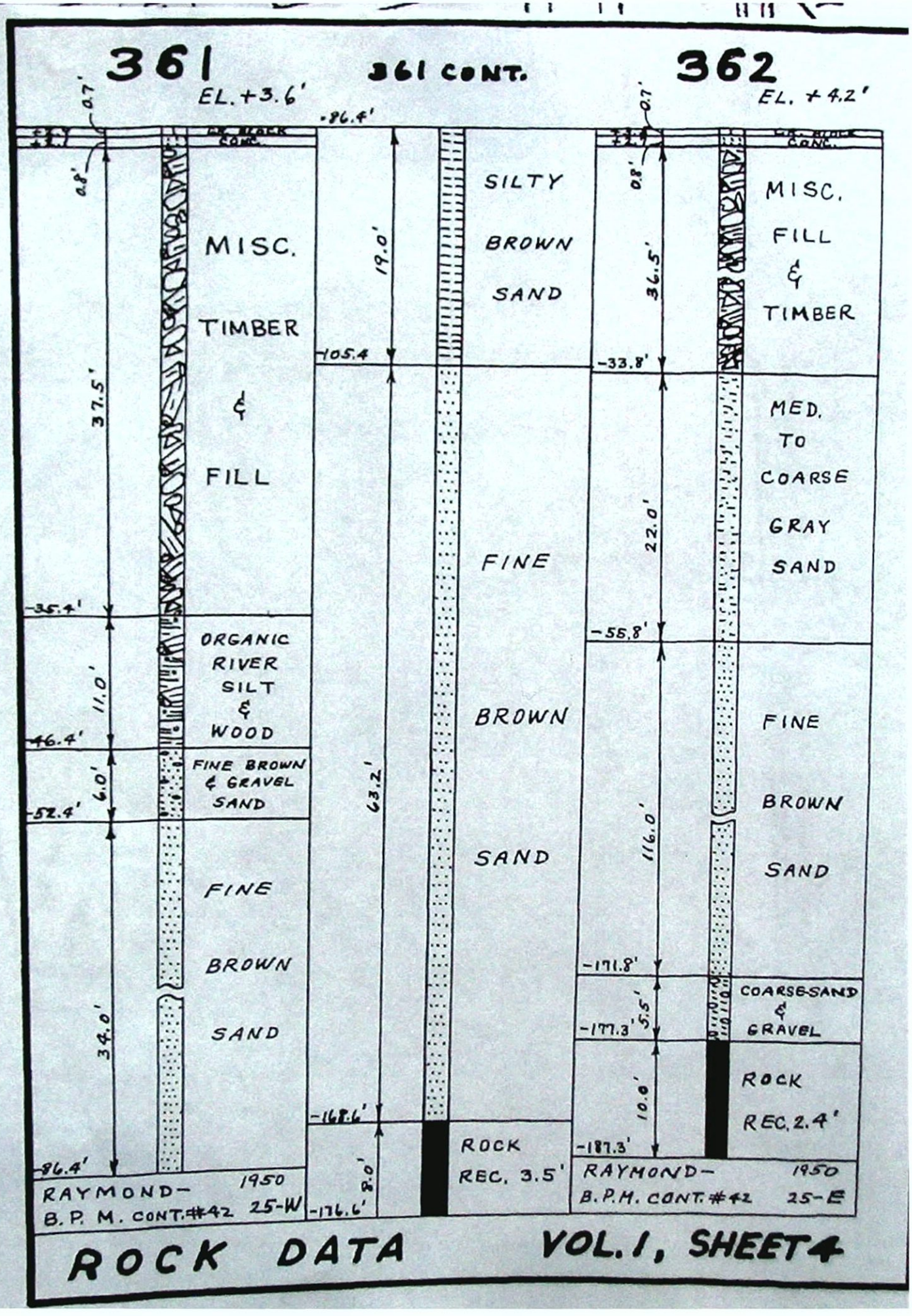


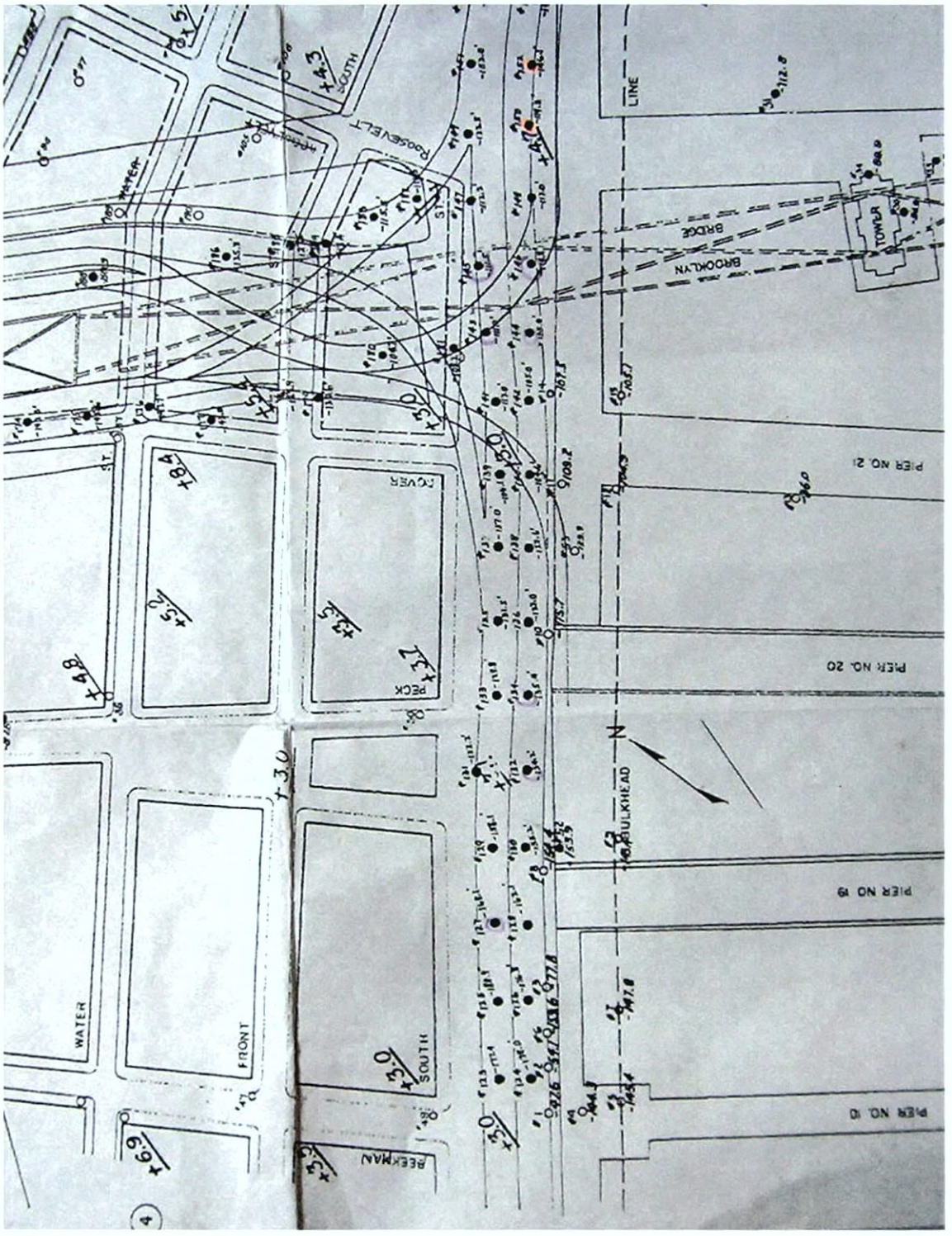
ROCK DATA VOL. 1, SHEET 4


354
EL. +4.3'
0.7'
0.8'
28.5'
-25.7'
MISC. FILL
8.0'
-33.7'
RIVER SILT (ORGANIC)
12.0'
-45.7'
FINE BROWN SAND & TRACE OF GRAVEL
108.0'
FINE BROWN SILTY SAND
-153.7'
13.0'
-166.7'
ROCK REC. 3.2'
RAYMOND B.P.M. CONT. #42 1950 21-E
355
EL. +3.7'
0.7'
0.8'
45.5'
-43.3'
MISC. FILL
23.0'
-66.3'
MED. SAND
20.0'
-86.3'
FINE BROWN SAND
70.0'
-156.3'
FINE BROWN SILTY SAND
8.0'
-164.3
COARSE BROWN SAND & GRAVEL
8.0'
-172.3'
ROCK REC. 3.5'
RAYMOND B.P.M. CONT. #42 1950 22-W
356
EL. +4.5'
0.7'
0.8'
28.5'
-25.5'
MISC. WOOD FILL
20.0'
-45.5'
RIVER (ORGANIC SILT) MUD
69.0'
-114.5'
FINE BROWN SILTY SAND
25.0'
-139.5'
FINE BROWN SAND
10.0
-149.5'
ROCK REC. 5.0'
RAYMOND B.P.M. CONT. #42 1950 22-E
ROCK DATA
VOL. 1, SHEET 4

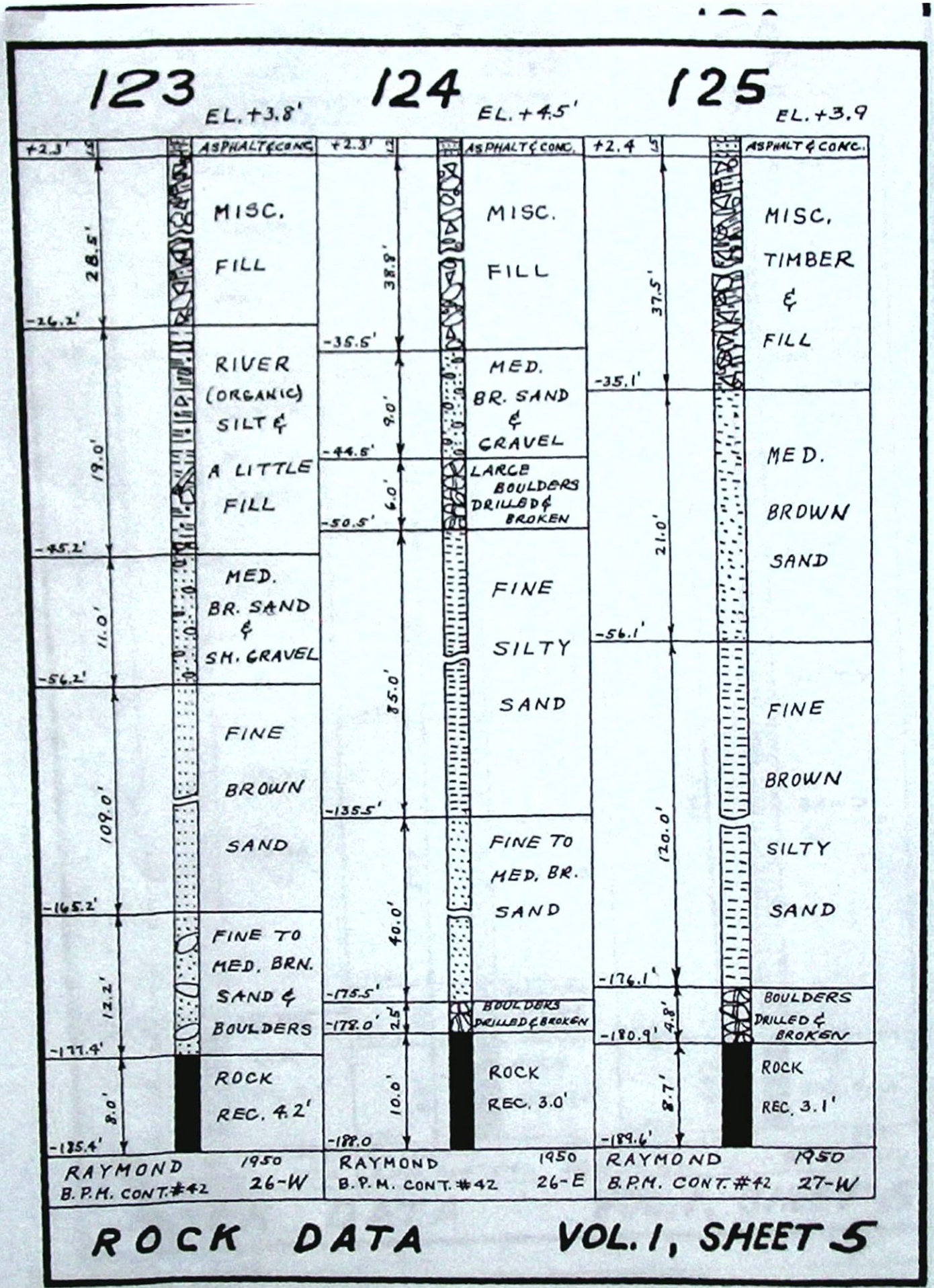

357
EL. +3.3
0.7'
+2.6'
0.8'
CR. BLOCK CONC.
MISC. FILL & TIMBER
25.5'
-23.7'
ORGANIC RIVER SILT
13.0'
-36.7'
MED. BROWN SAND
10.0'
-46.7'
BOULDER
-47.2'
0.5'
COARSE SAND
29.5'
-76.7'
FINE TO MED. BROWN SAND
70.0'
-146.7'
FINE BROWN SAND
19.0'
-165.7'
ROCK REC. 4.3'
8.0'
-173.7'
RAYMOND B.P.M. CONT. #42
1950
23-W
358
EL. +4.6'
0.8'
+3.9'
WOOD DECKING
OPEN SPACE
6.3'
-2.4'
MISC. FILL & WOOD
13.0'
-15.4'
ORGANIC RIVER SILT
35.0'
-50.4'
MED. BROWN SAND
16.0'
-66.4'
COARSE BR. SAND & LARGE GRAVEL
9.0'
-75.4'
358 CONT.
-75.4'
FINE TO MED. BROWN SILTY SAND
30.0'
-105.4'
FINE BROWN SAND
61.8'
-167.2'
BOULDERS & COARSE SAND
4.0'
-171.2'
ROCK REC. 2.9'
10.0'
-181.2'
RAYMOND B.P.M. CONT. #42
1950
23-E
ROCK DATA
VOL. 1, SHEET 4
Martina 2/17/65


359
359 CONT.
360
EL. +3.5'
EL. +4.0'
0.7'
0.8'
37.5'
MISC. FILL & TIMBER
-35.5'
21.0'
MED. TO COARSE SAND
-56.5'
27.0'
FINE BROWN SILTY SAND
-83.5'
-83.5'
72.0'
FINE BROWN SILTY SAND
-155.5'
15.1'
FINE TO MED. BROWN SAND
-170.6'
8.0'
ROCK REC. 3.8'
-178.6'
RAYMOND - B.P.M. CONT. #42 1950 24-W
0.7'
0.8'
38.5'
MISC. FILL
-36.0'
69.0'
FINE BROWN SILTY SAND
-105.0'
61.0'
FINE BROWN SAND
-166.0'
9.0'
MED. BROWN SAND
-175.0'
10.0'
ROCK REC. 2.5'
-185.0'
RAYMOND - B.P.M. CONT. #42 1950 24-E
ROCK DATA VOL. 1, SHEET 4

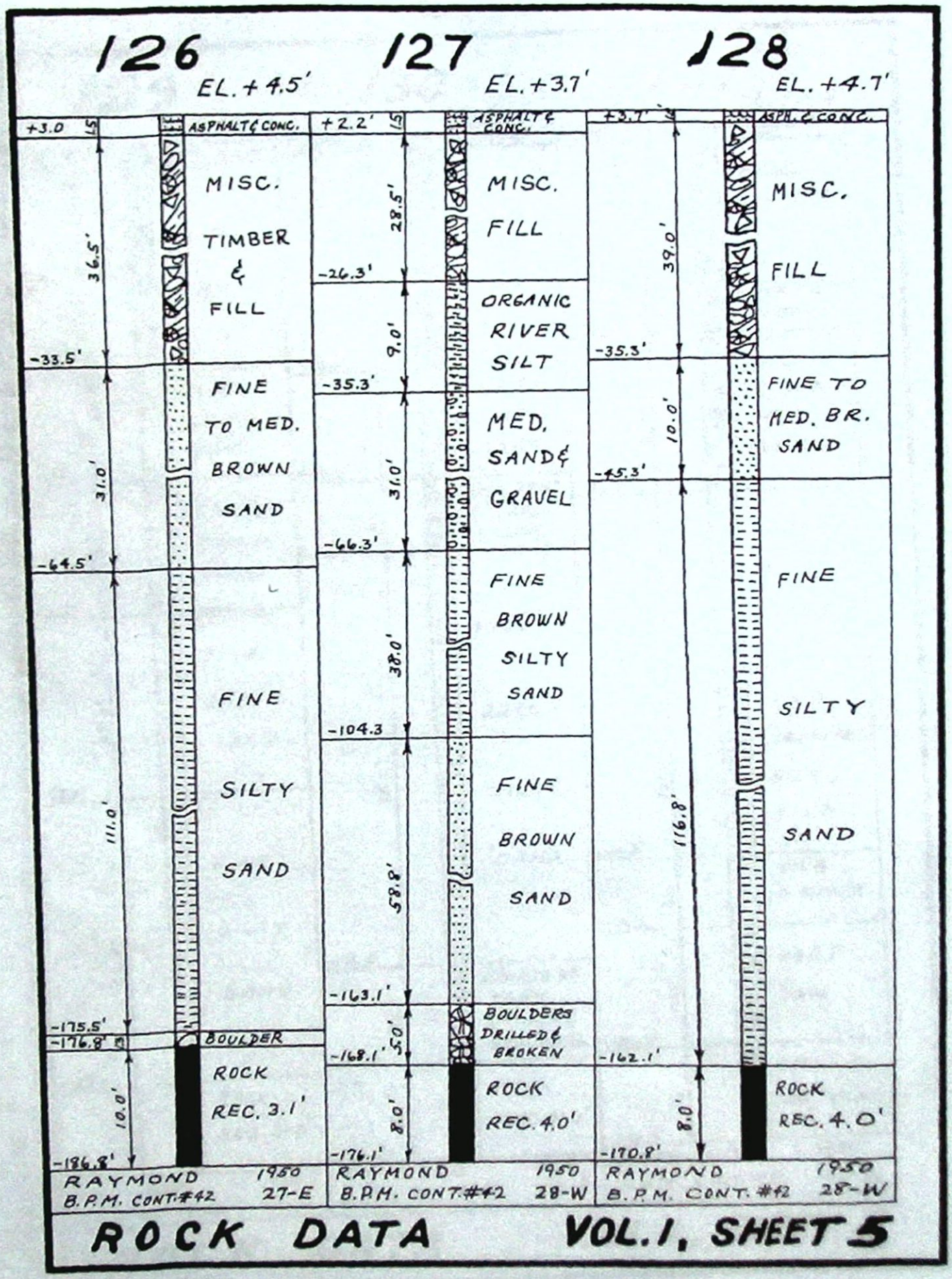

361
EL. +3.6'
0.7'
0.8'
37.5'
-35.4'
11.0'
-46.4'
6.0'
-52.4'
34.0'
-86.4'
MISC. TIMBER & FILL
ORGANIC RIVER SILT & WOOD
FINE BROWN & GRAVEL SAND
FINE BROWN SAND
RAYMOND- 1950
B. P. M. CONT. #42 25-W
361 CONT.
-86.4'
19.0'
-105.4'
63.2'
-168.6'
8.0'
-176.6'
SILTY BROWN SAND
FINE BROWN SAND
ROCK REC. 3.5'
362
EL. +4.2'
0.7'
0.8'
36.5'
-33.8'
22.0'
-55.8'
116.0'
-171.8'
5.5'
-177.3'
10.0'
-187.3'
MISC. FILL & TIMBER
MED. TO COARSE GRAY SAND
FINE BROWN SAND
COARSE SAND & GRAVEL
ROCK REC. 2.4'
RAYMOND- 1950
B.P.M. CONT. #42 25-E
ROCK DATA VOL. 1, SHEET 4



WPA Rock Data – Map 5
(Volume 1, Sheet 5. Borough of Manhattan, Office of the President, 1937, revised)

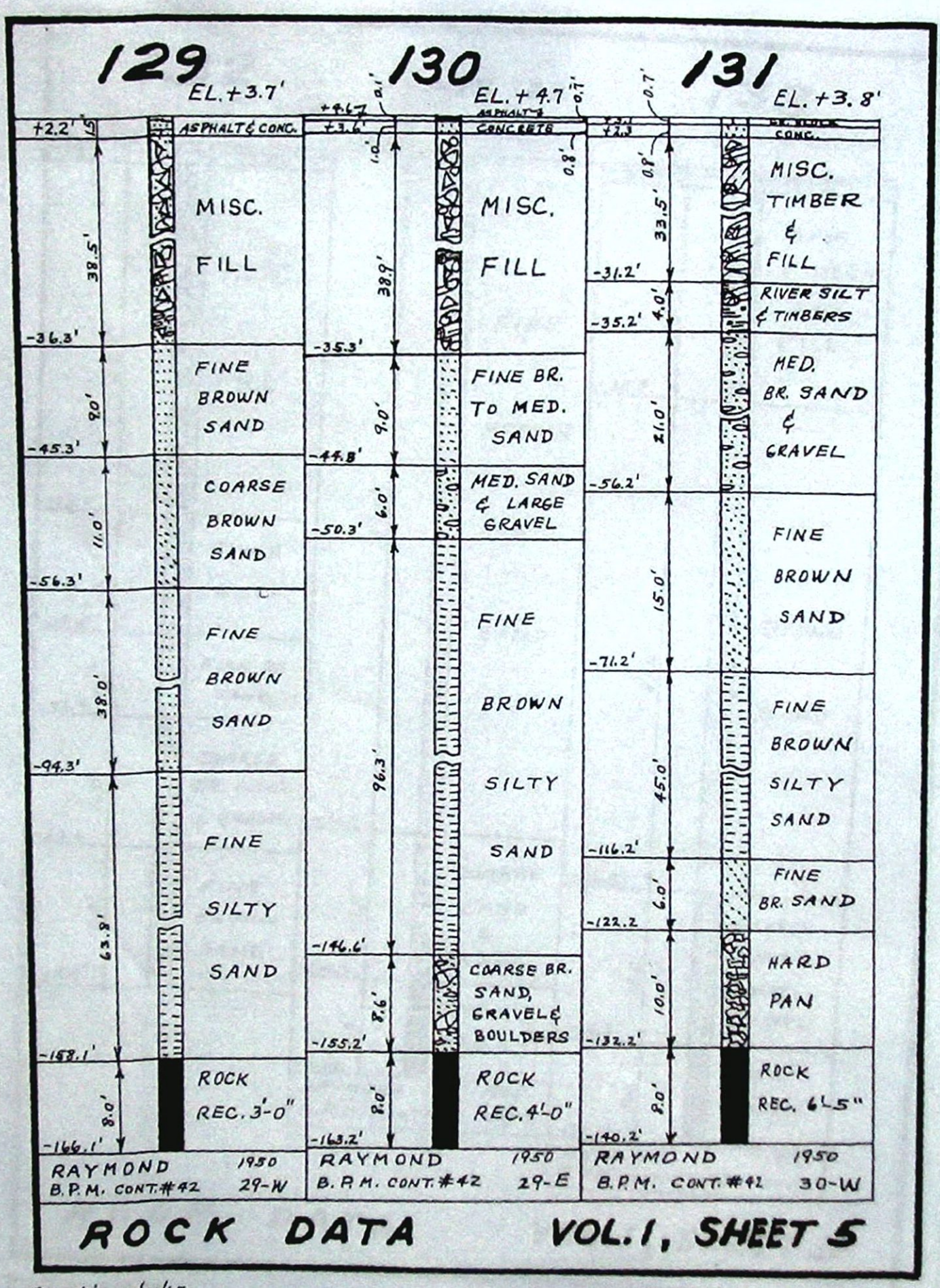


Martins 2/22/65.

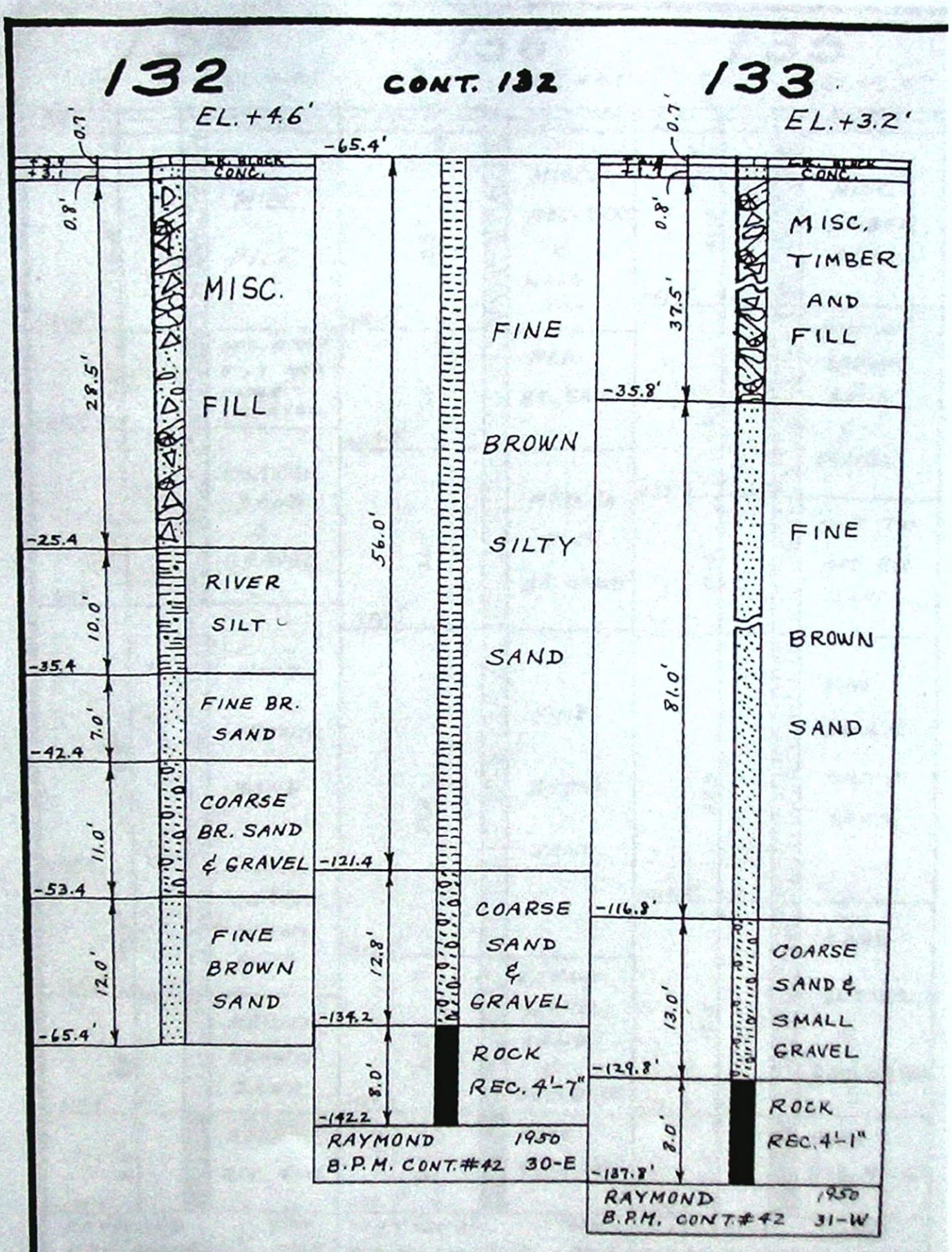


ROCK DATA VOL. 1, SHEET 5

Martins 2/23/65.

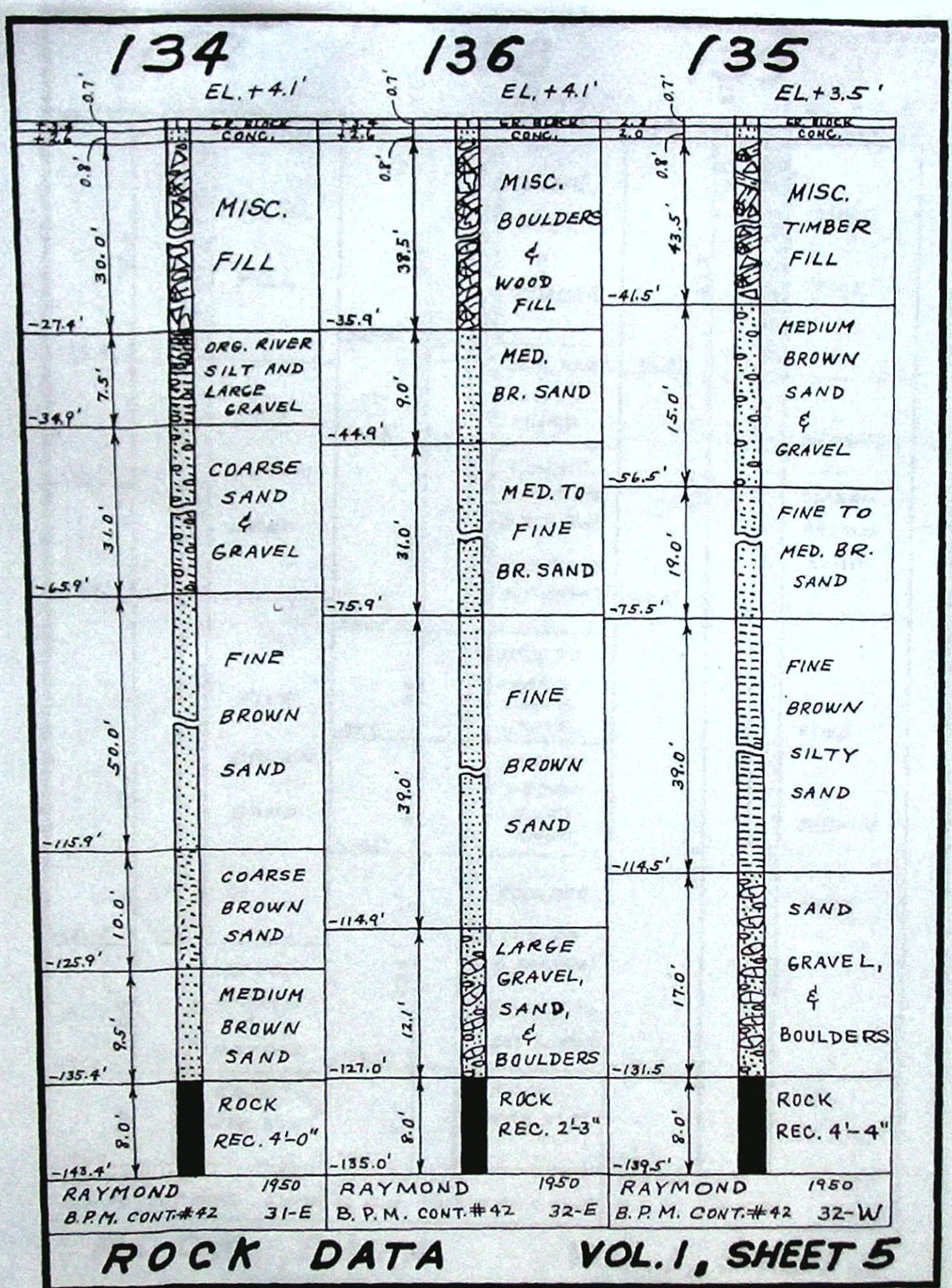


Martins 2/24/65.



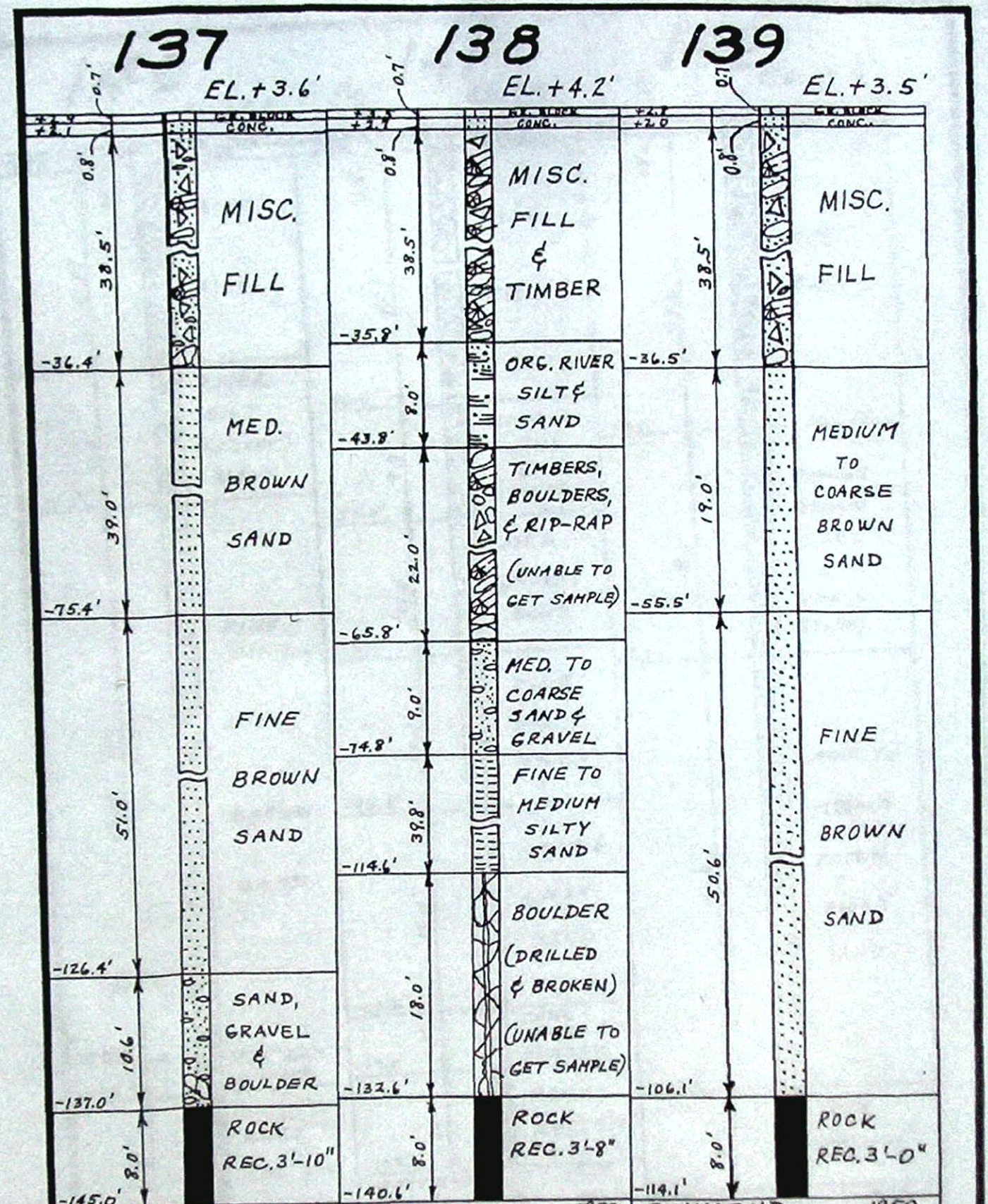
ROCK DATA VOL. 1, SHEET 5

Martins 2/28/45

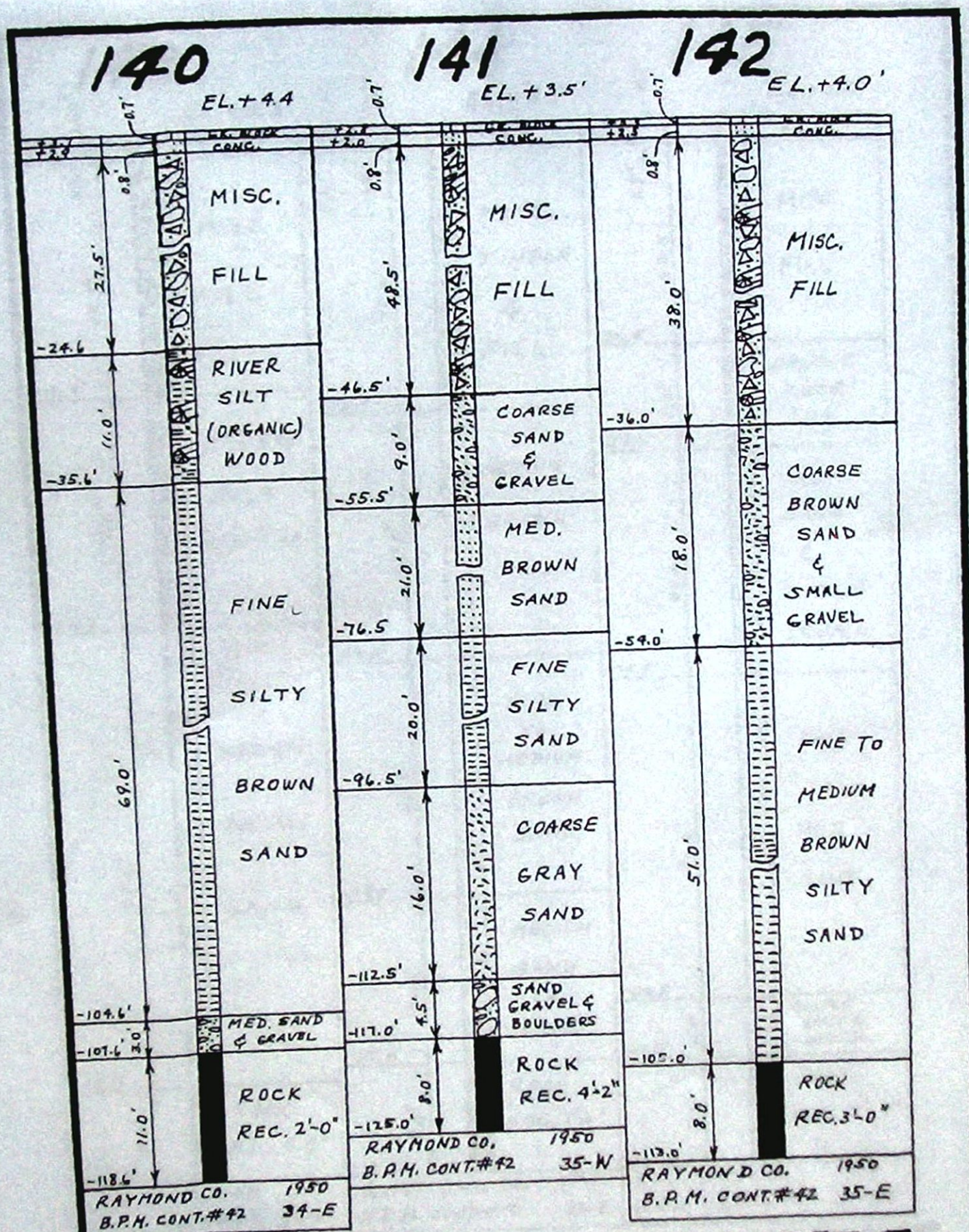


ROCK DATA VOL. 1, SHEET 5

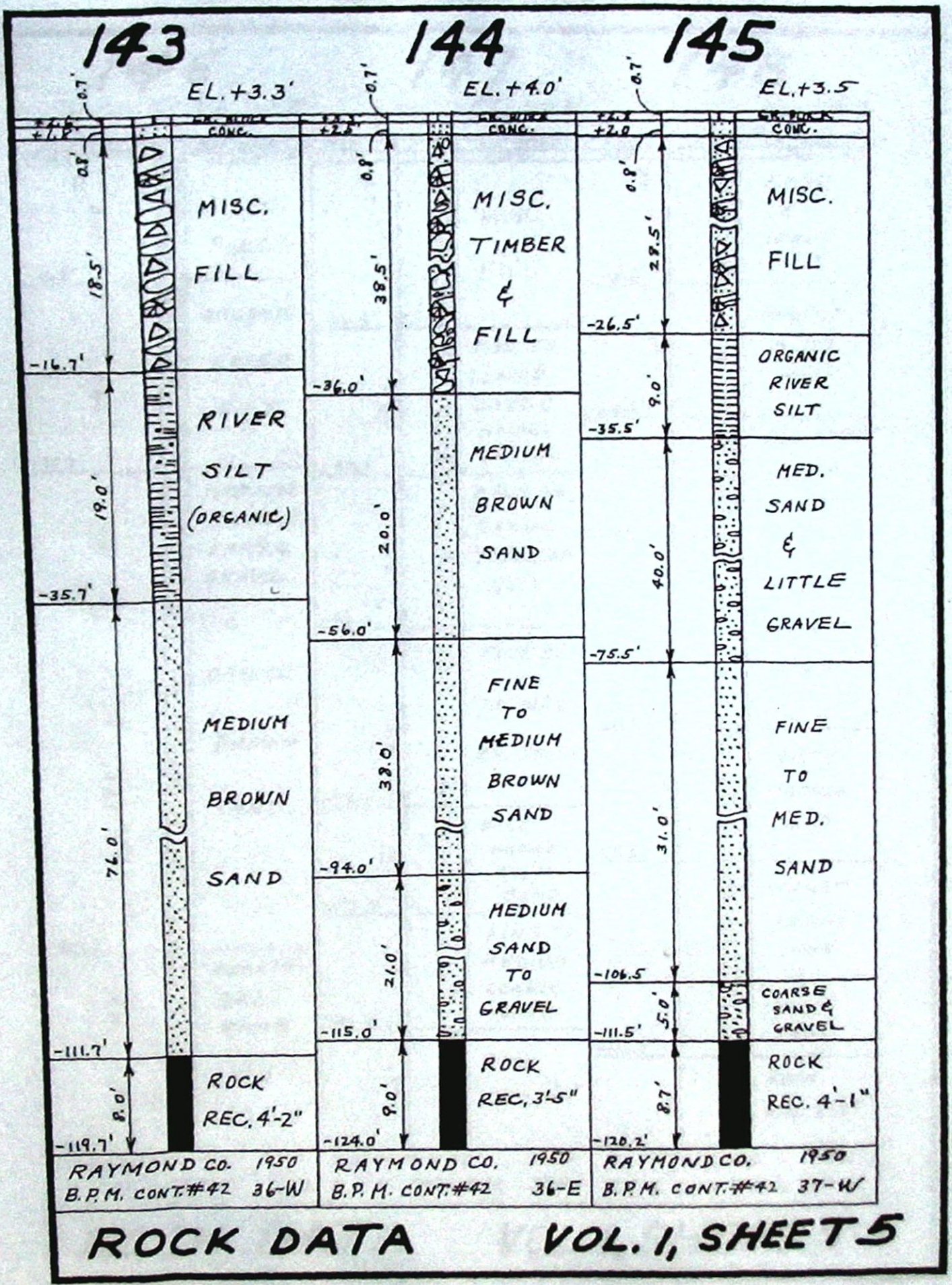
Martins 2/25/65.



Martins 2/26/65.

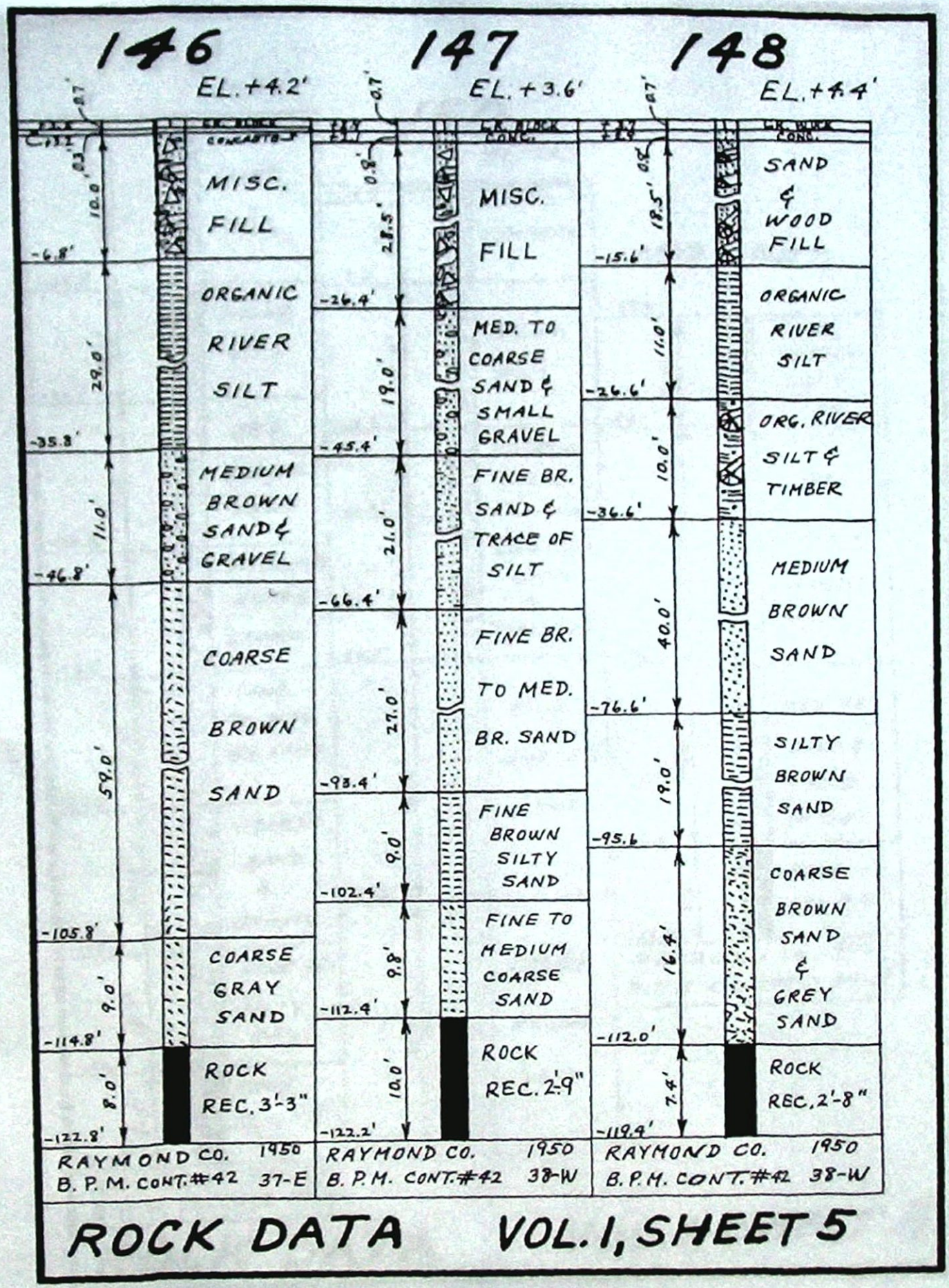


Martins 3/1/65.

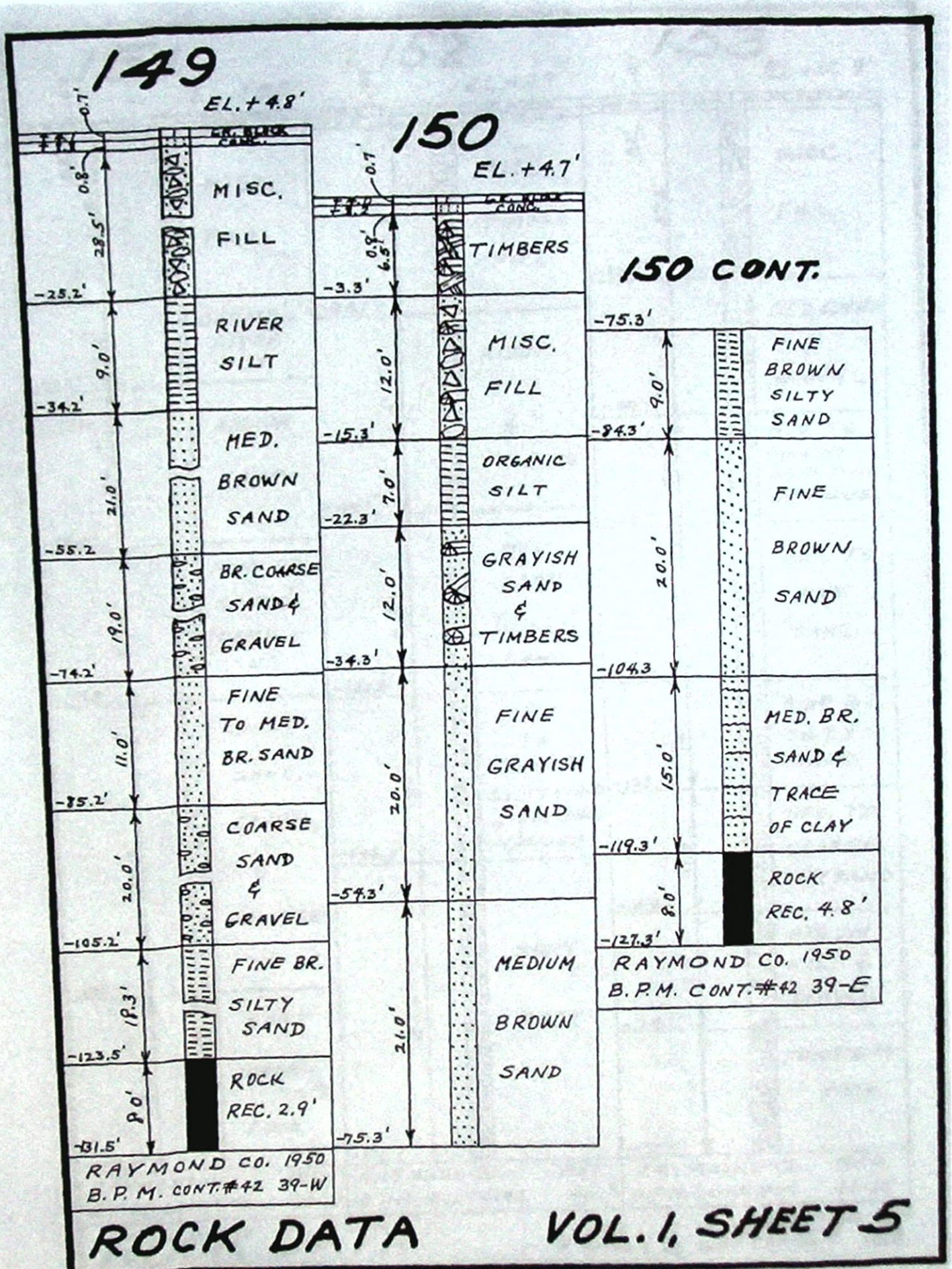


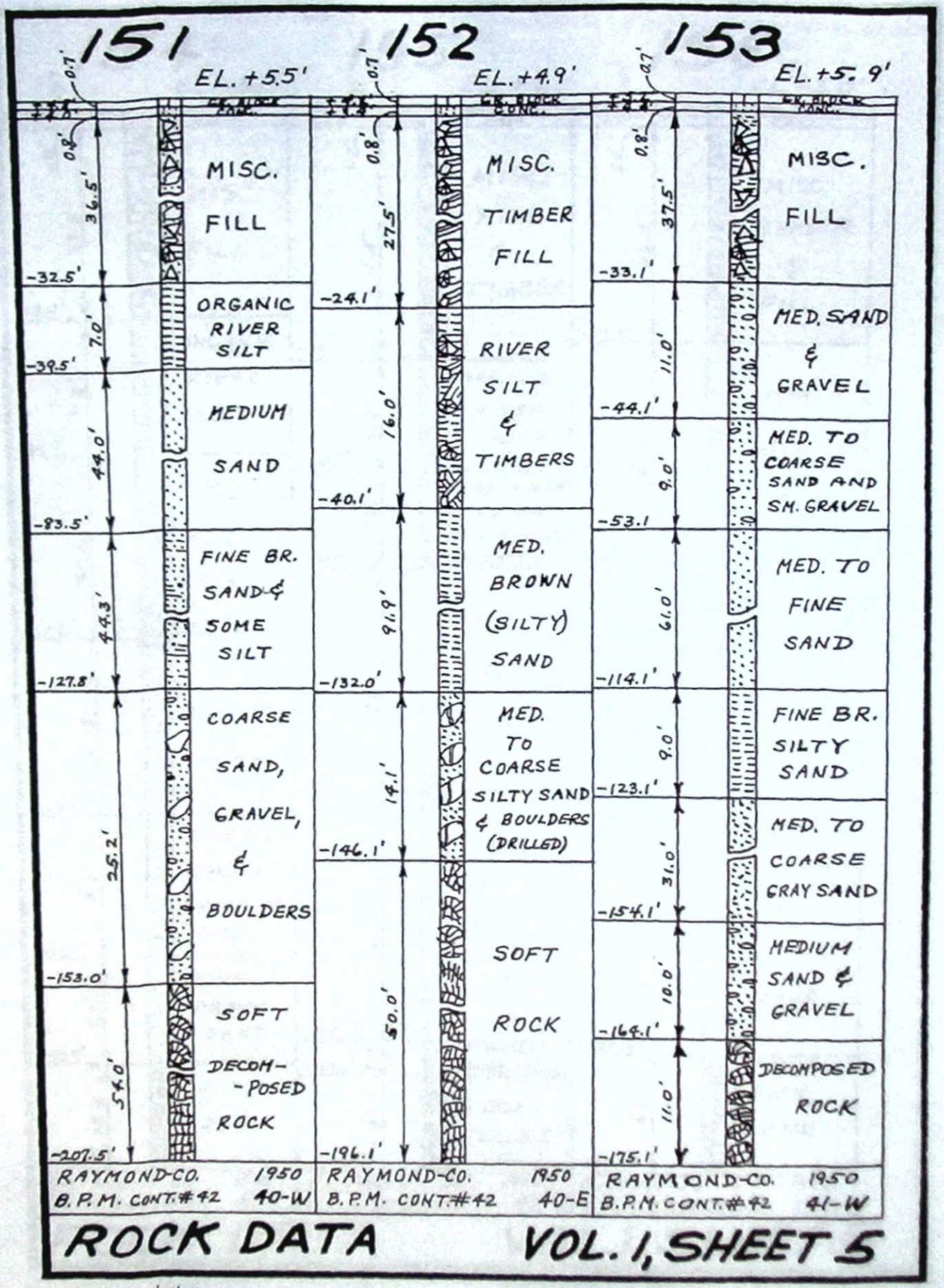
ROCK DATA VOL. 1, SHEET 5

Martine 3/1/65.

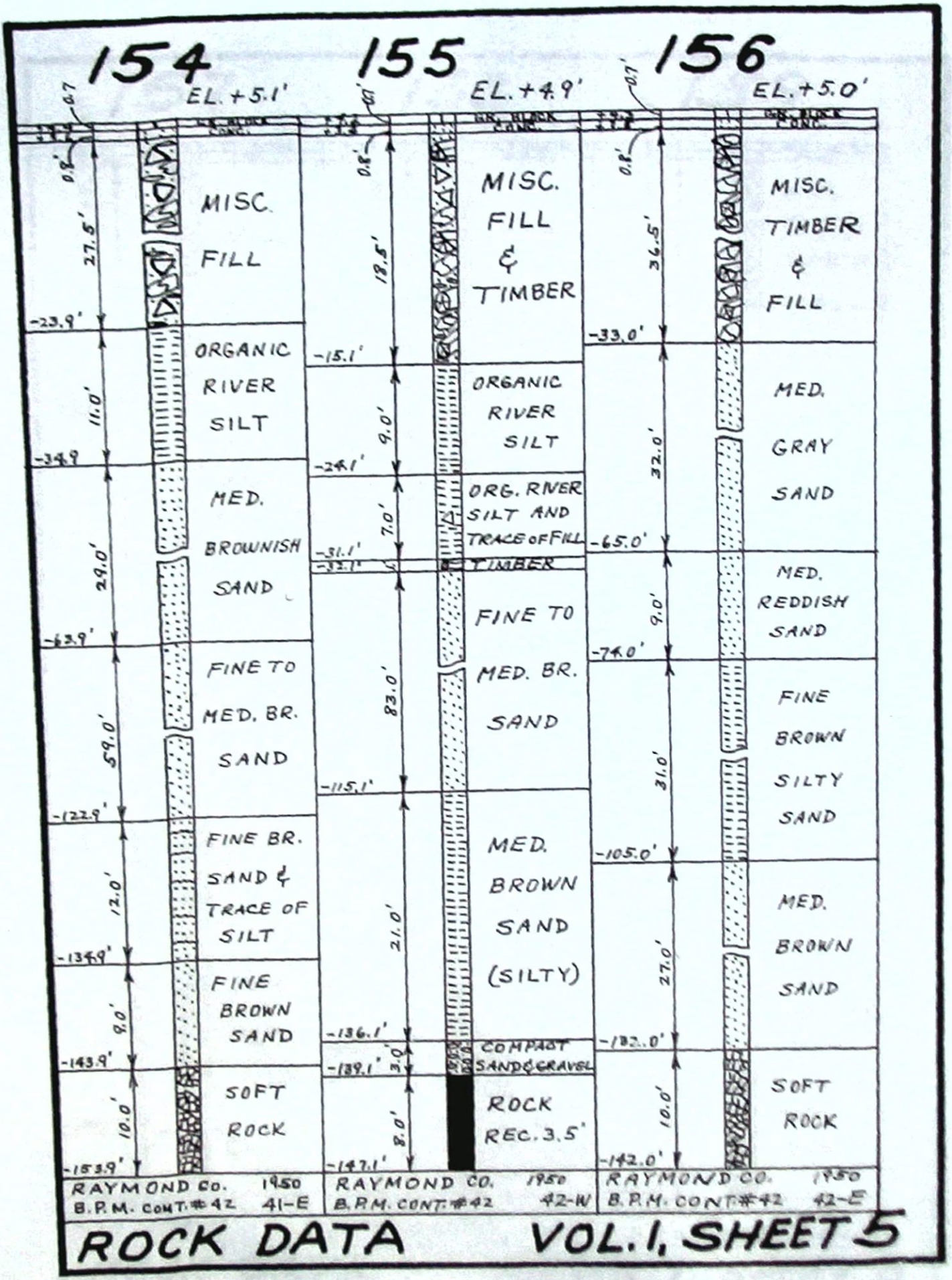


Martins 3/2/65


149
EL. +4.8'
0.7'
0.8'
28.5'
MISC. FILL
-25.2'
9.0'
RIVER SILT
-34.2'
21.0'
MED. BROWN SAND
-55.2
19.0'
BR. COARSE SAND & GRAVEL
-74.2'
11.0'
FINE TO MED. BR. SAND
-85.2'
20.0'
COARSE SAND & GRAVEL
-105.2'
18.3'
FINE BR. SILTY SAND
-123.5'
8.0'
ROCK REC. 2.9'
-131.5'
RAYMOND CO. 1950
B.P.M. CONT. #42 39-W
150
EL. +4.7'
0.7'
0.8'
6.5'
TIMBERS
-3.3'
12.0'
MISC. FILL
-15.3'
7.0'
ORGANIC SILT
-22.3'
12.0'
GRAYISH SAND & TIMBERS
-34.3'
20.0'
FINE GRAYISH SAND
-54.3'
21.0'
MEDIUM BROWN SAND
-75.3'
150 CONT.
-75.3'
9.0'
FINE BROWN SILTY SAND
-84.3'
20.0'
FINE BROWN SAND
-104.3
15.0'
MED. BR. SAND & TRACE OF CLAY
-119.3'
8.0'
ROCK REC. 4.8'
-127.3'
RAYMOND CO. 1950
B.P.M. CONT. #42 39-E
ROCK DATA
VOL. 1, SHEET 5
Martins 3/3/65.



Martins 3/5/65.



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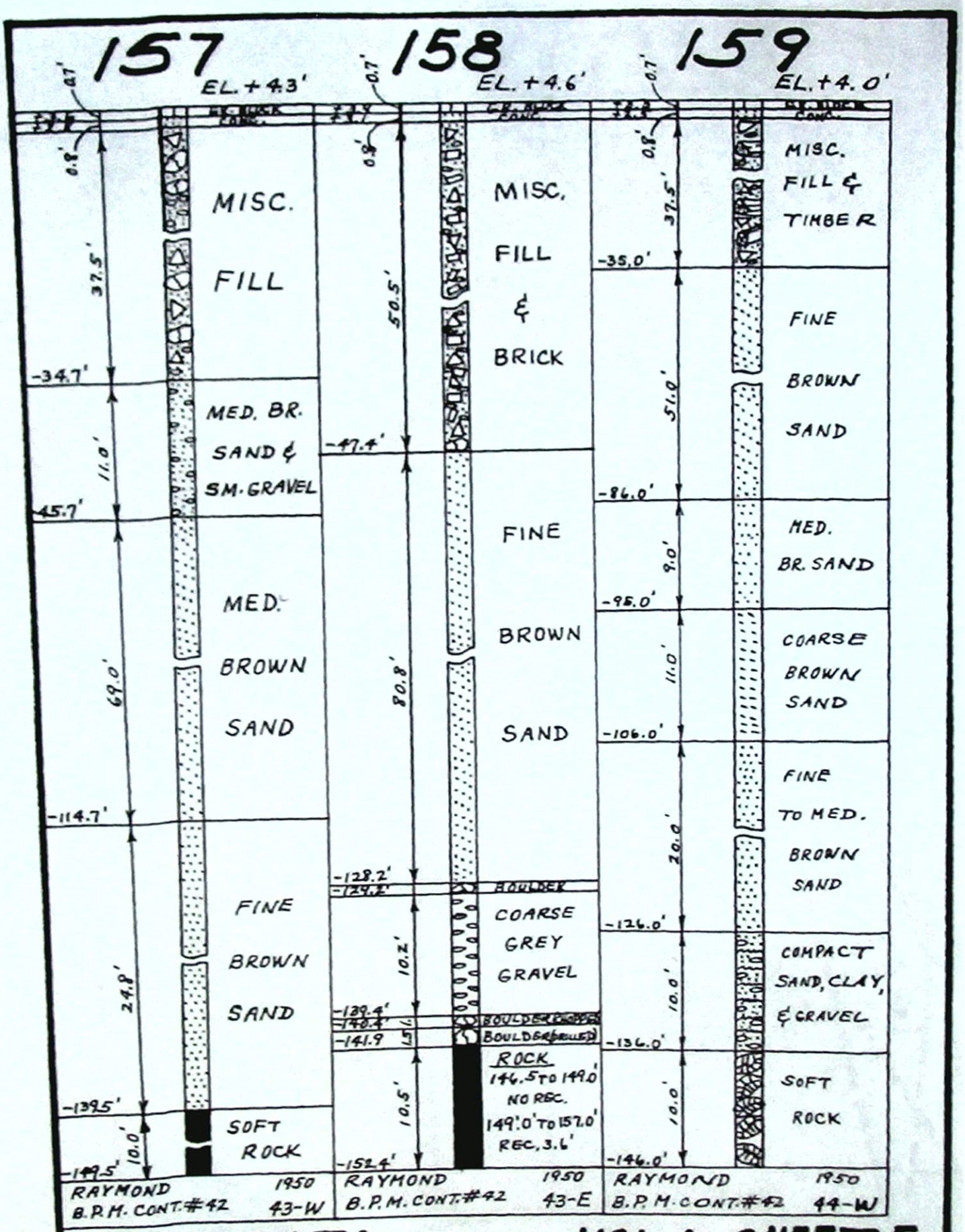

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