PHASE IA ARCHAEOLOGICAL SURVEY

NJ TRANSITGRID TRACTION POWER SYSTEM

Town of Kearny, Cities of Jersey City, Hoboken, Bayonne, and Union, and Townships of North Bergen and Weehawken, Hudson County, New Jersey

PREPARED FOR:

BEM Systems, Inc.
100 Passaic Avenue
Chatham, New Jersey 07928

June 2017

RGA CULTURAL RESOURCE CONSULTANTS

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Town of Kearny, Cities of Jersey City, Hoboken, Bayonne, and Union, and Townships of North Bergen and Weehawken, Hudson County, New Jersey

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Date:

June 16, 2017

EXECUTIVE SUMMARY

RGA, Inc. completed a Phase IA archaeological survey for the proposed NJ TRANSITGRID TRACTION POWER SYSTEM project to be constructed in the Town of Kearny, Cities of Jersey City, Hoboken, Bayonne, and Union, and Townships of North Bergen and Weehawken, in Hudson County, New Jersey. The purpose of the Phase IA archaeological survey was to determine if documented prehistoric and historic archaeological resources are present within the Area of Potential Effects (APE) and to assess the potential for the APE to contain undocumented, significant archaeological resources.

The Federal Transit Administration (FTA) and New Jersey Transit Corporation (NJ TRANSIT) plan to construct a microgrid within the Koppers Koke Site in Kearny, New Jersey. The proposed microgrid and associated infrastructure will enable trains to operate during widespread power failures. The facility will be sized to handle some of the daily operational power needs as well as emergency operations on a portion of the NJ TRANSIT and the National Railroad Passenger Corporation (Amtrak) systems, including some sections of the Northeast Corridor, Morris & Essex Line, and the Hudson-Bergen Light Rail Transit System (HBLR). This work requires the completion of cultural resources studies in compliance with Section 106 of the National Historic Preservation Act, as amended, the National Environmental Policy Act, and state regulations. The work was completed on behalf of NJ TRANSIT and its consultant, BEM Systems, Inc.

The impacts associated with the proposed project consist of the construction of a microgrid (hereafter the Main Facility) that will consist of a power generation plant that will range in output from 104 megawatt (MW) to 190MW on a 20-acre parcel in the Koppers Koke Site. The Main Facility and associated infrastructure will enable trains to operate during widespread power failures. Project-related substations, transformers, and frequency converters will also be built on the Main Facility site to accommodate the different power needs of Amtrak's Northeast Corridor and NJ TRANSIT's commuter and light rail services. NJ TRANSIT will connect to an existing high pressure natural gas line on a six-acre parcel to the southeast of the power generation site. A new traction power substation (the new Kearny Substation) will be built to replace Amtrak's existing Substation No. 41. The new Kearny Substation will be located within Amtrak property west of Substation No. 41 and will require the construction of a fill pad in Cedar Creek Marsh to support the new equipment, with an elevation above the anticipated 500-year flood elevation. A new NJ TRANSITGRID Hoboken East Substation will be constructed on NJ TRANSIT property between the Morris & Essex Line, the HBLR, and Jersey Avenue to serve the Henderson Street Substation. The new NJ TRANSITGRID Hoboken East Substation will be constructed on a 60-foot by 100-foot pad resting on fill that will be contained with a retaining wall to be constructed to raise the elevation of the substation site. Several electrical lines of varying sizes will also be constructed between the Main Facility site and the NJ TRANSIT Mason, new Kearny, and Henderson substations. From the new NJ TRANSITGRID Hoboken East Substation, the circuit would be divided with feeder lines running north and south to HBLR substations. Electrical lines along HBLR may be installed on new utility poles or within duct banks.

The Phase IA archaeological survey was completed in compliance with Section 106 of the National Historic Preservation Act of 1966, as amended and the National Environmental Policy Act of 1969. The Phase IA archaeological survey complies with the New Jersey Register of Historic Places Act Rules (N.J.A.C. 7:4) as enacted in 2008, and the New Jersey Department of Environmental Protection's Historic Preservation Office's (NJHPO) Guidelines for Phase I Archaeological Investigations and Guidelines for Preparing Cultural Resources Management Archaeological Reports (New Jersey Historic Preservation Office 1994, 1996, 2003).

The Phase IA archaeological survey determined that the APE has low to high sensitivity for prehistoric archaeological resources and low to high sensitivity for historic archaeological resources. Portions of the APE located where extensive ground disturbance has occurred have low sensitivity for prehistoric and historic archaeological resources. Proposed construction at the Main Facility site (Project Component A) and related natural gas pipeline and sanitary sewer connections may directly impact the State and

National Registers of Historic Places (NRHP) eligible Jersey City Water Works Pipeline, Jersey City Water Works Historic District, and Standard Chlorine Chemical Company Site, or undocumented prehistoric and historic archaeological resources, if any, within the APE. Project Component A has high sensitivity for prehistoric archaeological resources, due its proximity to the Standard Chlorine Chemical Company Site, and moderate sensitivity for historic archaeological resources related to the late nineteenth to early twentieth century drainage infrastructure construction of the Bergen and Hudson County Mosquito Commissions. Locations where new substations and a natural gas pipeline interconnection (Project Component B) are proposed have low prehistoric and historic archaeological sensitivity.

The proposed electrical line routes (Project Components C through G) have low to high sensitivity for prehistoric and historic archaeological resources. Portions of Project Components C through G located where extensive ground disturbance has occurred have low sensitivity for prehistoric and historic archaeological resources. No areas of archaeological sensitivity were identified in Project Component F. Known archaeological resources are located along Project Component E, and have archaeological sensitivity. Areas of Project Component E where prehistoric archaeological resources or deeply buried prehistoric land surfaces have been reported, and where limited ground disturbance has occurred, have moderate to high sensitivity for prehistoric archaeological resources. Areas along Project Component E proximate to documented historic archaeological resources, including the Covert/Larch Historic District, the New York, Susquehanna, and Western Railroad Engine Repair Site, the Morris Canal, St. Peter's Cemetery, and locations along Project Component G where archaeological resources exist associated with the Morris Canal, the Central Railroad of New Jersey (CRRNJ), and nineteenth century landfilling have moderate to high sensitivity for historic archaeological resources. Locations where Project Component G intersects the former route of the Morris Canal have high sensitivity for historic archaeological resources. In Bayonne and Weehawken, portions of Project Component G where geoarchaeological borings identified stable buried land surfaces are assessed with historic archaeological sensitivity. Locations in the Jersey City portion of Project Component G assessed with historic archaeological sensitivity during previous surveys not subjected to further investigation retain historic archaeological sensitivity. The installation of at-grade duct banks located along the length of the proposed electrical line would have no effect on archaeological resources within the APE.

Avoidance of direct impacts is recommended for areas of moderate to high prehistoric and/or historic archaeological sensitivity. Proposed direct impacts related to archaeological resources, if any, within the APE include the construction of underground duct banks, a natural gas pipeline, monopole foundations, and pile-driven structure foundations within Project Component A and the proposed new Kearny Substation. Installation of pile-driven foundations would have no adverse effect on the Standard Chlorine Chemical Company Site or undocumented prehistoric or historic archaeological resources, if any, within the APE, since no soil removal via excavation would result from the installation. Deeply buried Early to Middle Holocene upland landform soils associated with a documented prehistoric archaeological resource may extend into the new Kearny Substation portion of the APE based on available geotechnical data from previous studies of the Koppers Koke Site. Installation of pile-driven foundations would have no adverse effect on any archaeological resources that may be present in the deeply buried upland soils since no soil removal would result from the installation. No further archaeological survey is recommended in areas within the APE where pile-driven foundations are proposed. Proposed construction at Project Component A and related natural gas pipeline and sanitary sewer connections within the utility easement may directly impact the previously identified Jersey City Water Works Pipeline and Jersey City Water Works Historic District. Project Components C and D bisect the Jersey City Waterworks Pipeline at Route 7. Project Component E runs parallel to the Jersey City Waterworks Historic District from east of Route 7 to the Bergen Tunnel West Portal.

Avoidance of the Jersey City Water Works Pipeline and Jersey City Water Works Historic District could be achieved if no ground disturbing activities, including trenching and shaft drilling, are undertaken in the mapped route of the Jersey City Water Works Pipeline and the Jersey City Water Works Historic District. Construction plans would depict the location of the Jersey City Water Works Pipeline and Jersey City Water Works Historic District within Project Components A, C, D, and E and stipulate that no excavation or drilling occur within 25 feet of those locations. Underground duct banks or monopole foundations have the potential to adversely affect the Jersey City Water Works Pipeline and Jersey City Water Works Historic District. Duct banks located at grade would have no adverse effect on archaeological resources within Project Components C, D, and E.

The installation of underground duct banks or construction of foundations for new monopoles in areas of archaeological sensitivity in Project Components E and G would have direct impacts on prehistoric and historic archaeological resources, if any exist in the APE. Avoidance of direct impacts in these Project Components may include alterations to monopole placement, selection of installation options that involve shallow, rather than deep, ground disturbance, and the installation of at-grade duct banks. The installation of at-grade duct banks located along the length of the proposed electrical line routes would have no adverse effect on archaeological resources, if any, within the APE since no disturbance of subsurface soil strata would occur. The placement of monopoles or underground duct banks outside the archaeological sensitivity areas would minimize the likelihood that archaeological resources, if any, would be directly impacted by the proposed construction. Where sensitivity areas cannot be avoided through project design, selection of a construction option that will minimize ground disturbance that damages or destroys archaeological resources, if any, within the APE is recommended. Where archaeological resources may be deeply buried beneath thick historic and/or modern fill deposits, the installation of duct banks with shallow subsurface ground disturbance (i.e. no more than five feet below the existing ground surface) would conserve archaeological resources, if any, in deeply buried contexts. Recommendations for specific archaeological sensitivity zones within the APE address each of these avoidance options. An area of prehistoric archaeological sensitivity extends from east of Project Component A to near the western limit of Project Component B along the northern boundary of Project Component E. A potential for deeply buried upland soils exists in this sensitivity area. Installation of monopole foundations along the north side of Project Component E have the potential to adversely affect any prehistoric archaeological resources that may exist in this prehistoric archaeological sensitivity zone. Shallow underground duct banks no deeper than five feet below existing ground surface would have no adverse effect on archaeological resources within the APE since construction activities would not disturb deeply buried natural soils. Areas of Project Component E proximate to documented historic archaeological resources, including the Covert/Larch Historic District, the New York, Susquehanna, and Western Railroad Engine Repair Site, and St. Peter's Cemetery, have moderate sensitivity for historic archaeological resources. Installation of monopole foundations along the south side of Project Component E has the potential to adversely affect any historic archaeological resources related to the Covert/Larch Historic District and the New York, Susquehanna, and Western Railroad Engine Repair Site that may exist in this historic archaeological sensitivity zone. Installation of monopole foundations along the north side of Project Component E proximate to St. Peter's Cemetery has the potential to adversely affect any historic archaeological resources that may exist in this portion of the historic archaeological sensitivity zone. Installation of shallow underground duct banks no deeper than five feet below existing ground surface would have no adverse effect on archaeological resources within the APE provided that ground disturbing activities do not disturb natural soils underlying surficial fill layers. Duct banks installed at grade would have no adverse effect on archaeological resources within the APE.

Due to the depth of the culturally sensitive strata beneath historic and modern fill layers up to 25 feet thick and the limited nature of the construction impacts, few prudent and feasible approaches are available for archaeological identification and evaluation surveys. Conventional archaeological identification approaches, such as shovel test pits and remote sensing, are unlikely to fully penetrate fill deposits and provide adequate characterization of the APE. Monitoring and/or assessment of geotechnical borings by a qualified geoarchaeologist/archaeologist would be completed in archaeologically sensitive areas proximate to locations where monopole installations are proposed. Depending on the results of the geotechnical borings, archaeological monitoring and sampling during construction would be considered a prudent and feasible approach to archaeological survey where trench excavations deeper than five feet below ground surface are proposed or where drilled shafts will penetrate fill layers so that soil stratigraphy in the drilled shaft may be inspected by the archaeologist. For drilled shafts, where natural soils are deeply buried beneath fill layers, archaeological monitoring is unlikely to result in significant recovery of archaeological data. If archaeological resources are identified during monitoring, additional archaeological site investigation would be necessary to evaluate the potential eligibility of the resource for NRHP listing.

As project plans develop and the locations, nature, and extent of direct project impacts are refined, locations where further archaeological survey is warranted can be identified through continued consultation. In order to satisfy the FTA's Section 106 responsibilities, a Programmatic Agreement (PA) will be developed between the NJHPO, NJ TRANSIT, FTA and the Advisory Council on Historic Preservation in order to provide for the identification, evaluation, and appropriate treatment of historic properties. Stipulations can include the following tasks: Archaeological Monitoring; Phase II Archaeological Investigations; Effects Assessment; Mitigation; Curation; and Reporting. The stipulations within the PA will outline in detail all of the potential actions necessary to carry out the requirements of the Section 106 process as project plans develop and are finalized.

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1.0 INTRODUCTION

RGA, Inc. (RGA) completed a Phase IA archaeological survey for the proposed NJ TRANSITGRID TRACTION POWER SYSTEM project that will include electrical line improvements, the construction of a new substation, and the construction of an electric power generating plant on a 20-acre parcel of land within the Koppers Koke Site located in the Town of Kearny and the construction of a new substation and electrical lines in the Cities of Jersey City, Hoboken, Bayonne, and Union, and Townships of North Bergen and Weehawken, Hudson County, New Jersey (see Section 1.2; Figures 1.1a – 1.1c and 1.2a – 1.2c). The purpose of the Phase IA archaeological survey was to determine if documented prehistoric and historic archaeological resources are present within the Area of Potential Effects (APE) and to assess the potential for the APE to contain undocumented, significant archaeological resources.

The Federal Transit Administration (FTA) and New Jersey Transit Corporation (NJ TRANSIT) plan to construct a microgrid within the Koppers Koke Site in Kearny, New Jersey. The proposed microgrid and associated infrastructure will enable trains to operate during widespread power failures. The facility will be sized to handle some of the daily operational power needs as well as emergency operations on a portion of the NJ TRANSIT and the National Railroad Passenger Corporation (Amtrak) systems, including some sections of the Northeast Corridor, Morris & Essex Line, and the Hudson-Bergen Light Rail Transit System (HBLR). This work requires the completion of cultural resources studies in compliance with Section 106 of the National Historic Preservation Act, as amended, the National Environmental Policy Act, and state regulations. The work was completed on behalf of NJ TRANSIT and its consultant, BEM Systems, Inc.

The impacts associated with the proposed project consist of the construction of a microgrid (hereafter the Main Facility) that will consist of a power generation plant that will range in output from 104MW to 190MW on a 20-acre parcel in the Koppers Koke Site. The Main Facility and associated infrastructure will enable trains to operate during widespread power failures. Project-related substations, transformers, and frequency converters will also be built on the Main Facility site to accommodate the different power needs of Amtrak's Northeast Corridor and NJ TRANSIT's commuter and light rail services. NJ TRANSIT will connect to an existing high pressure natural gas line on a six-acre parcel to the southeast of the power generation site. A new traction power substation (the new Kearny Substation) will be built to replace Amtrak's existing Substation No. 41. The new Kearny Substation will be located within Amtrak property west of Substation No. 41 and will require the construction of a fill pad in Cedar Creek Marsh to support the new equipment, with an elevation above the anticipated 500-year flood elevation. A new NJ TRANSITGRID Hoboken East Substation will be constructed on NJ TRANSIT property between the Morris & Essex Line, the HBLR, and Jersey Avenue to serve the Henderson Street Substation. The new NJ TRANSITGRID Hoboken East Substation will be constructed on a 60-foot by 100-foot pad resting on fill that will be contained with a retaining wall to be constructed to raise the elevation of the substation site. Several electrical lines of varying sizes will also be constructed between the Main Facility site and the NJ TRANSIT Mason, new Kearny, and Henderson substations. From the new NJ TRANSITGRID Hoboken East Substation, the circuit would be divided with feeder lines running north and south to HBLR substations. Electrical lines along HBLR may be installed on new utility poles or within duct banks.

Sharon D. White and Teresa Bulger were the Principal Investigators and authored this report. Project geomorphologist John Stiteler conducted research and analysis of geotechnical data for the Main Facility. Allison Gall and Tabitha Hilliard conducted background research in July 2015 and November 2016. David Strohmeier and Patricia McEachen produced report graphics. Paul McEachen, Mary Lynne Rainey, and Richard Grubb edited the report. Catherine Smyrski edited and formatted this report. Copies of this report are on file at RGA headquarters in Cranbury, New Jersey.

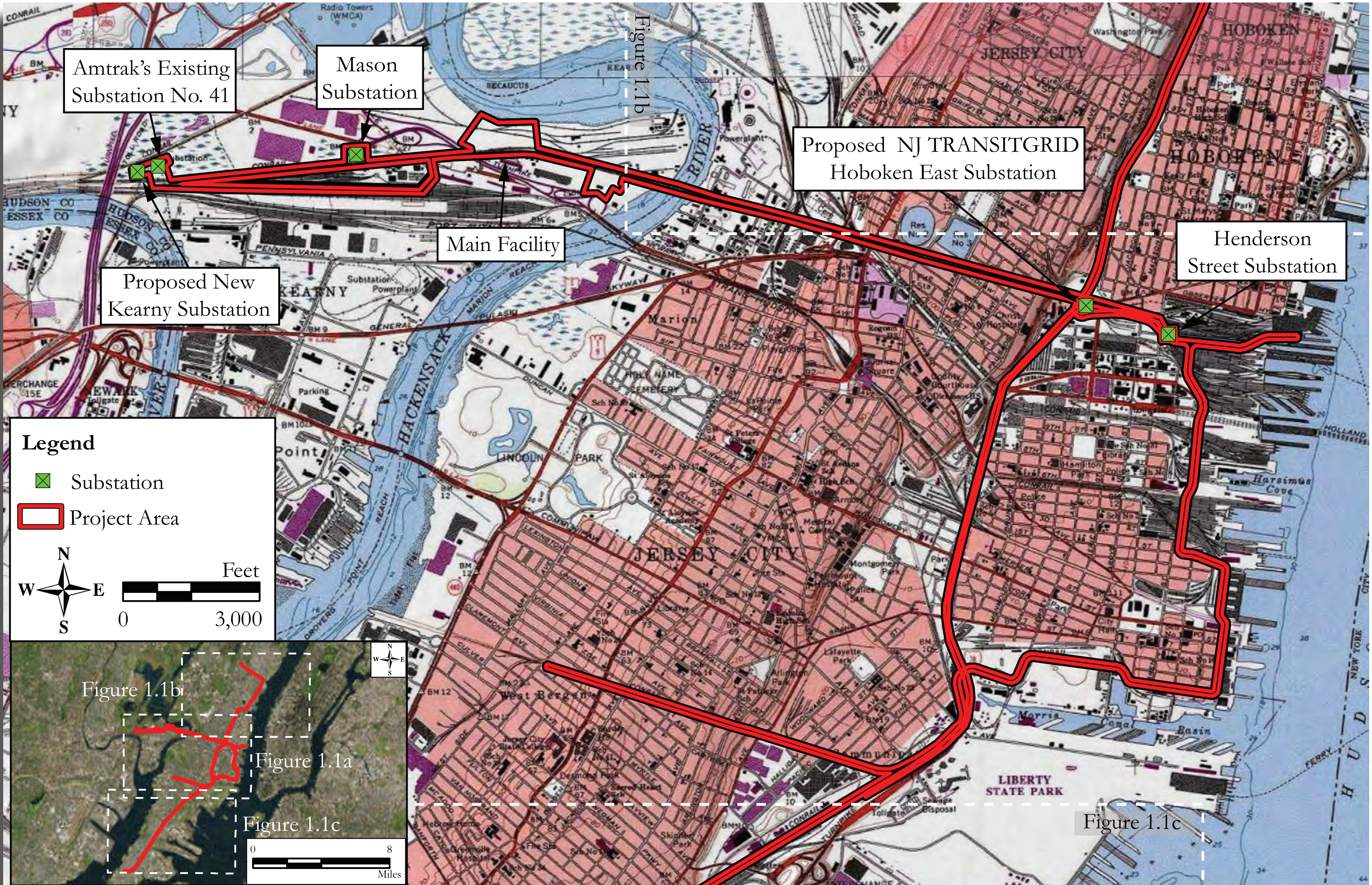

Figure 1.1a: U.S.G.S. Map
(from U.S.G.S. 7.5' Quadrangles: 1967 Jersey City, NJ [photorevised 1981]; 1995 Weehawken, NJ-NY).

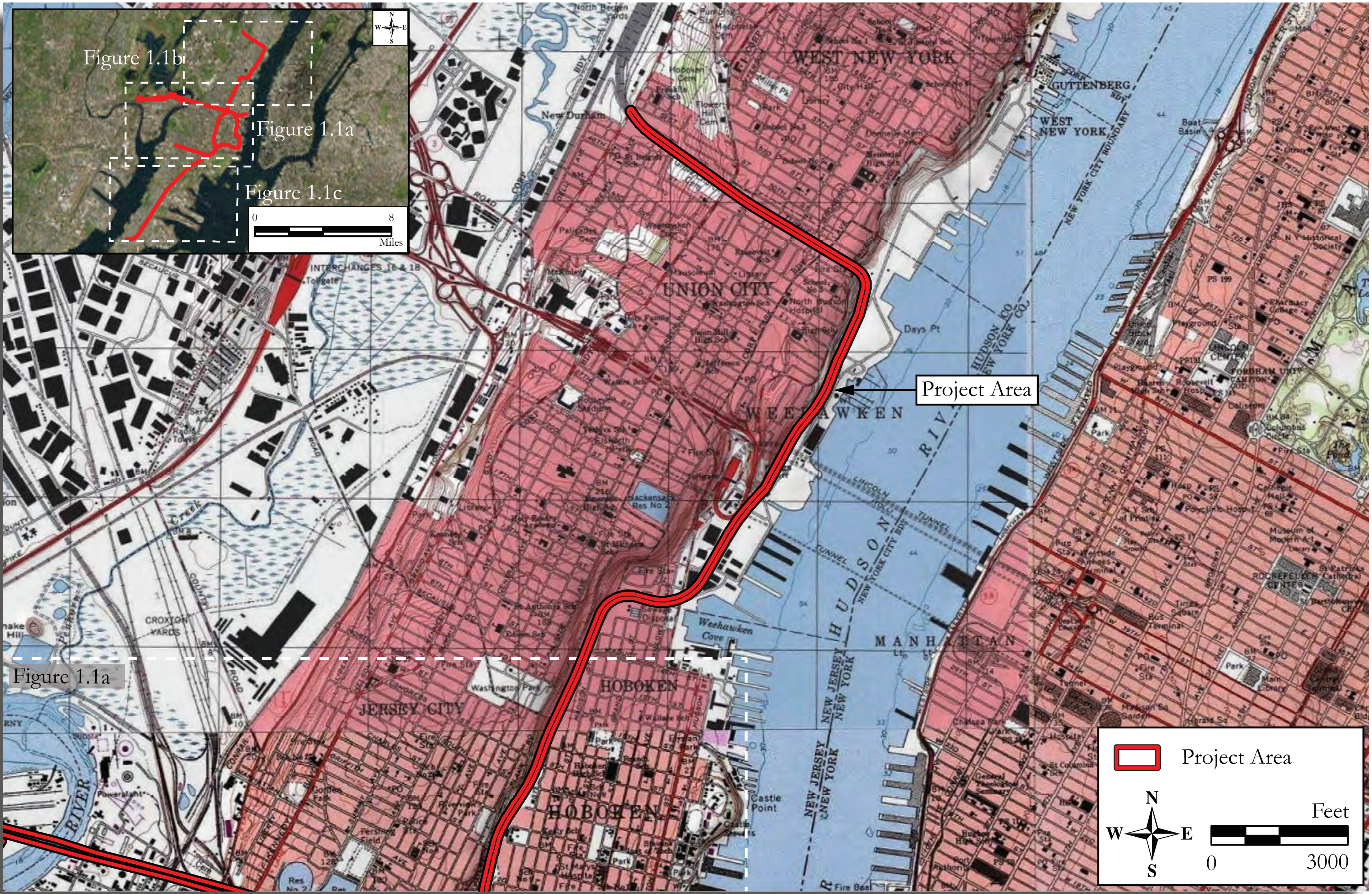

Figure 1.1b: U.S.G.S. Map
(from U.S.G.S. 7.5' Quadrangles: 1967 Jersey City, NJ [photorevised 1981]; 1995 Weehawken, NJ-NY).

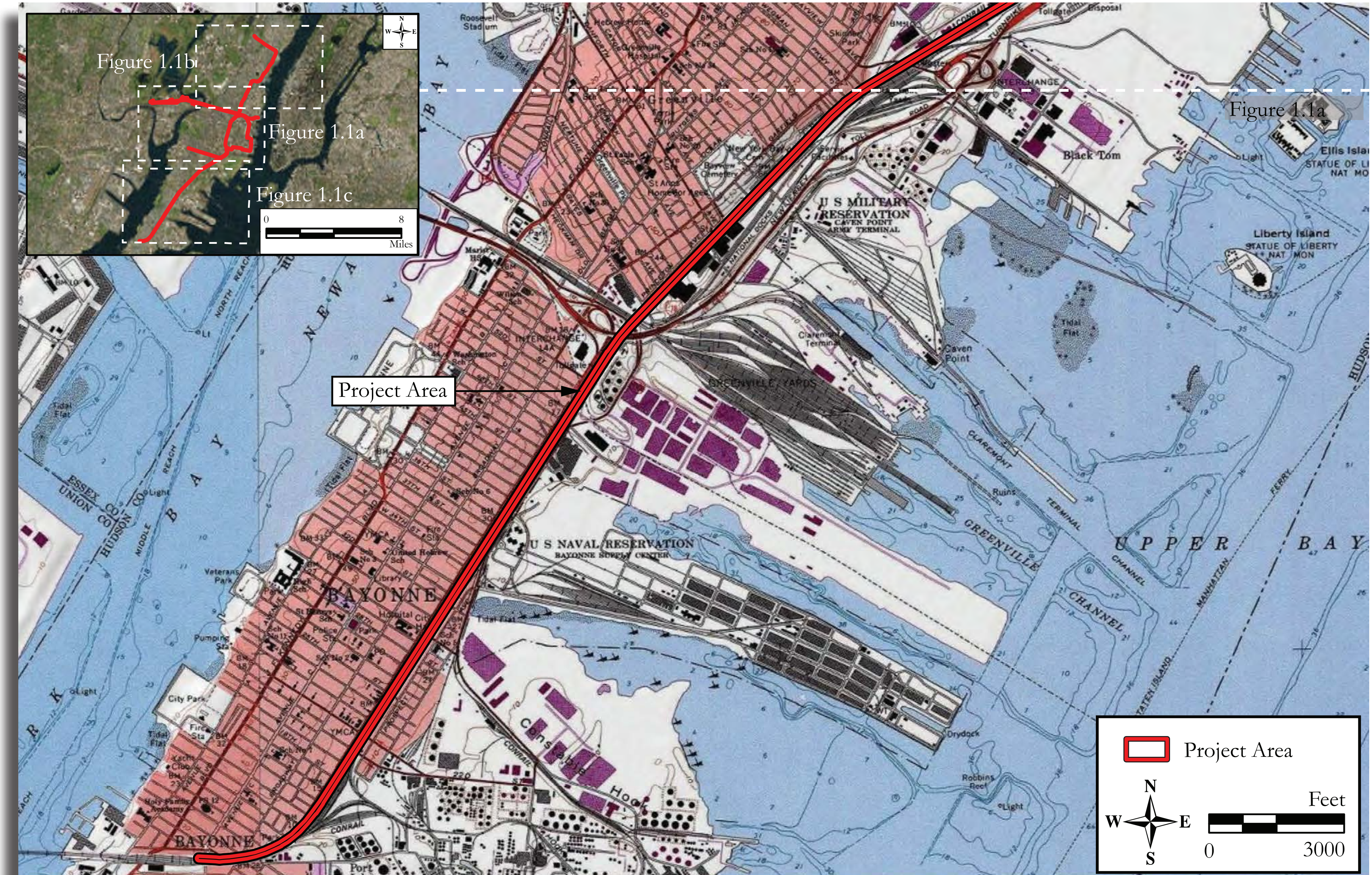

Figure 1.1c: U.S.G.S. Map
(from U.S.G.S. 7.5' Quadrangles: 1967 Jersey City, NJ [photorevised 1981]; 1995 Weehawken, NJ-NY).

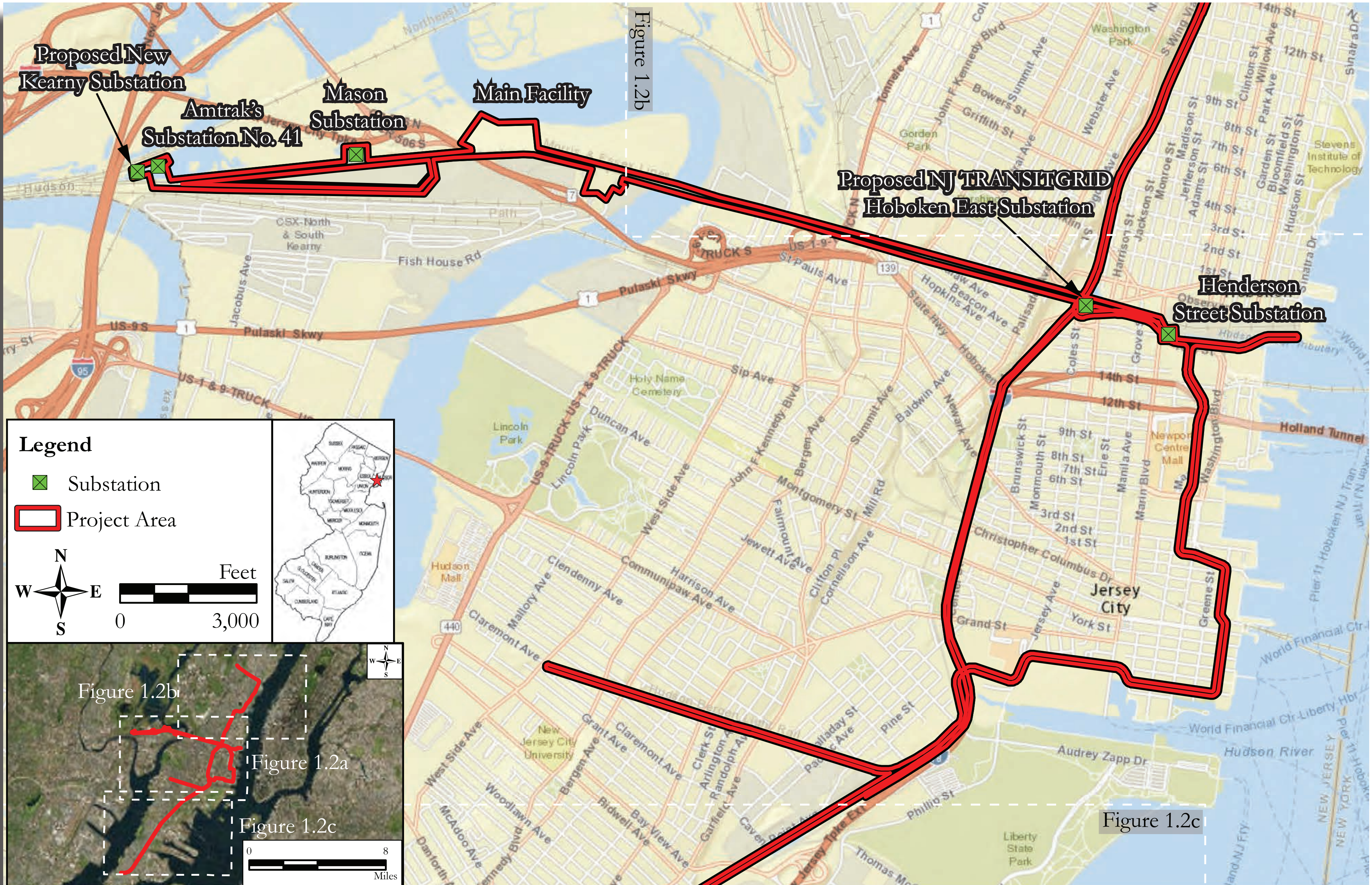

Figure 1.2a: County Map
(World Street Map, ESRI 2014).

Figure 1.2b: County Map
(World Street Map, ESRI 2014).

Figure 1.2c: County Map
(World Street Map, ESRI 2014).

1.1 Regulatory Context

This Phase IA archaeological survey was performed in accordance with Section 106 of the National Historic Preservation Act of 1966, as amended; the Protection of Historic Properties, as revised in 2004 (36 CFR 800); Procedures for Determining Site Eligibility for the National Register of Historic Places (NRHP) (36 CFR 60 and 63); Executive Order 11593, Protection and Enhancement of the Cultural Environment; the Archaeological and Historic Preservation Act of 1974; the National Environmental Policy Act of 1969; and the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation (48 FR 44716). Under the requirements of these federal laws, regulations and guidelines, archaeological and historical resources eligible for listing on the NRHP must be identified in order to determine if the project, which is a federal undertaking, will affect such resources. The lead federal agency for this project is the FTA, and the main state-level review agency is the New Jersey Department of Environmental Protection (NJDEP) – Historic Preservation Office (NJHPO). This Phase IA archaeological survey complies with NJDEP's Guidelines for Phase I Archaeological Investigations and Guidelines for Preparing Cultural Resources Management Archaeological Reports (NJHPO 1994, 1996, 2003). The Principal Investigators exceed the professional qualifications standards of 36 CFR 61 set forth by the National Park Service (see Attachment A).

1.2 Project Description

The FTA and NJ TRANSIT plan to construct the NJ TRANSITGRID TRACTION POWER SYSTEM, which will be composed of the Main Facility, interconnections to existing high-pressure natural gas pipelines and a new metering station to be installed within an adjacent six-acre parcel, a new traction power substation (the new Kearny Substation), a new NJ TRANSIT substation (new NJ TRANSITGRID Hoboken East Substation), and several electrical lines (see Attachment B).

The Main Facility will consist of an approximately 190-megawatt (MW) natural gas fired electric power generating plant on a 20-acre parcel in the Koppers Koke Site in Kearny. The Main Facility will consist of bays for five turbines and six reciprocating engines, and associated equipment such as pumps, and switchgear. The site would also include a maintenance shop, locker room, laboratory, control room, office facilities, and other general-use spaces. Up to five stacks for the ventilation of natural gas by products (e.g., carbon dioxide, methane, and nitrous oxide) from the gas turbines will be located near the center of the parcel. The stacks will be approximately 150 feet high and 10 feet in diameter. Project-related substations, transformers, and frequency converters will also be built on the Main Facility site to accommodate the different power needs of Amtrak's Northeast Corridor and NJ TRANSIT's commuter and light rail services. The Main Facility may be built on a foundation of 24-inch diameter closed end pipe piles that will be driven to rock approximately 75 feet below the existing ground surface.

During a regional or local power outage condition, the Main Facility would disconnect from the PSE&G commercial grid and become the primary source of power to support the following services, subject to further design and concept verification:

- Limited commuter rail service on Amtrak's Northeast Corridor between New York Penn Station and County Yard/Jersey Avenue Station in New Brunswick via connection to a new Kearny Substation;
- Limited NJ TRANSIT commuter rail service between Hoboken and Newark's Broad Street Station on the Morris & Essex Line, via connection to the Mason Substation;
- Service on NJ TRANSIT's HBLR between Tonnelle Avenue in North Bergen and 8th Street in Bayonne, via connections to the individual traction power substations along the HBLR right-of-way (ROW).

In addition to providing traction power, the Main Facility would be designed to support the following non-traction loads, to the extent technically feasible:

- NJ TRANSIT Hoboken Terminal and Yard through input to Henderson Substation;
- The majority of NJ TRANSIT HBLR station loads, supported through the connections to the traction power substations mentioned above;
- Northeast Corridor signal power, tunnel ventilation, pumping, and lighting loads for the sections of operable track;
- NJ TRANSIT Main Line's operating segment signal power.

Interconnections will be built to existing high pressure natural gas pipelines on a six-acre parcel to the southeast of the Main Facility in Kearny. The approximately 0.5-mile long gas line interconnection will extend eastward along the southern border of the Redevelopment Area, run beneath the Morris & Essex Line, and southward within the six-acre parcel to connect to one or two of the existing pipelines (see Attachment B). The gas line interconnection will be installed in a trench two to three feet in width and five feet deep. A gas metering station enclosed in a small structure, security fencing, and other security improvements would be installed on the six-acre parcel. Water and sewer connections are to be tied into any sanitary sewer and water main extensions that may be brought to the Main Facility site by other developers. If no extensions have been constructed, the project would include the installation of a 12-inch-diameter gravity sewer between the Main Facility site and one of the Kearny Municipal Utilities Authority pump stations south of the Morris & Essex Line and CSX South Kearny Yard. One possible pump station is at the intersection of 2nd Street and Central Avenue and the other pump station is at the intersection of Jacobus Avenue and Pennsylvania Avenue.

The new Kearny Substation will be built to replace Amtrak's existing Substation No. 41 (see Attachment B). The new Kearny Substation will be located within Amtrak property west of Substation No. 41 and will require the construction of a fill pad in Cedar Creek Marsh to support the new equipment. This new fill area will need a final ground surface elevation extending above the anticipated 500-year flood elevation to meet NJ TRANSIT's Flood Design Criteria. The new Kearny Substation will be built on a foundation of piles that will be driven to rock.

The new NJ TRANSITGRID Hoboken East Substation will be constructed on NJ TRANSIT property between the Morris & Essex Line, HBLR, and Jersey Avenue to serve the new Henderson Street Substation (by others). The new NJ TRANSITGRID Hoboken East Substation will be constructed on a 60-foot by 100-foot pad resting on fill that will be contained by a retaining wall to be constructed to raise the elevation of the substation site. No disturbance of the existing ground surface is anticipated by foundation construction.

Several electrical lines of varying sizes will be constructed between the Main Facility site and the NJ TRANSIT Mason Substation to supply power to the Morris & Essex Line; between the Main Facility site and new Kearny Substation to supply power to the Northeast Corridor; and between the Main Facility site and new NJ TRANSITGRID Hoboken East and Henderson substations. Electrical lines between the Main Facility site and the new NJ TRANSITGRID Hoboken East and Henderson substations will be routed within the Morris & Essex Line ROW (see Attachment B). Electrical line route segments on the Morris & Essex Line include:

- Main Facility to Mason Substation, approximately 0.7 miles in length
- Main Facility to new Kearny Substation, approximately 1.75 miles in length
- Main Facility to Henderson Street Substation & NJ TRANSITGRID Hoboken East Substation, approximately 2.9 miles in length

At the Hackensack River, the Morris & Essex electrical line will include the installation of a submarine cable along the river bottom. A segment of the Morris & Essex electrical line will travel through the 0.8-mile Bergen Tunnels.

From the new NJ TRANSITGRID Hoboken East Substation, the circuit would be divided with a feeder headed north on the HBLR easement to feed the HBLR north substations, a feeder headed east to feed Hoboken Yard and a small section of HBLR just south of Hoboken Yard , and a feeder headed south to NJ TRANSIT's Caven Point facility. This route for the south feeder would use a NJ TRANSIT easement (parallel to Hoboken Avenue), continue along NJ Turnpike (I-78) ROW to the Caven Point facility, and continue service to HBLR. Monopoles would be installed between the new NJ TRANSITGRID Hoboken East Substation and the NJ Turnpike, where the line would continue south attached directly to the NJ Turnpike structure. NJ TRANSIT is coordinating with the NJ Turnpike Authority regarding this electrical line route. In the event the NJ Turnpike route is not viable, the electrical line route will proceed from the new NJ TRANSITGRID Hoboken East Substation through Jersey City along the HBLR ROW.

The proposed electrical lines will be installed on new monopoles of varying heights wherever feasible. Between the Main Facility site and the New Henderson Substation, monopoles of similar characteristics to existing infrastructure will be installed in proximity to the existing electrical lines along the Morris & Essex Line's ROW at intervals of 1,200 to 1,500 feet. In the industrial area in Kearny, new monopoles could stand up to 240 feet in height and would be located at a spacing of approximately 1,000 feet along the Morris & Essex Line tracks to feed the Mason and new Kearny Substations. Within Cedar Creek Marsh South, two existing lattice towers would be removed and replaced with one monopole up to 240 feet in height. Electrical lines along the HBLR will be installed on new monopoles up to 39 feet high. Monopole foundations varying in diameter between two and 12 feet will be constructed in auger-drilled shafts with permanent steel casing and may extend to 20 to 95 feet below ground surface.

Use of underground cables in duct banks and submarine cables will be considered in locations where overhead construction is not practical. Duct banks would be located within the railroad ROW and designed to protect the electrical cables from water damage and physical stress. Submarine cables may be used to cross the Hackensack River to feed the HBLR and Hoboken Yard. If submarine cables are not used in this location, the electrical line will be attached directly to the Lower Hack Draw Bridge. The lines would be attached internally to existing tunnel walls where they pass through the Bergen Tunnel in Jersey City and between John F. Kennedy Boulevard in Weehawken Township and John F. Kennedy Boulevard in North Bergen Township, where the HBLR runs underground below 48th Street. Underground duct banks will be installed in trenches three to five feet in width and three to five feet deep.

1.3 Area of Potential Effects

The APE is defined in 36 CFR 800.16(d) as "the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if any such properties exist. The area of potential effects is influenced by the scale and nature of an undertaking and may be different for different kinds of effects cause[d] by the undertaking."

The APE for the project includes locations that may potentially be impacted by construction, or that may experience effects once construction is completed. For example, the APE includes all locations where an undertaking may result in disturbance of the ground and where the activity may result in changes in land use. Project effects can include physical destruction, demolition, damage, or the alteration of an historic resource. The APE includes all locations of potential ground disturbance for 1) the Main Facility (Project Component A), 2) the natural gas pipeline interconnection (Project Component B), 3) the Morris & Essex electrical lines (Project Components C, D, and E), 4) new Kearny Substation (part of Project Component D), 5) new NJ TRANSITGRID Hoboken East Substation (part of Project Component E), and 6) the HBLR north and south electrical lines (Project Component G) (Figures 1.3a – 1.3c; Attachment B).

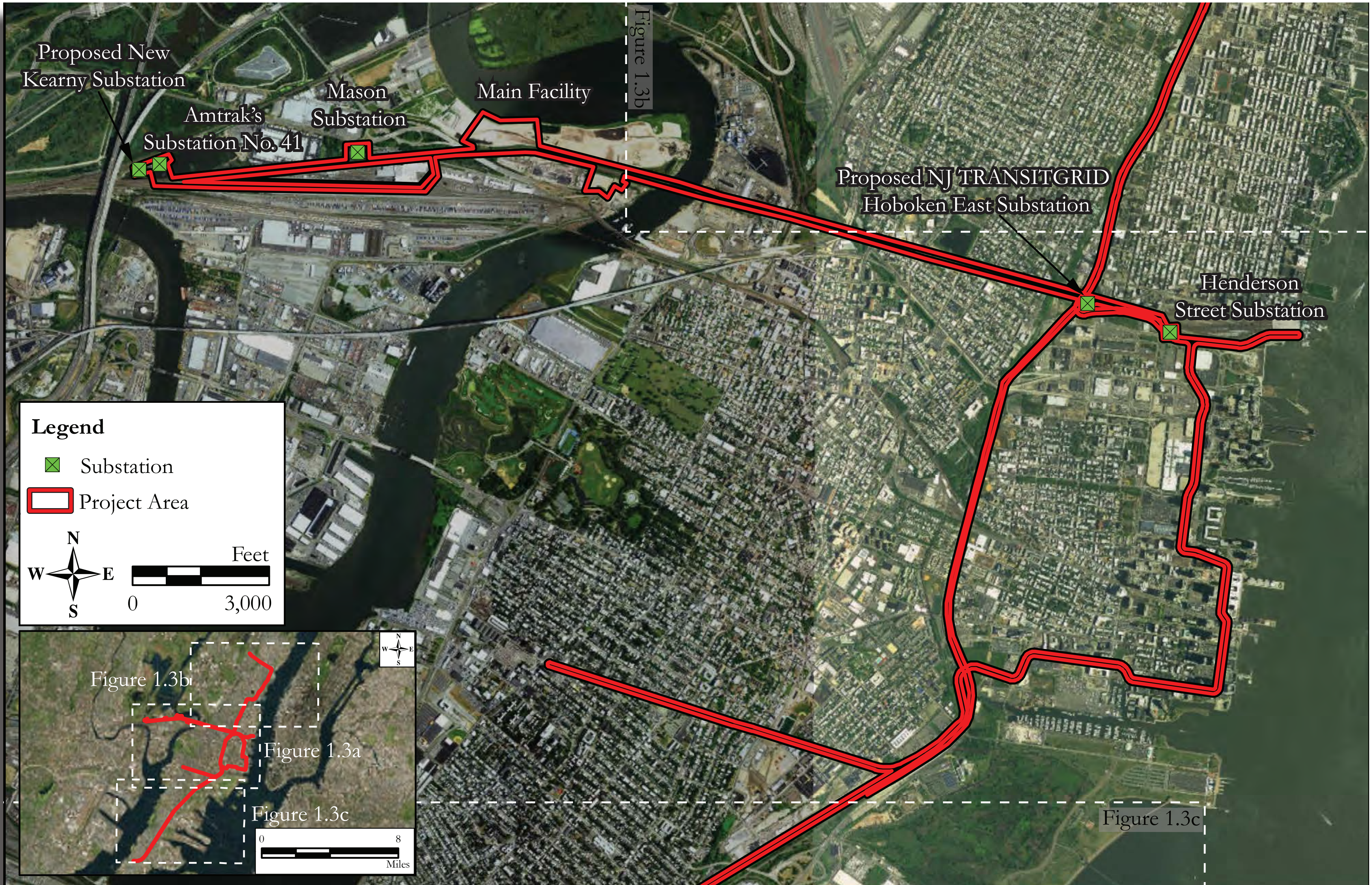

Figure 1.3a: Aerial photograph showing the APE
(World Imagery, ESRI 2014).

Figure 1.3b: Aerial photograph showing the APE
(World Imagery, ESRI 2014).

Figure 1.3c: Aerial photograph showing the APE
(World Imagery, ESRI 2014).

2.0 RESEARCH GOALS AND DESIGN

The goals of the Phase IA archaeological survey were to determine if documented prehistoric and historic archaeological resources are present within the APE and to assess the potential for the APE to contain undocumented, significant archaeological resources. Determinations of significance or potential significance are based on the National Register Criteria of historic and/or archaeological significance.

2.1 National and New Jersey Registers of Historic Places Criteria

Section 106 of the National Historic Preservation Act of 1966, as implemented by federal regulations appearing at 36 Code of Federal Regulations (CFR) Part 800, requires federal agencies to consider the effects of their actions on any properties listed in or determined eligible for listing in the NRHP. Federal agency preservation officials, in consultation with the New Jersey State Historic Preservation Office (NJHPO), must determine whether a proposed action would have any effects on the characteristics of an historic property that qualifies it for the State and/or National Register. If no historic properties are affected or adversely affected then the Section 106 process is complete. If historic properties are adversely affected then consultation continues, and a Memorandum of Agreement or a Programmatic Agreement is executed to mitigate or minimize the adverse effect.

Significant historic properties include districts, structures, objects, or sites that are at least 50 years of age and meet at least one National Register criterion (National Park Service 1995). Criteria used in the evaluation process are specified in the Code of Federal Regulations, Title 36, Part 60, National Register of Historic Places (36 CFR 60.4). To be eligible for inclusion in the National Register of Historic Places, a historic property(s) must possess:

> the quality of significance in American History, architecture, archaeology, engineering, and culture [that] is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and:

a) that are associated with events that have made a significant contribution to the broad patterns of our history, or

b) that are associated with the lives of persons significant in our past, or

c) that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components lack individual distinction, or

d) that have yielded, or may be likely to yield, information important in prehistory or history (36 CFR 60.4).

There are several criteria considerations. Ordinarily, cemeteries, birthplaces, or graves of historical figures, properties owned by religious institutions or used for religious purposes, structures that have been moved from their original locations, reconstructed historic buildings, properties primarily commemorative in nature, and properties that have achieved significance within the past 50 years shall not be considered eligible for the National Register of Historic Places. However, such properties will qualify if they are integral parts of districts that do meet the criteria or if they fall within the following categories:

a) a religious property deriving primary significance from architectural or artistic distinction or historical importance, or

b) a building or structure removed from its original location but which is significant primarily for architectural value, or which is the surviving structure most importantly associated with a historic person or event, or

c) a birthplace or grave of a historical figure of outstanding importance if there is no other appropriate site or building directly associated with his/her productive life, or

d) a cemetery which derives its primary significance from graves of persons of transcendent importance, from age, from distinctive design features, or from association with historic events, or

e) a reconstructed building when accurately executed in a suitable environment and presented in a dignified manner as part of a restoration master plan, and when no other building or structure with the same association has survived, or

f) a property primarily commemorative in intent if design, age, tradition, or symbolic value has invested it with its own historic significance, or

g) a property achieving significance within the past 50 years if it is of exceptional importance. (36 CFR 60.4)

When conducting National Register evaluations, the physical characteristics and historic significance of the overall property are examined. While a property in its entirety may be considered eligible based on Criteria A, B, C, and/or D, specific data is also required for individual components therein based on date, function, history, and physical characteristics, and other information. Resources that do not relate in a significant way to the overall property may contribute if they independently meet the National Register criteria.

A contributing building, site, structure, or object adds to the historic architectural qualities, historic associations, or archeological values for which a property is significant because a) it was present during the period of significance, and possesses historic integrity reflecting its character at that time or is capable of yielding important information about the period, or b) it independently meets the National Register criteria. A non-contributing building, site, structure, or object does not add to the historic architectural qualities, historic associations, or archeological values for which a property is significant because a) it was not present during the period of significance, b) due to alterations, disturbances, additions, or other changes, it no longer possesses historic integrity reflecting its character at that time or is incapable of yielding important information about the period, or c) it does not independently meet the National Register criteria.

Archaeological sites are frequently eligible for inclusion on the National Register under Criterion D. The application of Criterion D to archaeological sites is based on a researcher's assessment of a particular site's significance and whether a particular site is likely to yield important information for the reconstruction of past lifeways (Glassow 1977; Talmage and Chesler 1977; Raab and Klinger 1977; Moratto and Kelly 1978; Raab 1981; Tainter and Lucas 1983; Shott 1987).

Raab and Klinger (1977) have argued that significance should be measured in terms of a site's potential to provide information on specific research issues that are carefully formulated based on prior research studies. Glassow (1977) and Tainter and Lucas (1983) have argued that significance should be judged on the theory neutral dimensions of variety, quantity, clarity, integrity, and environmental context. An archaeological site is evaluated as significant when it possesses the potential to address important research issues and the integrity to convey this significance.

The empirical dimensions of a site, including the presence of sufficient data sets to address significant research issues, must be considered to determine integrity. Only sites possessing both the potential to address specific research questions coupled with integrity are considered significant (King 1998:77; Little 1997:179-180; Little et al. 2000; National Park Service 1995:44-46).

2.2 Criteria of Adverse Effect

Whenever a historic property may be affected by a proposed undertaking, Federal agency officials must assess whether the project constitutes an adverse effect on the historic property by applying the criteria of adverse effect. According to the Advisory Council on Historic Preservation, the criteria of adverse effect (36 CFR 800.5), is as follows:

1) An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that would qualify it for inclusion in the National Register, in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Consideration shall be given to all qualifying characteristics of a historic property, including those that may have been identified subsequent to the original evaluation for the property's eligibility for the National Register. Adverse effects may include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance or cumulative.

2) Adverse effects on historic properties include, but are not limited to (36 CFR 800.5(a)(2)):

    i) Physical destruction of or damage to all or part of the property;

    ii) Alteration of a property, including restoration, rehabilitation, repair, maintenance, stabilization, hazardous material remediation and provision of handicapped access, that is not consistent with the Secretary's Standards for the Treatment of Historic Properties (36 CFR part 68) and applicable guidelines;

    iii) Removal of the property from its historic location;

    iv) Change of the character of the property's use or of physical features within the property's setting that contribute to its historic significance;

    v) Introduction of visual, atmospheric or audible elements that diminish the integrity of the property's significant historic features;

    vi) Neglect of a property which causes its deterioration, except where such neglect and deterioration are recognized qualities of a property of religious and cultural significance to an Indian tribe or Native Hawaiian organization; and

    vii) Transfer, lease, or sale of property out of Federal ownership or control without adequate and legally enforceable restrictions or conditions to ensure long-term preservation of the property's historic significance.

A finding of adverse effect or no adverse effect could occur based on the extent of alteration to a historic property, and the proposed treatment measures to mitigate the effects of a proposed undertaking. According to 36 CFR 800.5(3)(b):

> The agency official, in consultation with the NJHPO/THPO, may propose a finding of no adverse effect when the undertaking's effects do not meet the criteria of § 800.5(a)(1) or the undertaking is modified or conditions are imposed, such as the subsequent review of plans for rehabilitation by the NJHPO/THPO to ensure consistency with the Secretary's Standards for the Treatment of Historic Properties (36 CFR part 68) and applicable guidelines, to avoid adverse effects.

3.0 ENVIRONMENTAL CONTEXT

The APE is located within the Piedmont Lowlands physiographic province bounded on the west by the Delaware River and on the east by the Hudson River and Upper New York Bay (Wolfe 1977; Figure 3.1). The Piedmont consists of lowlands and low, gently rounded hills with elevations of 200 to 400 feet above sea level as well as higher areas of volcanic basaltic ridges, such as the Sourland Mountains and Watchung Mountains (Wolfe 1977). The APE is situated adjacent to the eastern boundary of the Piedmont. Elevations within the APE vary from three feet to 180 feet above mean sea level.

3.1 Ecology and Hydrology

The APE is situated in an area of New Jersey that is classified as Mixed Oak Forest, Northern Phase (Collins and Anderson 1994). Historically, low-lying areas near the Hackensack River were covered by "a mosaic of Atlantic white cedar swamps, floodplain forests, and cattail marshes" (Collins and Anderson 1994: 145). Human alterations to the landscape slowly altered these vegetation communities and facilitated the development of a tidal marsh along the lower reaches of the Hackensack River and Newark Bay (Collins and Anderson 1994; Robichaud and Buell 1973). The natural vegetation in tidal marsh consists of saline-tolerant marsh grasses (including cordgrass, salt-meadow grass, black marsh grass and spike grass) and plants and shrubs such as goldenrod, sea myrtle and marsh elder found toward the inner zones of the tidal marsh (Robichaud and Buell 1973:123). Natural vegetation in upland areas was dominated by red, white, and black oaks with a few chestnut oaks and sugar maples. Understory plant species in upland areas consisted of red maple, white ash, black birch, sour gum, flowering dogwood, maple-leaved viburnum, sassafras, and hop hornbeam (Collins and Anderson 1994: 114). Modern urban development has resulted in the removal of most of the natural vegetation. Colonizing species such as phragmites, cattails, cordgrass, and three-square cover marshy areas within the APE. Mixed herbaceous weeds, shrubs, and secondary growth deciduous trees are found along the railroad corridor margins within the APE.

The western portion of the APE is located within the Hackensack Meadowlands, which is drained by the Passaic and Hackensack rivers. The Passaic and Hackensack rivers flow south into Newark Bay, which drains into Kill Van Kull, New York Bay, and ultimately the Atlantic Ocean. The eastern portion of the APE is drained by the Hudson River, which flows south into Upper New York Bay, New York Bay, and ultimately the Atlantic Ocean. Historically, tidal marshes extended along the margins of the lower Hackensack River, Newark Bay, and Upper New York Bay. Extensive areas of tidal marsh were filled between the late nineteenth and mid-twentieth centuries to support the urban development of the New York City metropolitan area.

3.2 Geology

The geology of the Piedmont is dominated by the Newark Basin, which consists of three lower formations of Late Triassic age, the Stockton, Lockatong, and Passaic Formations, and volcanic intrusions of Jurassic age, including the Palisades Sill. The Palisades Sill extends along the western side of the Hudson River from Nyack, New York south to Jersey City, New Jersey as cliffs and forested talus slopes with elevations from 300 feet to more than 600 feet above the Hudson River. The Palisades Sill diminishes in elevation southward from Jersey City, extends beneath the Inner Harbor, and reappears on Staten Island. The Palisades Sill is an eroded cross-section of diabase that intrudes through the Late Triassic sedimentary red bank rocks of the Lockatong and Stockton Formations forming an unconformity near the base of the Stockton Formation. The Hudson River follows the trace of this underlying unconformity. During periods of low sea level, the Hudson River preferentially followed this unconformity (U.S.G.S. 2016).

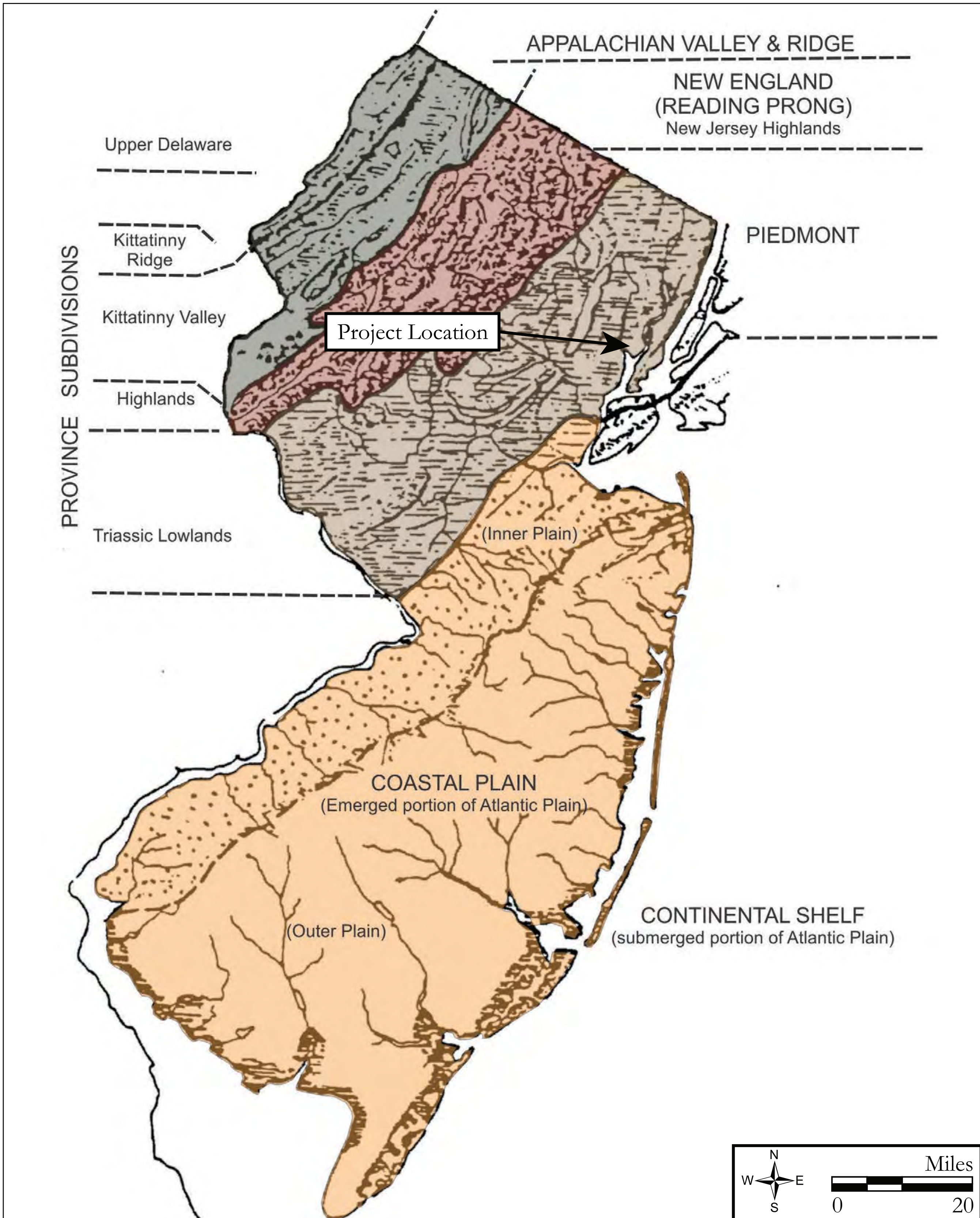

Figure 3.1: Physiographic Provinces Map
(adapted from Wolfe 1977).

The bedrock geology of the APE includes the Jurassic period Diabase that forms the Palisades as well as four members of the Brunswick Group, Newark Supergroup: Lower Jurassic and Upper Triassic period siltstone and shale of the Passaic Formation; Upper Triassic period dolomitic or silty argillite, mudstone, siltstone, and limestone of the Lockatong Formation; arkosic sandstone and hornfels of the Lockatong Formation, Arkosic Sandstone Facies, and Upper Triassic period sandstone, mudstone, argillaceous siltstone, and shale of the Stockton Formation. Cambrian and Late Proterozoic Serpentinite also occurs within the APE along the Hudson Waterfront in Hoboken (Drake et al. 1996; Lyttle and Epstein 1987). The surficial geology of the APE is mapped as Holocene epoch Salt-Marsh and Estuarine Deposits, composed of silt, sand, peat, clay, and pebble gravel, Late Wisconsinan Glacial Delta Deposits of sand, pebble and cobble gravel, and silt, and Late Wisconsinan Rahway Till, composed of clayey silt, sandy silt, pebbles, cobbles, and boulders (Stone et. al. 2002).

3.3 Soils and Geomorphology

Soils within the APE are mapped as Laguardia artifactual coarse sandy loam, 0 to 3 percent slopes (LagA), Rock outcrop-Holyoke complex, 15 to 45 percent slopes (RNHE), Secaucus artifactual fine sandy loam, 0 to 3 percent slopes (SecA), Secaucus artifactual fine sandy loam, 3 to 8 percent slopes (SecB), Westbrook mucky peat (WectA), Urban Land, wet substratum, 0 to 8 percent slopes (URWETB), and Urban land, till substratum, 0 to 8 percent slopes (URTILB) (Figures 3.2a – 3.2c; Natural Resources Conservation Service [NRCS] 2014a). Laguardia artifactual coarse sandy loam is composed of historic fills that contain construction debris. Within the APE, Laguardia coarse sandy loam is found in lowland and upland areas filled in the late nineteenth and early twentieth century. Rock outcrop-Holyoke complex is characterized as a steeply sloping soil composed of loamy till derived from basalt and diabase and is found on hills. Bedrock outcrops punctuate the terrain. The Holyoke component of this soil type is classified as well drained with very low water movement. Rock outcrop-Holyoke complex has a low shrink-swell potential, a low potential for frost action, and a moderate susceptibility to whole soil erosion (NRCS 2014b). Secaucus artifactual fine sandy loam is composed of historic fills that contain construction debris. Within the APE, Secaucus fine sandy loam is found in marshy areas filled in the late nineteenth and early twentieth century. Westbrook mucky peat is characterized as nearly level to gently sloping soil composed of herbaceous organic material over loamy drift and/or marine deposits found on tidal salt marshes. Westbrook mucky peat is classified as very poorly drained, frequently ponded and very frequently flooded. Westbrook mucky peat has a high potential for frost action, and a low susceptibility to whole soil erosion (NRCS 2014b). Urban Land, wet substratum and Urban Land, till substratum are miscellaneous areas defined as asphalt over human-transported sediments, composed of very artifactual coarse sandy loam deposits (NRCS 2014b).

Land classified as Historic Fill is mapped across the entire Koppers Coke Peninsula Redevelopment Area in Kearny, as a band along the east bank of the Hackensack River in Jersey City, and as a band along the west bank of the Hudson River (NJGeoWeb 2017). In Hudson County, the extent of Historic Fill generally correlates with surficial geology mapped as Salt-Marsh and Estuarine Deposits. The Main Facility site of the APE is situated on land where Historic Fill is mapped. Historic Fill also is mapped within the APE along the Morris & Essex Line from the new Kearny Substation to approximately 2,000 feet east of the Hackensack River near Westside Avenue in Jersey City. Areas of Historic Fill are mapped in Bayonne along the HBLR corridor between 23rd Street and 12th Street, between Linnet Street and Avenue C, between Newman Avenue and Avenue A. Historic Fill is mapped along the Hudson River in Jersey City from north of Chapel Avenue to Forrest Street, and from Wilson Street in Jersey City north along the base of the Palisades to 48th Street in Weehawken.

The Koppers Seaboard Coke and Byproducts Company facility in Kearny was demolished in 1979 and an analysis of on-site contamination from oil, pitches, and coal tar wastes was initiated (Geraghty & Miller, Inc. et al. 1981). A hydrogeologic investigation completed as part of site rehabilitation planning indicated that 20 feet of unconsolidated fill materials composed of sediments and construction debris overlay five feet of peat, silt, and clayey sand underlain by up to 100 feet of unconsolidated clayey

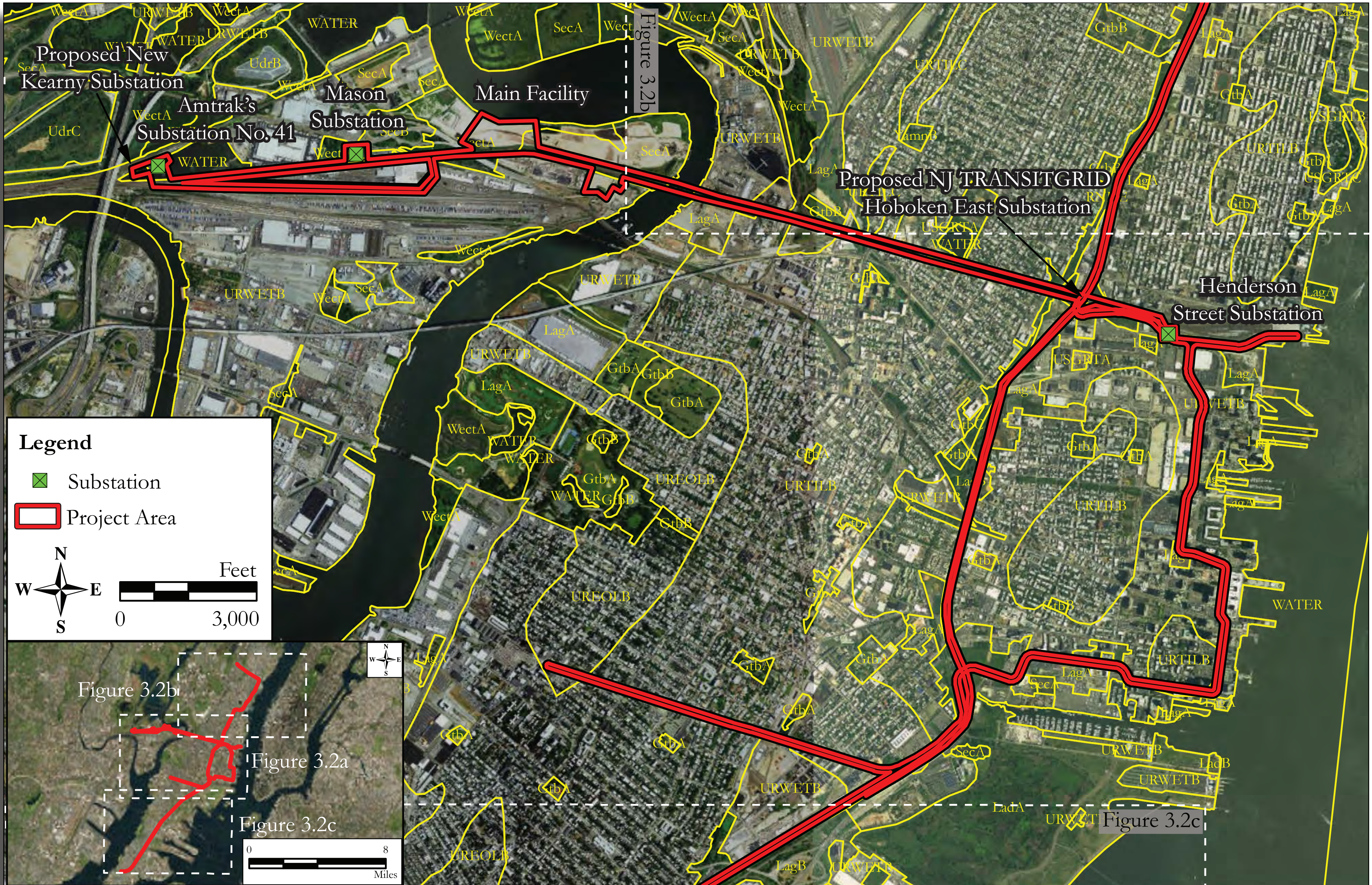

Figure 3.2a: Soils Map
(from 2014a Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Soil Survey Geographic [SSURGO]).

Figure 3.2b: Soils Map
(from 2014a Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Soil Survey Geographic [SSURGO]).

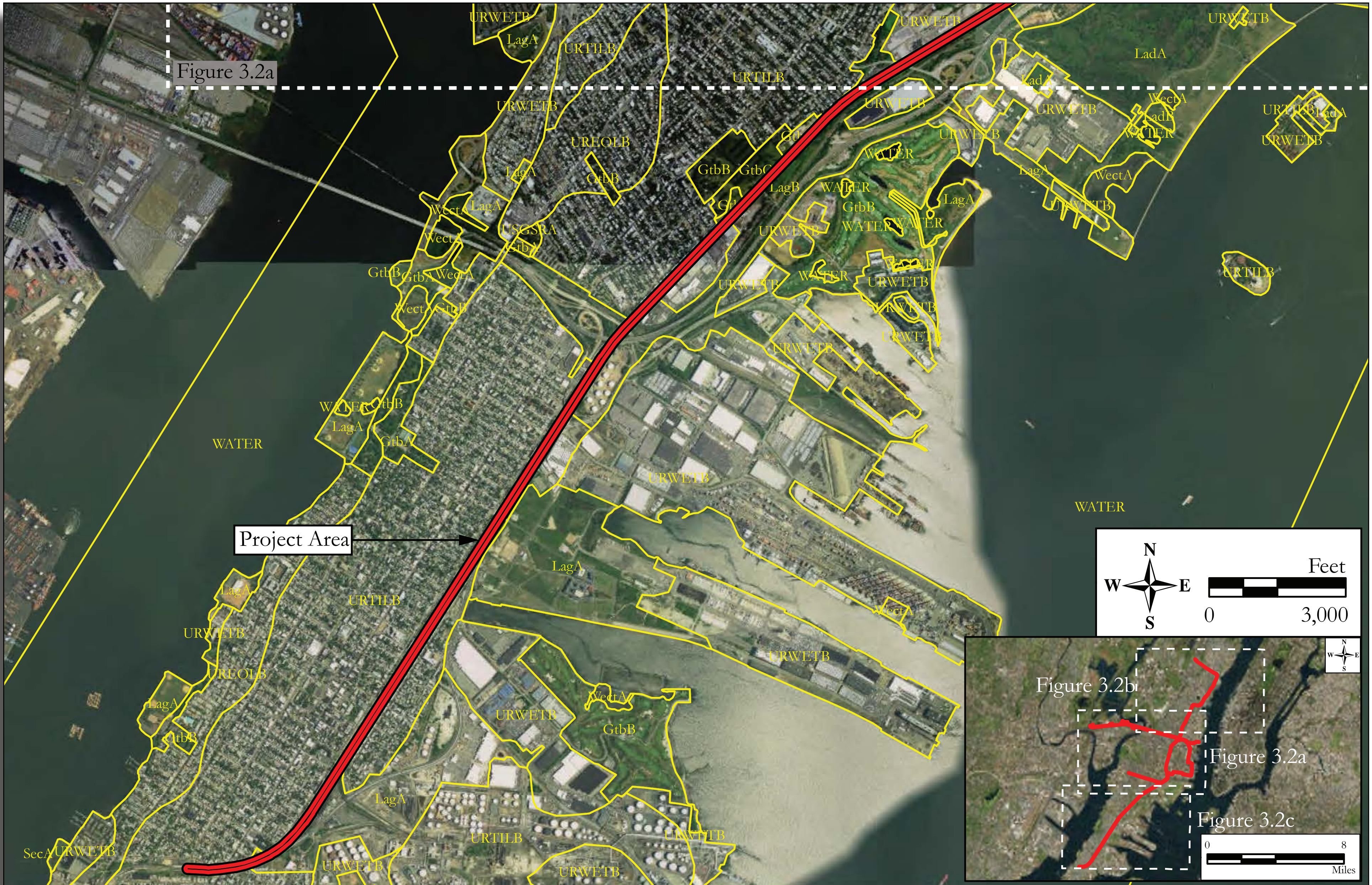

Figure 3.2c: Soils Map
(from 2014a Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Soil Survey Geographic [SSURGO]).

silts (Geraghty & Miller, Inc. et al. 1981: 2). Geochemical testing identified several contaminants above nonresidential direct-contact, soil cleanup criteria on the Koppers Company property and the site was listed on the NJDEP Known Contaminated Sites List in 1986 (New Jersey Meadowlands Commission 2012:13). Remediation of the Koppers Company site began in 1997, which included construction of a barrier system and the capping of the site with approximately 10 meters (33 feet) of processed dredge materials (PDM) (Hornsby and Sawchuck 1999: 89). The remediation cap proposed to re-use approximately 3,440,000 m3 of PDM and raise the ground surface elevation above the 100-year floodplain (Hornsby and Sawchuck 1999: 88-89). Various geotechnical studies have been completed within the former Koppers Company property and adjacent parcels as part of planning for the redevelopment of Kearny Peninsula (the Koppers Koke Site). The Phase IA archaeological survey included a review of existing geotechnical information for the Koppers Koke Site in comparison to data from adjacent parcels where a deeply buried, NRHP-eligible prehistoric archaeological resource (the Standard Chlorine Chemical Company Site [28-Hd-44]) is located (see Attachment C).

Previous geotechnical borings completed in the Koppers Koke Site include three locations within and adjacent to Project Component A (see Figure 1.3a; Attachment B). Soil stratigraphy recorded in these borings indicate that the deeply buried stable land surface on which 28-Hd-44 is located extends into the western and central portions of Project Component A (see Attachment C). Soil borings completed 1,000 feet west of and within the southwestern portion of Project Component A were described as fill deposits 11 to 19 feet thick overlying one to five feet of peat or marsh mat deposits and three to 4.5 feet of sandy alluvium interpreted as a deeply buried Holocene land surface (see Attachment C: 10). A similar stratigraphic profile was recorded in a series of borings (KYSPB03 - KYSPB05, MW-KY3D) completed over a distance of approximately 1,100 feet along the north side of the Morris & Essex Line from approximately 300 feet from the east boundary of Project Component A (see Attachment C: 15). Soil boring data was not available for the northern portion of the APE in Kearny (see Attachment C: 17). Soil borings in the eastern section of the Kearny Peninsula recorded soil profiles as disturbed or flood scoured prior to land filling activities and lacked the sandy alluvium interpreted as a deeply buried Holocene land surface (see Attachment C: 18).

4.0 BACKGROUND RESEARCH

Background research was conducted to determine if previously identified archaeological resources are within the APE and to evaluate the potential for unidentified cultural resources within an appropriate historic context. Research was conducted at the NJHPO in Trenton to identify any archaeological resources located within the APE that are listed in or eligible for the State and NRHP, and to review previously conducted cultural resources survey reports. Site files at the New Jersey State Museum (NJSM) in Trenton were examined to identify the locations of registered archaeological sites. A review of historic maps, local and county histories, and selected primary research documents was conducted at the New Jersey State Library and the New Jersey State Archives in Trenton and various digital data repositories administered by the New York Public Library, the Library of Congress, the United States Geologic Survey, the New Jersey Department of Environmental Protection, and Princeton University.

4.1 Prehistoric Context

Archaeologists organize chronological and cultural information about the prehistoric occupants of New Jersey and the Middle Atlantic into three broad time periods: Paleo-Indian +/-9500B.C.-8000 B.C., Archaic 8000-1000 B.C., and Woodland 1000 B.C.-A.D. 1600 (Table 4.1; Chesler 1982; Custer 1996; Grossman-Bailey 2001; Kraft 1986, 2001; Mounier 2003; Ritchie 1980). These periods act as a framework in order to study the approximately 12,000 years of human occupation in the region. The Archaic and Woodland periods are subsequently subdivided into Early, Middle, and Late sub-periods. The prehistoric era is considered to have ended approximately 1550 to 1600 A.D., during the time of initial contact between Native groups and Old World populations, and is followed by a period of extensive colonization by the Dutch, Swedish, and English. More localized settlement pattern studies have helped to refine this Middle Atlantic prehistory with reference to subsistence strategies and occupational patterns in New Jersey (Fitting 1979; Mounier 1978; Pagoulatos 1998; Ritchie 1980). A brief summary is presented below.

The prehistoric era begins with the Paleo-Indian period, which represents the earliest period of human occupation of the Americas. Early sites are relatively rare for several reasons: low populations, highly mobile lifestyles, rising sea levels and changing coastlines with concomitant changes in land forms, and lack of preserved sites. In New Jersey, most evidence for Paleo-Indian occupation comes from sporadic surface finds of fluted points (Marshall 1982). Large spears tipped with well-made chipped stone lance-shaped points characterized by the removal of a large channel flake, or flute, are temporal markers of the Paleo-Indian period. Areas with high probability for Paleo-Indian sites include ancient shorelines of the Delaware River, the shores of the glacial lakes Passaic and Hackensack, periglacial features in the Coastal Plain, upland bluff terraces, low-lying river terraces, the tops of cuestas, and the continental shelf (Grumet 1990; Kraft 1986). An early study (Mason 1959) noted that over 50 percent of all uncontrolled Paleo-Indian projectile point finds came from within ten miles of the Delaware River, and an additional 25 percent from along its principal tributaries. Marshall's (1982) literature review also underlines the preponderance of sites located on high terraces overlooking river or stream valleys. Additionally, Gardner (1978, in Custer 1984, 1989) has suggested that Paleo-Indian settlement patterning is closely linked to the availability of high-quality lithic raw materials. Some of the most important Paleo-Indian sites in the region include the Port Mobil site on Staten Island, the Plenge site on the Musconetcong River, the Shawnee-Minisink site north of the Delaware Water Gap, and the Zierdt site in Sussex County (Custer and Stewart 1990; Dent 1991; Kinsey 1972; Kraft 1986, 2001; Marshall 1982).

The Early Archaic period (circa 8000 B.C. to 6500 B.C.) may have been very similar to the preceding period in terms of mobile lifestyle and generalized hunting/gathering subsistence; the main differences are reflected in a change to small-stemmed and notched projectile point styles such as Kirk and Palmer types, which may signify a change in hunting technology

Table 4.1: Northern New Jersey prehistory

Time Frame	Period	Characteristics
1350-1600 A.D.	Minisink (Late Woodland)	- Unfortified hamlets, camps - Round-ended long houses - Foraging with agriculture - Petroglyphs - High collared, decorated ceramic vessels
1000-1350 A.D.	Pahaquarra (Late Woodland)	- Occupation of unfortified hamlets, camps - Long houses - Foraging with limited agriculture - Flexed burials - Collarless, cord-decorated ceramic vessels - Predominant use of triangular projectile points - Introduction of bow and arrow projectile technology
A.D. 0 to A.D. 900	Middle Woodland	- Hunter-gatherers, seasonal fission/fusion of social groups - Large and small camps - More kinds of ceramics - Mortuary ceremonialism - Large scale exploitation of seasonal resources
1000 B.C. to A.D. 0	Early Woodland	- Band level society with first evidence of community identity - Mortuary ceremonialism - Extensive trade networks for exotic raw materials - Shellfish exploitation - Experimentation and early use of ceramics - Climate: cool and wet
1000 B.C. to 3000 B.C.	Late Archaic	- Broadspear, narrow-stemmed, fishtail points - Mortuary ceremonialism - Extensive trade networks for exotic raw materials - Intensive use of local materials - Social differentiation - Increased sedentism - Change in vessel technology- soapstone bowls - Climate: warmer & dryer than present, sea level rise slows
3000 B.C. to 6500 B.C.	Middle Archaic	- Bifurcate points, stemmed points - Hunter-gatherers with increasing intensification of resource use - Use of shell fish documented in the region - Use of more varied lithic materials and tool categories - Large and small camps, stratified riverine settlement system - Band level society - Climate: warm and wet
6500 B.C. to 8000 B.C.	Early Archaic	- Corner-notched and stemmed point types - Spear- thrower technology - Use of more types of stone for tools - Exploitation of more kinds of food resources? - Very similar to Paleo-Indian period - Climate: cold and drier than present, rapid sea level rise
8000 B.C. to 9500 B.C.	Paleo-Indian	- Highly mobile - Large game hunting followed by generalized foraging patterns - Fluted projectile points usually made of jasper or chert - Band level society - Climate: cold and wet, mosaic of mixed grasslands, extremely rapid sea level rise

(e.g., Gardner 1989). The Broad Spectrum Revolution began during the Early Archaic and, with an expansion of the food base, plant gathering and processing played an increasingly important role in the subsistence system. Archaic populations likely consisted of small, mobile hunting and gathering bands that shifted their camps seasonally to exploit a wide variety of game and natural resources.

Sites are located primarily on floodplains of rivers, low- and high-order streams, and around former marsh lands. A three-tier settlement system is considered to have emerged during the Archaic period composed of macro-band base camps, micro-band base camps, and ephemeral camps designated as either "procurement sites" or "transient camps." Bands, likely extended family groups, moved between these different levels of sites on a seasonal basis, dividing up to utilize resources in many different environments—both up- and downstream of major drainages—and coming together in larger groups to conduct trade and marriages (Custer 1984:67, 1989:131, 278; Fitting 1979; Grossman-Bailey 2001; Kraft and Mounier 1982a; Mounier and Martin 1992). The transition to the Middle Archaic period is marked by the use of bifurcate base points and a variety of stemmed and notched points. Chipped and ground stone axes, adzes, and other woodworking and grinding tools came into use during the Middle Archaic suggesting greater exploitation of forest resources (Custer 1996; Kraft 2001). Some of the important sites in New Jersey pertaining to the Early and Middle Archaic period include Rockelein, Twombly Landing, West Creek, Harry's Farm, Logan, Turkey Swamp, and Shawnee-Minisink (Cavallo 1981; Cross 1941; Kraft 2001; Kraft and Mounier 1982a:66-67; Mounier 1975; Stanzeski 1996).

Site sizes and site numbers increase at the beginning of the Late Archaic period, around 4000 B.C. Subsistence-settlement pattern changes occurred at the beginning of the Late Archaic, which led to the exploitation of a greater variety of ecological settings. Environmental change to a warmer, drier climate may have played a key role in increasing the population by increasing the available food supply (Custer 1996; Dent 1995). The establishment of a deciduous broadleaf forest environment resulted in the availability and exploitation of new food sources such as small game, shellfish, nuts, and seeds. The diversification of food resources may have signaled population expansion. Groundstone axes, adzes, pestles, and other tools are interpreted as wood-working or seed and nut-grinding implements. Projectile points initially became much broader and thinner than their predecessors, followed by a narrower style with a fishtail-like base. Large, heavy, flat-bottomed containers were made of soapstone or steatite and may have been used as ceremonial feasting bowls. The use of stone vessels, the beginnings of experimentation with ceramics, and evidence for more permanent housing indicated by circular patterns of posts (e.g., Kraft 2001:132) may indicate a more sedentary lifestyle (Griffin 1978:231; Kraft 2001; Tuck 1978:38). A notable change in lithic materials also is considered a hallmark of the Late Archaic (Kinsey 1972:339). In New Jersey, this includes the increased use of argillite and locally available quartzite, as well as exotic materials, which suggests the existence of complex exchange and interaction networks.

Continuity in subsistence and settlement exists between the Late Archaic and succeeding Early and Middle Woodland periods (e.g., Custer 1984, 1996, Kraft 2001:151) with some key differences in technology and artifact types appearing in the Early and Middle Woodland. Regional models for settlement systems suggest that seasonal fission/fusion of social groups occurred as people occupied different types of sites throughout the year. Large base camps where smaller extended family groups came together are often found in rich environments at mid- to upper tributary stream confluences. Smaller procurement camps and specialized work camps are found in many settings at shorelines, headwaters, and marshes (e.g., Custer 1996; Grossman-Bailey 2001; Mounier 1978). Like the preceding period, the Early and Middle Woodland periods are marked by rapid and extensive social and political change. The presence of numerous cultural complexes, such as Meadowood and Middlesex, signified by differing artifact styles and burial ceremonialism, suggests an influx of people or interaction between contemporaneous groups in the northeast and the Ohio Valley (see Bello et al. 1997). The relationship between these intrusive cultural manifestations and probable indigenous Early Woodland populations has yet to be determined. During the Middle Woodland period, burial ceremonialism intensified and exotic grave goods found in select interments may indicate the beginning of some type of social stratification. The use of ceramic vessels became widespread and increased in size and quality of manufacture during the ensuing periods. Tools made of Ohio Valley and New York raw materials became more popular, as did the use of native copper, possibly from the Lake Superior area (Kraft 1986:103-104). Settlement systems include large base camps, fishing stations, shellfish middens, hunting/gathering camps, and mortuary sites.

The Late Woodland period is distinguished from earlier periods largely due to the inception of maize horticulture, which originated in Central America and began to be practiced in the Middle Atlantic circa A.D. 900 and perhaps earlier. The growing of maize, and a suite of plants that included beans, pumpkins, squash, and tobacco, had significant implications for Native Americans. Horticultural activities were supplemented by hunting and gathering of food staples such as large game, freshwater mussels, and berries. This period also marks the occupation of long houses, consisting of 18- to 60-foot structures, in small unfortified hamlets by extended family groups (Kraft and Mounier 1982b). Tools include small triangular arrow heads and various implements such as bone awls, scrapers, celts, and ceramic pipes, some with effigies. Distinctive collarless, cord-impressed ceramics are characteristic of the early Late Woodland, while collared vessels become commonplace by around A.D. 1350. The occupants of northern New Jersey at this time were related to the Munsee-speaking Delaware groups met by the European explorers in the late sixteenth century (Kraft and Mounier 1982b). Algonquian-speaking people who occupied northern New Jersey likely interacted with Iroquoian-speaking groups who inhabited New York State and central Pennsylvania based on the distribution of ceramics and other artifacts (Custer 1996:269).

The prehistoric era ends at the arbitrary date of A.D. 1600, about the time of first contact between Native groups and Old World populations, and the period of extensive colonization by the Dutch, English and French. This period of initial contact and colonization is poorly known in much of New Jersey. The first Europeans to arrive in what is now New Jersey encountered indigenous inhabitants collectively known today as the Lenni-Lenape. In the seventeenth century, the Lenape were village horticulturalists whose settlements did not exceed several hundred individuals each (Goddard 1978:213). They maintained a restricted wandering settlement pattern at this time, moving their principal winter villages short distances every dozen years or so as the fertility of nearby land diminished (Weslager 1972:58-9; Williams and Kardas 1982:192). Seasonal dispersion of the population was also the norm, with families or small groups splitting off to hunt and gather during the summer and early fall months (Goddard 1978:218-19). During the period of early relations with the Dutch, there is evidence of warfare and encroachment onto Lenni-Lenape lands by the Susquehannocks from the west and Mohawks from the north (Weslager 1972:98-103). The historic depth of this warfare is not known; greater access to Dutch trade near the coast may have been an economic incentive for this encroachment.

4.2 Historic Context

Settlement of the Hudson River's western shore began shortly after the Dutch West India Company established a trading post at New Amsterdam in 1624. Dutch, and then English, colonists established settlements during the seventeenth and eighteenth centuries throughout what ultimately became Hudson County. Nineteenth century industrialization in Hudson County provided the impetus for population growth, which transformed the Hudson River's western shore into the densely populated urban landscape of today. The APE is located within Kearny, Jersey City, Hoboken, Bayonne, Union City, Weehawken, and North Bergen, municipalities that experienced dramatic changes in land use and settlement patterns as a result of industrial growth and urbanization.

In 1629, the Dutch West India Company granted land between present-day Jersey City and Bayonne, known as the Patroonship of Pavonia, to Michael Pauw, a Hollander. Although Pauw may not have settled on his land, other Hollanders, induced to settle by the patroonship system that granted free land to those bringing other settlers with them, established plantations near the Hudson River. Early settlers included Maryn Andriasen, who was granted a patent at "Awiehaken" (Weehawken) in 1647 (Winfield 1872: 36). In the 1640s and 1650s, a series of conflicts with local Native American tribes resulted in bloodshed, during which every plantation on the western banks of the Hudson was destroyed (Eaton 1899). In 1660, the Dutch Colonial government in New Amsterdam granted permission to resettle the west side of the Hudson River, and repurchased the land south of Weehawken between the Hudson and Hackensack rivers. The settlements were grouped together in fortified villages for safety. Bergen, on the Palisades Ridge (1660), and then Communipaw, south of Paulus Hook on Communipaw Bay

(1661), were surveyed and opened for settlement. Bergen was laid out as an 800-foot square tract surrounded by log palisades and rectilinear streets, still evident in today's Bergen Square. The village is generally acknowledged to be New Jersey's first permanently occupied settlement (Wacker 1975: 123). Beyond the stockaded village were long narrow outlots, each with water frontage and averaging six to 10 acres (Wacker 1975: 242). The transition into English rule in 1664 passed smoothly in Bergen, as residents signed an oath of allegiance to the crown and were allowed to establish a Dutch Reformed Congregation, the first church in New Jersey (Federal Writer's Project 1939: 273). Small hamlets developed south and north of Bergen, including the lowlands in present-day Weehawken near the Lincoln Tunnel helix (Sherman and Gaulkin 2009: 7). Bergen became part of a larger territory called Bergen Township when Bergen County was established in 1683 (Snyder 1969: 145).

Eighteenth century Bergen Township extended from Bergen Point along the Kill Van Kull north to near Bellman's Creek. Bergen Township encompassed the Hackensack Meadowlands, a cedar swamp and salt meadows between the Passaic and Hackensack Rivers, the level uplands and salt meadows of Bergen Neck, the fortified village of Bergen, and the dense woods of the Palisades, which extended north from the village of Bergen. Settlement and development within the APE was heavily influenced by these varied landscapes.

Present-day Kearny was part of a 30,000-acre grant obtained in 1668 by Major William Sandford and named "New Barbadoes Neck" that encompassed most of the Meadowlands (Winfield 1872: 357-363). Following Sandford's death in 1708, Major Nathaniel Kingsland acquired the upper western tract of New Barbadoes Neck, which he sold in 1710 to Captain Arent Schuyler, whose discovery of copper within the grant developed into one of Kearny's earliest commercial enterprises. The peninsula that became Kearny is shown on John Hills 1781 Sketch of the Northern Parts of New Jersey as a cedar swamp surrounded by salt meadow bisected by the road from Schuyler's plantation to Bergen Neck (Figure 4.1; Hills 1781).

Bergen Neck, the peninsular landform upon which Jersey City and Bayonne were built, was considerably narrower during the eighteenth century than it is today. Eighteenth century maps (Hills 1781; Ratzer 1767) depict Bergen Neck as approximately one mile in width with coves and tidal islands along its eastern shore (see Figure 4.1). Several patents granted on Bergen Neck in the mid- to late seventeenth century induced Dutch settlers to establish farmsteads between Bergen and Bergen Point (Winfiled 1874). Bergen Hill ran north along the spine of Bergen Neck rising to become the Palisades Ridge in the northern portion of the APE. East of Bergen, Paulus Hook and Hoebuck (present-day Hoboken) are depicted as islands separated from the Palisades Ridge by salt meadows (see Figure 4.1). Scattered houses and farm fields are mapped along the road to Paulus Hook and on the island that became Hoboken. Initially, the lands surrounding the village of Bergen were used as community grazing and crop lands (Miller 1910). Allotments of these lands were partitioned and set out to the inhabitants beginning in 1764 (Winfield 1872: 29). Land near Bergen Point was purchased by a group of 15 men who purchased long lots along Kill Van Kull and Newark Bay in present-day Bayonne (Sherman and Gaulkin 2009: 8; Winfield 1872: 136 - 138).

Bergen Township became a major crossroads and agricultural center, providing produce for sale in New York City. Roads radiating out from Bergen Town connected it to settlements at Communipaw, Harsimus, and Bergen Point, as well as to the ferries operating over the Hudson River, the Hackensack River, the Kill Van Kull, and Newark Bay (Hills 1781; Winfield 1874: 357-363). The three most important early roads in the vicinity of the APE included the King's Highway (a.k.a. Bergen Avenue) running between Bergen Town and Bergen Point, the road to Newark, a cartway comprising present-day West Side Avenue, and the Hackensack Plank Road, which ran from Weehawken over the Palisades cliffs into the Bergen Woods. The road that became West Side Avenue existed by the 1760s and was referenced in various deeds of the period (Winfield 1872: 231-232). The King's Highway served as the principal north-south route and was used in combination with ferry service for stage traffic running between Philadelphia and New York (Winfield 1874: 359-360). The road to Newark, established by act of the colonial legislature in 1765, created the principal east-west connection between Paulus Hook and Newark. This road corresponded roughly with the later Newark plank road (a.k.a. Lincoln

Figure 4.1: 1781 J. Hills, Sketch of the Northern Parts of New Jersey.

Highway; U.S. Routes 1 & 9) (see Figure 4.1). Ferries provided the connections across the Passaic and Hackensack rivers (Winfield 1874: 360-361). Along the Hudson River, the Weehawken Ferry was established in 1717 and the Hoboken Ferry in 1754 (Rutsch and Leo 1979: 12; Lane 1939: 25-44; Marshall 1981: 23-25).

Hoboken was originally part of Michael Pauw's "Pavonia" patent, and subsequently granted to Nicholas Varleth, the brother-in-law of Peter Stuyvesant. In 1711 the land passed to Samuel Bayard, Varleth's stepson, who farmed it and planted orchards (Windfield 1872, 1874). The development of Hoboken was initiated by John Stevens, Jr., who purchased Hoboken in 1784 and contracted with Charles Loss to map his property and lay out streets and building lots. The land was originally a peninsula sloping down from Castle Point to the Hudson River in the east and to the marshes that separated Hoboken from Bergen Heights and Weehawken. Hoboken Kill ran north through the marshes to Weehawken Cove (Kraft 1978a). North of Weehawken Cove, the Bergen Woods extended along the Palisades Ridge and was a sparsely populated section of Bergen Township.

Early nineteenth century maps depict the growing communities of Bergen, Jersey City, Hoboken, and West Hoboken, serviced by a developing railroad network that included the New Jersey Railroad (NJRR) and the Paterson and Hudson River Railroad (PHR) (Figure 4.2; Gordon 1833; U.S. Coast Survey 1837a, 1837b; Hassler 1844). Jersey City's development was sparked by speculators from New York who purchased lands at Paulus Hook in 1804 and announced the sale of property lots. The new settlement, called Jersey Town, expanded rapidly utilizing a grid street system for laying out roads and building lots. The grid system would govern the subdivision of other parts of the growing city as tracts were gradually consolidated and opened for development. In 1820, when Jersey City was formed, the population was listed at 300; by 1845 it reached 4,000 (Trust Company of New Jersey 1921). The industrial development of Jersey City began on a large scale in the 1820s with the opening of the Dummer Glass Works and the Jersey City Pottery Company (Van Winkle 1924). The PHR was established in 1833 to link Paterson to Jersey City via a junction with the NJRR at Marion on the west side of Bergen Hill (Treese 2006:110-111). The NJRR began service in 1834 between Newark and Jersey City (Treese 2006:111). Both railroads linked production and agricultural centers in northern New Jersey to Hudson River ports and spurred the development of Bergen Township and its communities. As early nineteenth century settlement in the township developed along the Hudson and Hackensack rivers, Bergen Township was subdivided into Jersey City (formed in 1820), Van Vorst Township (set off in 1841), and North Bergen Township (set off in 1843) (Snyder 1969: 145-147).

The development of Hoboken was initiated by Colonel John Stevens, who laid out lots near the Hudson River and built Hoboken's first wharves in 1804 as part of a planned residential and commercial development for Hoboken. In the early nineteenth century, Hoboken was a resort for the people of New York City known especially for its Elysian Fields, the gardens and groves laid out in 1814 north of Castle Point, the home of Colonel John Stevens (Gordon 1834; Barber and Howe 1844:234). The western margins of Hoboken comprised low-lying marsh that impeded the expansion of the town. In 1814, Samuel and Robert Swartout purchased the marsh for vegetable gardening and a failed attempt at land reclamation and development. The Hudson River was kept out of the meadows by tidal gates and street embankments, which caused the surface of the meadow to sink up to two feet. In 1829 the property was foreclosed and not until 1860 was it finally broken into lots (Hoboken Board of Trade 1907).

Maps published in the 1830s (Gordon 1833; U.S. Coast Survey 1837a, 1837b) depict a dispersed settlement pattern in most of the APE with small crossroads villages and towns linked by a developing road network along which small farmsteads had been established. Present-day Kearny is shown as a vast salt meadow, undeveloped except for the road to Bergen and the NJRR (see Figure 4.2; Gordon 1833). Bergen was a town of 20 to 30 dwellings by 1834 located approximately three miles west of Jersey City, which had grown to a town of approximately 1,500 people (Gordon 1834:102, 163; see Figure 4.2). In 1834 Jersey City contained approximately 200 houses, 20 stores, five taverns, two churches, two schools, an academy, a delftware pottery, a flint glass manufactory, and the Morris Canal

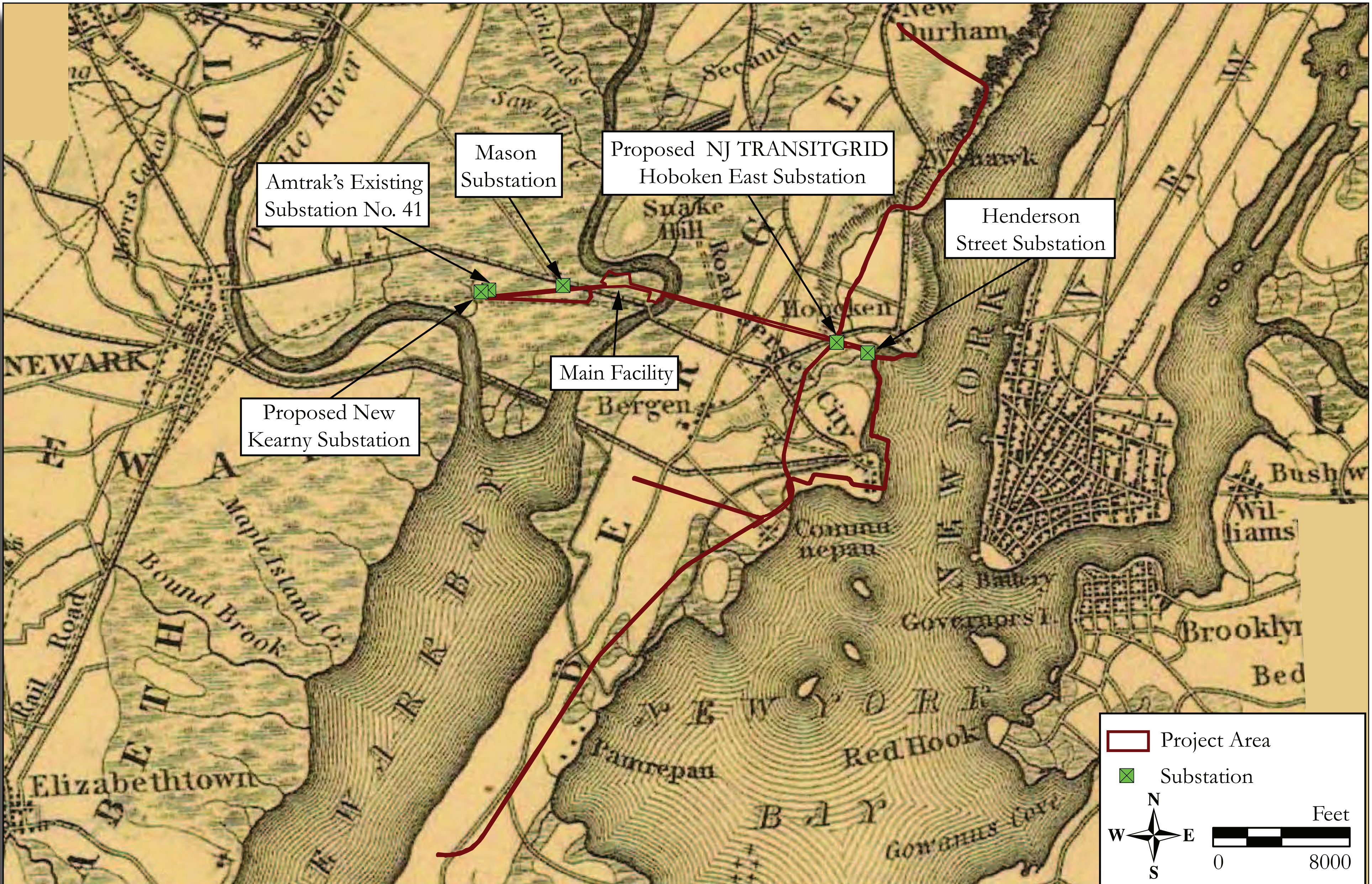

Figure 4.2: 1833, T. Gordon, A Map of the State of New Jersey with Parts of the Adjoining States.

Banking Company (Gordon 1834:163-164). Two turnpikes, the PHR, the NJRR, and the Morris Canal carried people and commodities to and from Jersey City (see Figure 4.2).

In 1834, Hoboken was described as "built chiefly on one street," with around 100 dwellings, 700 inhabitants and five stores (Gordon 1834:158). An 1837 Topographic Survey of the New Jersey Coast depicts Hoboken extending along Washington Street between Stevens Point and the Road to Newark, beyond which lay undeveloped land (Figure 4.3a; U.S. Coast Survey 1837a). Upon Stevens' death in 1838, the unsold lots passed to the Hoboken Land and Improvement Company. North of Hoboken, the Hudson River waterfront was sparsely occupied except for a ferry at "Wehawk" (Weehawken) where the Hackensack Plank Road ascended the Palisades and ran through the Bergen Woods northwest toward "New Derham" (New Durham) (see Figure 4.3a). A small crossroads village occupied the Palisades Ridge northwest of Hoboken, which would develop into West Hoboken by mid-century. Few settlers resided along the Bergen Road leading north through Bergen Woods into what would become North Bergen Township (see Figure 4.3a).

South of Jersey City, the villages of Communepau (Communipaw), Pamrepau, and Centreville developed on Bergen Neck (Figure 4.3b; U.S. Coast Survey 1837b). Communipaw is depicted as a cluster of dwellings along Upper New York Bay on an island bounded on the north and south by tidal marsh (see Figure 4.3b). Pamrepau developed along the road to Bergen north of the Morris Canal's crossing of Bergen Neck, while Centreville developed at the crossroads of the road to Bergen and the road to Constable's Hook in what would eventually become Bayonne (see Figure 4.3b). Most notable on 1830's maps is the developing transportation network that linked New Jersey's cities to the Hudson River waterfront through railroad and canal routes.

In 1834, the NJRR, the third railroad incorporated in the state, became the first to reach Bergen Neck. By 1836, the NJRR had reached Bergen Hill and by 1838 had opened the Bergen Cut, a 40-foot deep channel excavated through the traprock of Bergen Hill, to arrive at the Hudson River waterfront (Lane 1939: 312; Messer and Roberts 2002: 117). In 1836, as the rail tracks were being laid, the Morris Canal reached Jersey City (U.S. Coast Survey 1837). Initiated in 1825, construction of the Morris Canal was intended to connect the coalfields near Easton, Pennsylvania with the iron furnaces of northern New Jersey and markets in Newark. Jersey City's manufacturing increased with the extension of the Morris Canal from Newark to the banks of the Hudson River (Winfield 1874: 366). This extension crossed the Hackensack River near the old road to Newark at the foot of Brown's Ferry Road, turned south through the tidal meadows along the east bank of Newark Bay, and then southeast to skirt the bottom of Bergen Hill near the Bayonne border, a turn called the "Fiddler's Elbow". Finally, the canal returned northward along the bank of the New York Bay to its outfall at Paulus Hook (see Figures 4.2 and 4.3b; Gordon 1833; U.S. Coast Survey 1837b). An 1836 map showing New York City and its surrounding area depicts the developed portions of Jersey City between present-day Christopher Columbus Drive and the former Morris Canal Basin (Colton 1836). Harsimus Cove extended from present-day Montgomery Street north to Hoboken (Colton 1836). The Morris Canal turned east as it crossed the road to Communipaw and cut through the salt meadows that fringed Paulus Hook to a basin on the Jersey City waterfront (Colton 1836). The Morris Canal, and eventually the railroads, became the catalyst for industrial and residential growth and came to dominate Jersey City physically, economically, and politically (Cunningham 1997: 250-265).

Hudson County, comprising Bergen Township, Jersey City, and Harrison Township, split from Bergen County in 1840 (Snyder 1969: 145, 147). Following its formation, the county was divided between the heavily settled areas near the Hudson River shoreline and the more sparsely settled areas in the highlands and the Hackensack Meadowlands. Hudson County's economy benefitted from its topography, since Manhattan lacked the shoreline and space to accommodate shipping operations. While Manhattan became the passenger ship hub of New York and Brooklyn attracted freight shipping, Hudson County's location on the continental side of the most important harbor in the country drew shipping and industry (Lovero 1999: 65-66; Kelly et al. 1960: 50). Population increased almost 150 percent from 1850 to 1860, a time that also saw new railroads, warehouses, stockyards, classification yards (sorting freight cars), grain elevators, and rail terminals.

Figure 4.3a: 1837 United States Coast and Geodetic Survey, Topographic Survey of the New Jersey Coast, Sheet T-17.

Figure 4.3b: 1837 United States Coast and Geodetic Survey, Topographic Survey of the New Jersey Coast, Sheet T-18.

In the mid-nineteenth century, Kearny was encompassed by Harrison Township. The Hackensack Meadowlands extended south through the eastern portion of Harrison Township and was the focus of land reclamation schemes from the early nineteenth through the early twentieth centuries. Attempts to reclaim land for agricultural uses by draining the marsh began in the 1820s when Robert Swartout and his brothers constructed earthen dikes and tidal gates in a portion of the Meadowlands (Marshall 2004:10). Southeast Kearny is shown on the 1844 Map of New-York Bay and Harbor and the Environs as unaltered, except for a block of drained fields that extended south from the road to Newark and from the Passaic River on the west to the Hackensack River to the east (Figure 4.4a; Hassler 1844). Roads from Belleville and Newark, as well as the NJRR, crossed the Hackensack Meadowlands by the 1840s (Douglass 1841; Hassler 1844).

Maps from the 1840s depict a series of towns on Bergen Hill surrounded by agricultural land that extends to lowlands covered in forest or salt meadows (see Figure 4.4a; Hassler 1844; Douglass 1841; Sidney 1849). The villages of South Bergen, Bergen, and Cross Roads (which developed into Hudson City) are shown along the road to Bergen west of Communipaw, and the expanding towns of Jersey City and Hoboken are depicted along the Hudson River waterfront (see Figure 4.4a). The 1841 Douglass Topographical Map of Jersey City, Hoboken, and the Adjacent Country shows the western limits of present-day Jersey City as a series of long lots extending from the road to Bergen (present-day Tonnelle Avenue) west to the Hackensack River. The meandering channel of Bridge Creek is shown flowing through these lots to a confluence with the Hackensack River (Douglass 1841). The 1844 Map of New-York Bay and Harbor and the Environs provides additional details on the natural terrain and the settlement pattern of Bergen Neck and the Palisades. In 1844, the land in present-day Jersey City that the M&E Railroad would eventually traverse is depicted as marsh land between the Hackensack River and the PHR on west side of Bergen Hill and between the east side of Bergen Hill and the Hudson River (see Figure 4.4). The present-day HBLR line traverses portions of Bergen Neck depicted as farmsteads and marsh in 1844 (see Figures 4.4a and 4.4b; Hassler 1844). In present-day Bayonne, two dwellings are depicted proximate to the 22nd Street Station, east of the HBLR line, which may correspond to the dwellings labeled "C. Vreeland" and "J. Gaberty" on Sidney's 1849 map. One dwelling is depicted east of the HBLR line between present-day 30th and 31st streets, which may be the "A. Wood" dwelling on the 1849 map. One dwelling is depicted east of the HBLR line at 52nd Street, which may be the "J. Carias" dwelling on the 1849 map (see Figure 4.4b; Hassler 1844; Sidney 1849). Two dwellings are depicted proximate to the HBLR line south of Caven's Point east of present-day Princeton Avenue between Linden and Lembeck Avenues. Between present-day Chapel and Fulton Avenues, the HBLR line is proximate to the former west bank of the Morris Canal, then crosses the mapped course of the Morris Canal farther north between present-day Woodlawn Avenue and Richard Street (see Figure 4.4b). The HBLR headquarters is located south of the former road to Communipaw, as depicted in 1844, and one dwelling is depicted where an HBLR stockyard now exists (see Figure 4.4b). The HBLR crosses the mapped course of the Morris Canal again at present-day Garfield Avenue south of its intersection with present-day Union Street (see Figure 4.4a). In Paulus Hook, the HBLR crosses the former course of the Morris Canal at two locations: present-day Morris Boulevard proximate to the current Boys & Girls Club building and west of the HBLR's Marin Avenue Station (see Figure 4.4a). Essex Street Station is located where the Jersey City waterfront is depicted in 1844, and all Jersey City and Hoboken stations north of this are situated at locations depicted as either shallow open water or marsh land (see Figure 4.4a). The 1844 Map of New-York Bay and Harbor and the Environs records the shallow waters of the Hudson River and Upper New York Bay as three to six feet in depth to approximately 1.8 miles from its western shore (see Figure 4.4a). The 1841 Douglass map shows a street grid for Hoboken that extends west to the Palisades ridge and overlies salt marsh cut through by Hoboken Creek, which suggests that the western streets were so-called "paper roads" (Douglas 1841).

Land north of Hoboken was set off in 1843 as North Bergen Township (Snyder 1969: 147; Van Winkle 1924: 436). North Bergen Township was located on the west side of the Bergen Ridge and originally comprised wooded common lands, farms, and scattered settlements, including Weehawken and West Hoboken (see Figure 4.4a; Hassler 1844; Sidney 1849; Van Winkle 1924:124-7; Barber and Howe 1844). North Bergen's farms produced vegetables for the New York market (New Jersey Department

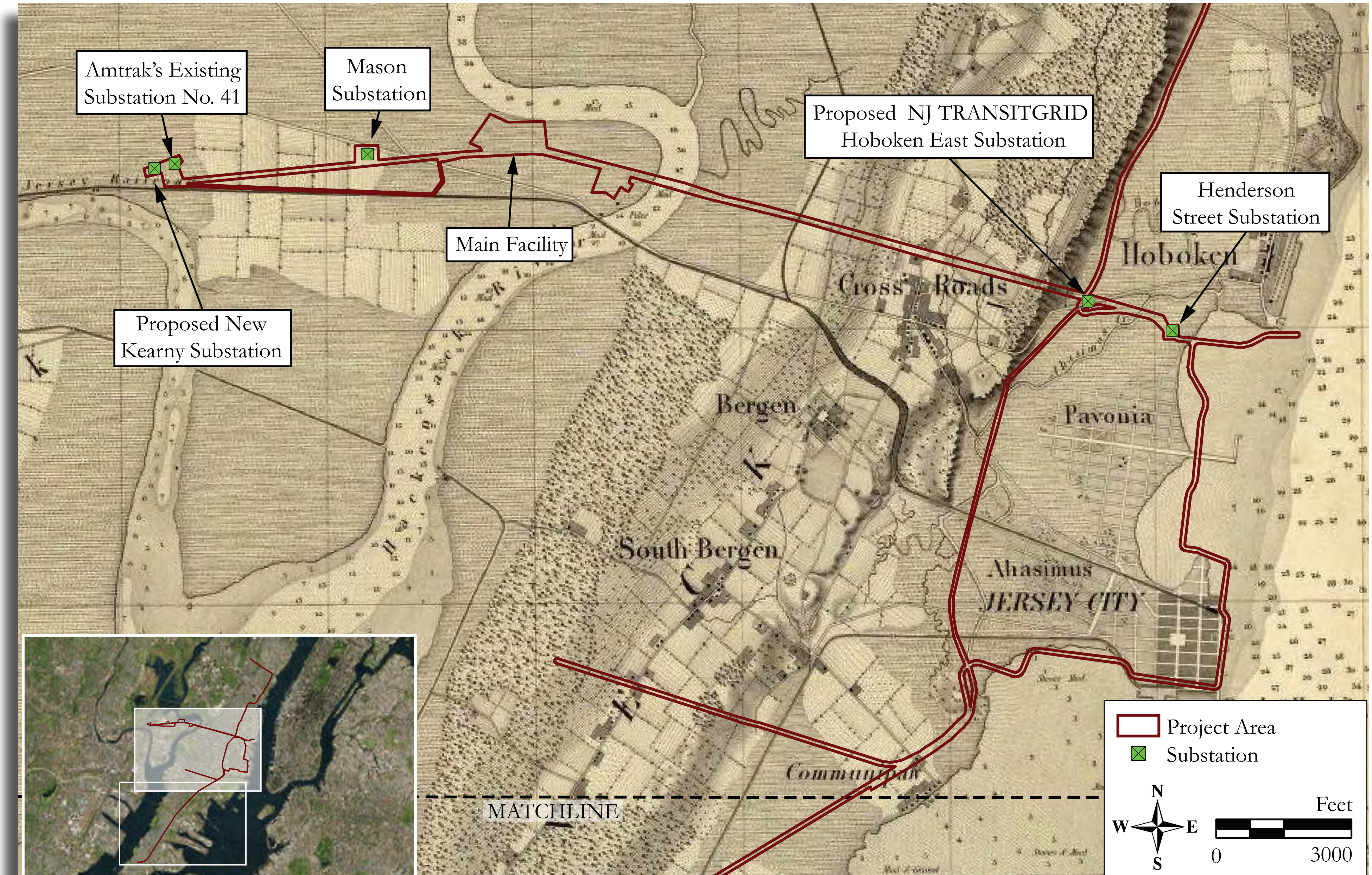

Figure 4.4a: 1844 F.R. Hassler, Map of New-York Bay and Harbor and the Environs.

Figure 4.4b: 1844 F.R. Hassler, Map of New-York Bay and Harbor and the Environs.

of Transportation-Bureau of Environmental Analysis 1980:21). In 1844, the Hudson River shoreline north of Hoboken diminished to a narrow salt marsh cut with small coves and bounded by the Palisades Ridge (see Figure 4.4a; Hassler 1844). Portions of present-day Park Avenue cross land created by the infilling of these small coves, as does the eastern half of the Lincoln Tunnel helix.

Bergen Township experienced significant changes in settlement pattern, transportation infrastructure, and political organization during the mid-nineteenth century. Bergen Neck's crossroads villages developed steadily during this period influenced by commercial growth serviced by an expanding railroad network. The communities of Bergen Point, Centreville, Saltersville, and Greenville, as well as proposed street grids for their expansion and the development of Constable Hook, are depicted on Walling's 1860 Map of the City of New York and its Environs. The route of the HBLR crosses through a developed part of Saltersville immediately south of the Morris Canal approximately between present-day 43rd and 48th streets (Walling 1860). Bayonne was formed from Bergen Township in 1861 as a township that extended from south of the Morris Canal to Bergen Point and encompassed Saltersville, Centreville, Constable Hook and Bergen Point (Snyder 1969: 145).

Population growth in the northern portion of Bergen Township led to the formation of Hudson City in 1855 and annexd by Jersey City in 1870 (Snyder 1969: 146). Greenville, Communipaw, Claremont, Bergen, and the smaller communities of Woodrow, Sherwood, and Lafayette, remained part of Bergen Township in 1860 (Walling 1860). Topographically, Bergen Township comprised marsh land drained by Bridge Creek along the east shore of the Hackensack River and uplands from present-day Tonnelle Avenue to Palisades Avenue (Wood 1855). Concerns for sufficient potable water to supply these expanding communities led to the development of a regional water system. The Jersey City Aqueduct was constructed through the Hackensack Meadowlands during the mid-nineteenth century, running parallel with the former Belleville Turnpike. By 1854, two cast iron pipes, 20 inches in diameter, were activated supplying an abundant source of clean water to Jersey City (RBA Group 1999, 2007). The New York and New Jersey Water Company maintained a pipeline within an eight-foot ROW. Infrastructure improvements to Jersey City mirrored transportation developments that facilitated its commercial and residential growth. In 1857, the Morris & Essex (M&E) Railroad began construction to extend the railroad from Newark, reaching Hoboken in 1862 (Treese 2006:112). The M&E Railroad, the predecessor to the Delaware, Lackawanna & Western Railroad (DL&WRR), began service in 1836 and was instrumental in linking Morristown and points west with the greater New York area. The M&E Railroad was leased by the DL&WRR in 1868 and became the Morris & Essex Division (Treese 2006:105-106). The DL&WRR, which had formed from the consolidation of two Pennsylvania and New York railroads and the New Jersey-based Warren Railroad, operated the M&E Railroad until the two railroads merged in 1945 (Treese 2006:112).

In 1849 the Township of Hoboken was set off from North Bergen (Snyder 1969: 146). By 1851, development had increased in the southeast corner of Hoboken with nearly built-out blocks on the north side of Newark Street between Hudson and Garden streets, rowhouses on the north side of Ferry Street (now Observer Highway) between Washington Street and Hudson Street, and a cluster of buildings on the south side of Ferry Street between Washington Street and the Hudson River (Clerk and Bacot 1851). In 1855 Hoboken was reincorporated as the City of Hoboken (Snyder 1969: 146). In 1857, construction began to extend the M & E Railroad to the Hoboken Ferry and to build a terminal on the Hudson River waterfront (Treese 2006: 112). The expansion of Hoboken was facilitated by land reclamation projects designed to drain salt marsh on the eastern and western margins of the city. Hoboken's dry land measured less than one-half mile wide from the shore of the Hudson to the edge of the meadows and comprised about 270 acres (Shaw 1884: 1211). In the mid-nineteenth century, Hoboken's waterfront was located at present-day Marin Boulevard (formerly Henderson Street) along the edge of Harsimus Cove, a shallow tidal bay (Douglass 1841; Clerk 1848).

The salt meadows on the western margins of Hoboken were developed on paper long before they were filled in and built on. The 1841 Douglass map depicts Grand Avenue, Washington Avenue, Adams Avenue, Jefferson Avenue, Madison Avenue, Monroe Avenue, Jackson Avenue, and Marshall Avenue with a salt marsh overlay, which suggests they were proposed rather than constructed roads.

By the 1860s Hoboken's dry land was fully developed and unable to accommodate the burgeoning population. An 1863 "Act to confirm the laying out of the westerly part of the city of Hoboken," dictated that the roads in the meadows had to "correspond with the streets and avenues running through and across the eastern portion of the city." The 1863 law also ordered that any meadow roads in existence prior to the 1860 plan be vacated (New Jersey State Legislature 1863: 49).

Despite early legislative attempts to direct development in the tidal marsh areas of Hoboken, the land remained unimproved in 1865 (Bache 1865). In 1866 the State of New Jersey addressed the drainage issue, passing an act to "provide for the drainage of certain lowlands lying in the city of Hoboken and the Township of Weehawken" through the use of "dykes, dams, tide banks, ditches, drains, sluices, sluice gates, engine pumps, and all others works structures and machinery necessary…" (New Jersey State Legislature 1866: 941). Drainage proposals depicted on maps made by Robert C. Bacot of Jersey City, and Levi V. Post of Hudson City called for the construction of sewers running "east and west along Ferry Street, First Street, Third Street, Tenth Street, and Fifteenth Street" that discharged into the Hudson River at low tide (New Jersey State Legislature 1866: 941; Van Winkle 1924: 296). In 1869, William Hexamer, a water commissioner, noted that "about three miles of box sewers and ditches had been built, principally in Ferry and First Streets" according to the plan laid out by Bacot and Post (Van Winkle 1924: 296; Shaw 1884: 1211). Another box sewer was constructed along Third Street, and extended "from the Hudson River to Adams Street," and received "the drainage of sewers in Garden Street, Park Avenue, Willow Avenue, Clinton Street, Grand, and Adams Streets" (Van Winkle 1924: 296). Just four years after the completion of some of these sewers, the New York Times noted that the meadows, which at that time extended by "from Adams Street for a half-mile westward, to the foot of the Hudson City Hills," continued to be "flooded with stagnant pools and health-destroying offal" (New York Times 1873: 8).

Land reclamation schemes also targeted the Hackensack Meadowlands for development. In 1867 Spencer B. Driggs and Samuel Pike attempted to reclaim land in the Meadows by the construction of a system of earthen dikes reinforced by iron plates, tidal gates, and pumps (Marshall 2004:10). The Driggs and Pike project was abandoned in 1873. Nevertheless, population growth on the uplands west of the Meadowlands led to the formation of Kearny Township in 1867 from Harrison Township (Snyder 1969: 147). General N. M. Halsted, a prominent resident, campaigned for the creation of an independent township that could more easily administer local affairs.

East of the Meadowlands municipal development was driven by commercial interests, including the railroad companies' desire to link Pennsylvania coal fields to New York City markets. All railroads into Jersey City were forced to use the NJRR tracks through the Bergen Cut or to transfer passengers onto NJRR trains to reach the Hudson River by rail, giving the NJRR a virtual monopoly over access to the Port of New York. In 1858 the NJRR built a terminal at Exchange Place near the former location of Fulton's ferry. In 1856 the Erie Railroad (henceforth the Erie), which absorbed the PHR in 1853, began construction of the Long Dock Tunnel to connect its line to the Hoboken Terminal, at the former site of Steven's ferry terminal, and bypass the Bergen Cut. The Long Dock Tunnel opened for service in 1861 and carried Erie and M&E trains until the M&E's successor, the DL&WRR, constructed the North Bergen Tunnel in 1876 and 1877. While the Long Dock Tunnel was under construction, the Erie built a new terminal at Hudson Street in the Pavonia section of Jersey City. The DL&WRR continued to use the Hoboken Terminal (Winfield 1874; Lane 1939; Treese 2006).

The Central Railroad of New Jersey (CRRNJ) circumvented the NJRR by successfully bridging lower Newark Bay and extending their own mainline from Elizabethport to a terminal it constructed at Communipaw in 1864 (Winfield 1874: 369; Treese 2006:50). This allowed the railroad to deliver passengers over its own tracks to a new Hudson River terminal. On March 1, 1866, interests of the CRRNJ chartered the Newark & New York Railroad to compete directly with the NJRR for Newark passenger, commuter, and freight traffic. The new railroad opened officially for passenger service on July 23, 1869. Travel time took just 17 minutes (New York Times 1869). On June 6, 1871, the CRRNJ leased the Newark & New York Railroad outright, thereby formalizing the relationship between the two companies (New Jersey Secretary of State 1871). From that point forward it was known as the

Newark & New York Branch of the CRRNJ. A clear benefit of the CRNNJ route was to open lands along its route to development. Even before its completion, one reporter from the New York Times noted that "along its lines new villages will spring up. The path of progress in this latter day is the path of the cars" (New York Times 1867). Until the mid-nineteenth century, Bergen Neck comprised dispersed farmsteads, open fields, and undeveloped marsh land, except for the construction of the Morris Canal (Douglass 1841; Wood 1855). By the time George Hopkins published his atlas of Jersey City in 1873, the area surrounding the canal had been mapped out for new city streets and subdivided into numerous house lots (Hopkins 1873).

The subdivision of North Bergen Township into smaller municipalities during the mid-nineteenth century reflects the rapid and disproportionate population growth that occurred along the Hackensack and Hudson Rivers. The townships bordering the Hudson River developed rapidly, established separate identities and divided from North Bergen (Van Winkle 1924: 124-7). Union Township and West Hoboken Township split from North Bergen in 1861. As North Bergen Township's population density increased, agricultural production tended to specialize, but without the degree of urbanization and industrialization that had occurred along the banks of the Hudson River. The West Shore Hudson River Railroad (WSRR) incorporated in 1867 and operated as part of the New York Central Railroad. The WSRR built a line through North Bergen Township along the east side of the former New Jersey Midland Railroad (later part of the New York, Susquehanna and Western Railway) and began service between Jersey City and Newburgh, New York in 1883. Part of the route necessitated a tunnel that extended 4,000 feet through the Palisades to the WSRR terminal Weehawken, which was completed in 1884 and operated until 1959 (Treese 2006:103). The route of the WSRR provided communities on the Palisades Ridge, including West Hoboken and Union Hill, with access to New York City markets and improved transportation between North Bergen and Jersey City. Weehawken Township was set off from North Bergen in 1859, followed by Union Township and West Hoboken Township in 1861 (Snyder 1969:148). Union Town was created from Union Township in 1864 (Snyder 1969:148). Walling's (1860) Map of the City of New York and its Environs illustrates the proposed expansions of West Hoboken and Union Hill west from Palisades Avenue. The smaller communities of Weavertown, Bonnsville, and North Hoboken extended along Bergen Road. Weehawken, in the 1860s, comprised a series of large estates extending along the west bank of the Hudson River from the Elysian Fields on the northeastern boundary of Hoboken to north of Day's Point (Walling 1860; Dripps 1863). Palisades Avenue and Bulls Ferry Road marked the western boundary of Weehawken. Maps of the 1860s record water depths of two to six feet along the Hudson River shoreline, marked by a bulkhead line that would eventually contain fill used to expand the Weehawken waterfront (Walling 1860; Dripps 1863). Portions of the HBLR traverse made land between Castle Point and Port Imperial, north of Day's Point (Walling 1860; Dripps 1863). The WSRR Tunnel was constructed through the circa mid-nineteenth century estate of James Brown and along the northern periphery of North Hoboken at present-day 49th Street in North Bergen Township (Dripps 1863; Hopkins 1873). The Grove Church Cemetery is depicted at the intersection of the roads that became John F. Kennedy Boulevard and 49th Street and is labeled as a "grave yard" (Dripps 1863). An 1873 map of North Bergen Township depicts the proposed route of the WSRR Tunnel north of the Grove Church Cemetery (Hopkins 1873).

Once the Long Dock Tunnel was completed, land for a new railroad station in Jersey City was made by filling Harsimus Cove using a combination of dredge, garbage, and spoils from various construction projects. The new land spanned the boundary between Hoboken and Jersey City and became the location of a large rail yard servicing the DL&WRR in Hoboken and the Erie Railroad in Jersey City (Taber 1977: 78). The 1873 Hopkins Atlas of the State of New Jersey and the County of Hudson depicts the Erie's freight depots along the north side of Harsimus Cove (Hopkins 1873: Plate B). Morris Canal structures are depicted south of Harsimus Cove at the intersection of Essex and Van Vorst Streets on the west side of the canal, and rowhouses are shown along both sides of Essex Street between Van Vorst and Warren streets proximate to the location of the HBLR Marin Boulevard Station (Hopkins 1873: Plate C). Further east along Essex Street, buildings associated with the Mathiesson & Wiechers Sugar Refinery, the J.J. Gautier & Co. Fire Brick Manufactory, Thomas & Haley, and John Cahill are depicted between Warren and Hudson Streets (Hopkins 1873: Plate A).

Buildings along the east side of Hudson Street, near the Paulus Hook waterfront, included Took & Seurs, the Wm. C. Hutton Boiler Works, the First National Bank, and several buildings owned by the Jersey City Associates (Hopkins 1873: Plate A). The HBLR route is proximate to all of these late nineteenth century properties. Between Montgomery and Steuben streets, the HBLR route passes through the former NJRR depot and railyard (Hopkins 1873: Plate A). The filling of Harsimus Cove facilitated the further expansion of this industrial district. In 1874, further improvements along the Hudson River waterfront included the dredging and construction of a 100-foot-wide canal called the "Long Slip" to increase the railroad's overall wharf frontage and allow for the direct exchange of freight between rail cars and sea-going vessels without the use of lighters (Taber 1977: 86). Related improvements included elevated passenger and freight tracks and new railroad bridges with stone abutments built in 1876 over Marin Boulevard (formerly Henderson Street) and other public roadways (Interstate Commerce Commission 1925).

The opening of the DL&WRR's North Bergen Tunnel in 1877 precipitated a reconfiguration of the rail lines and improved freight facilities that included nine piers (Bromley & Bromley 1887). Along Marin Boulevard (formerly Henderson Street), between the branching track stems leading to the passenger and freight terminals, several buildings (no longer standing) served both the railroad and local businesses. The private residences formerly located along the east side of the street were replaced by a grouping of three buildings attributed to the New York & New Jersey Produce Company, including an office, an ice house, and several other outbuildings. Structures on the west side of Henderson Street featured a yard office and an interlocking tower (Bromley & Bromley 1887; Hughes and Bailey 1904; New Jersey State Board of Assessors 1910; Sanborn Map Company 1912). At the head of the Long Slip, the railroad company maintained a frame store house for cement, a material used extensively on the line (New Jersey State Board of Assessors 1910: 40-41). The 1880 Spielmann & Brush Sanitary Map of Hudson County, New Jersey shows the simplified rail lines in place as well as the former extent of Harsimus Cove and the marsh lands (Figure 4.5a). Upon exiting the North Bergen Tunnel, the rails divide east of Newark Road, with trains proceeding either left to the DL&WRR terminal or right to the Erie Terminal (see Figure 4.5a). The 1880 Spielmann and Brush map depicts extensive areas of made, reclaimed or cut land (symbolized by stippling and shading) at Paulus Hook and Harsimus Cove (see Figure 4.5a).

While the land reclamation was underway on the eastern margins of Jersey City and Hoboken, construction of buildings on the western margin of Hoboken was sparse through the 1870s (Loudan 1876). Sections of Hoboken west of Willow Street are still depicted as marsh land on the 1880 Spielmann and Brush map, even though the southern portions of the meadows were well supplied with sewers (see Figure 4.5a). In western Jersey City, the 1880 Spielmann & Brush map indicates that land west of James Street (present-day James Avenue) was marsh land (see Figure 4.5a). Kearny in 1880 also remained marsh land bisected by railroads, turnpikes, and the Jersey City Waterworks pipelines (see Figure 4.5a). North of Hoboken, reclaimed land is not indicated on the 1880 Spielmann & Brush map except for limited areas surrounding existing docks (see Figure 4.5c). South of Jersey City, development was concentrated on the spine of Bergen Neck and uplands at Communipaw and Constable Hook. The 1873 Hopkins Atlas shows both existing and proposed streets in the Greenville section of Jersey City and in Bayonne, as well as the routes of the Morris Canal and the CRRNJ (Hopkins 1873). In Bayonne, no buildings are depicted proximate to the CRRNJ except for rail stations. Near the Morris Canal, between Centre and Grand Streets and east of Avenue E, dwellings are depicted along the west side of the CRRNJ tracks (Hopkins 1873). The CRRNJ brought both industrial development and tourism to Bayonne, which became a boating and yachting center during the late nineteenth century. In the 1880s the construction of paint, zinc, and chemical factories on Constable Hook and petroleum plants and tank farms in southern Bayonne spurred population growth. Between 1880 and 1890, Bayonne's population increased from 800 to 5,500 (Richard Grubb & Associates, Inc. 1998: 22). In the Greenville section of Jersey City, land surrounding the CRRNJ is depicted as undeveloped in 1873 (Hopkins 1873). The CRRNJ is depicted crossing the Morris Canal's Fiddler's Elbow on the Bayonne/Greenville boundary (Hopkins 1873). In 1889 the CRRNJ built a new terminal at Communipaw to replace its existing terminal. Several buildings are depicted in 1873

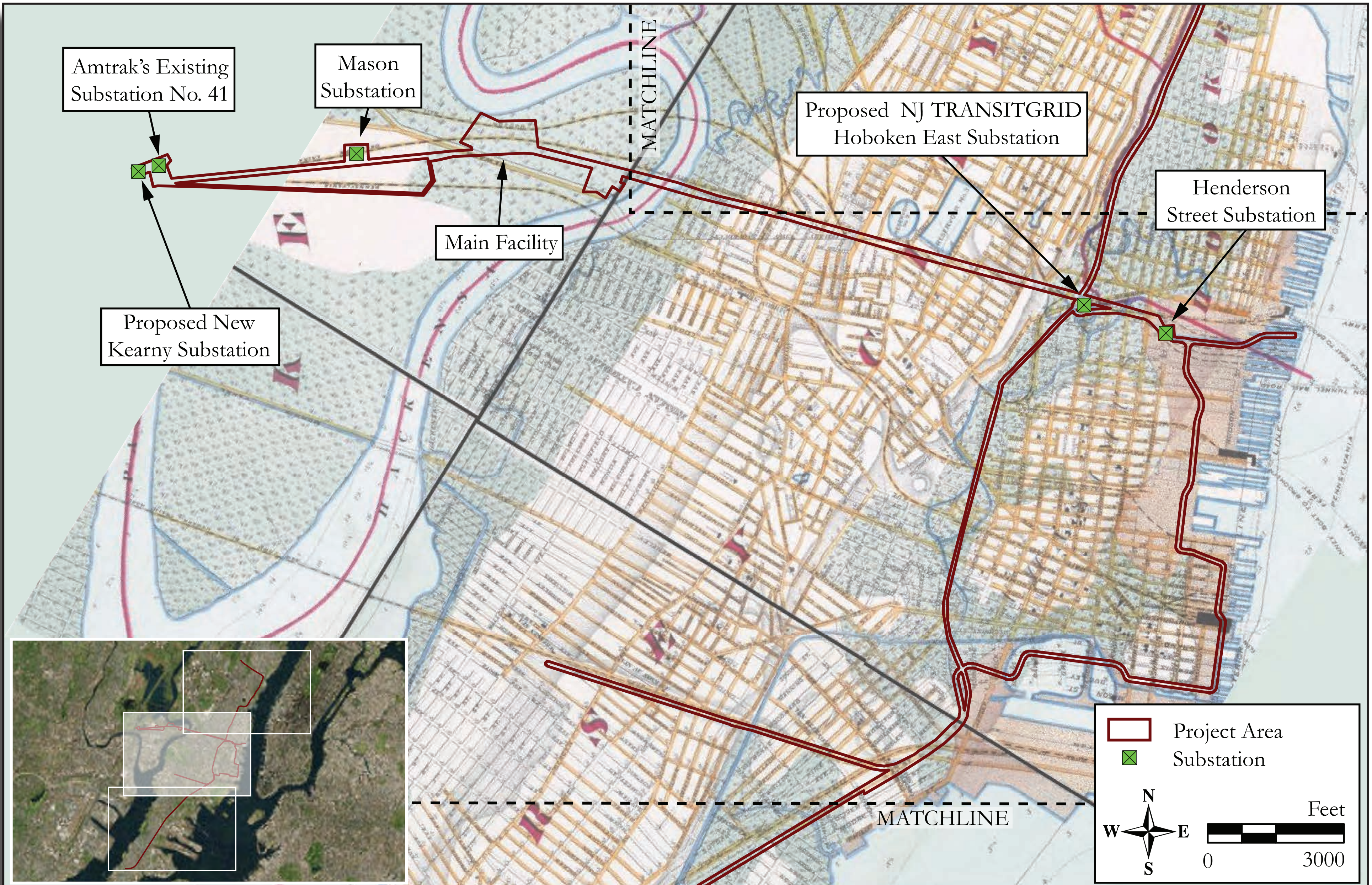

Figure 4.5a: 1880 Spielman and Brush, Sanitary and Topographical Map of Hudson County, New Jersey.

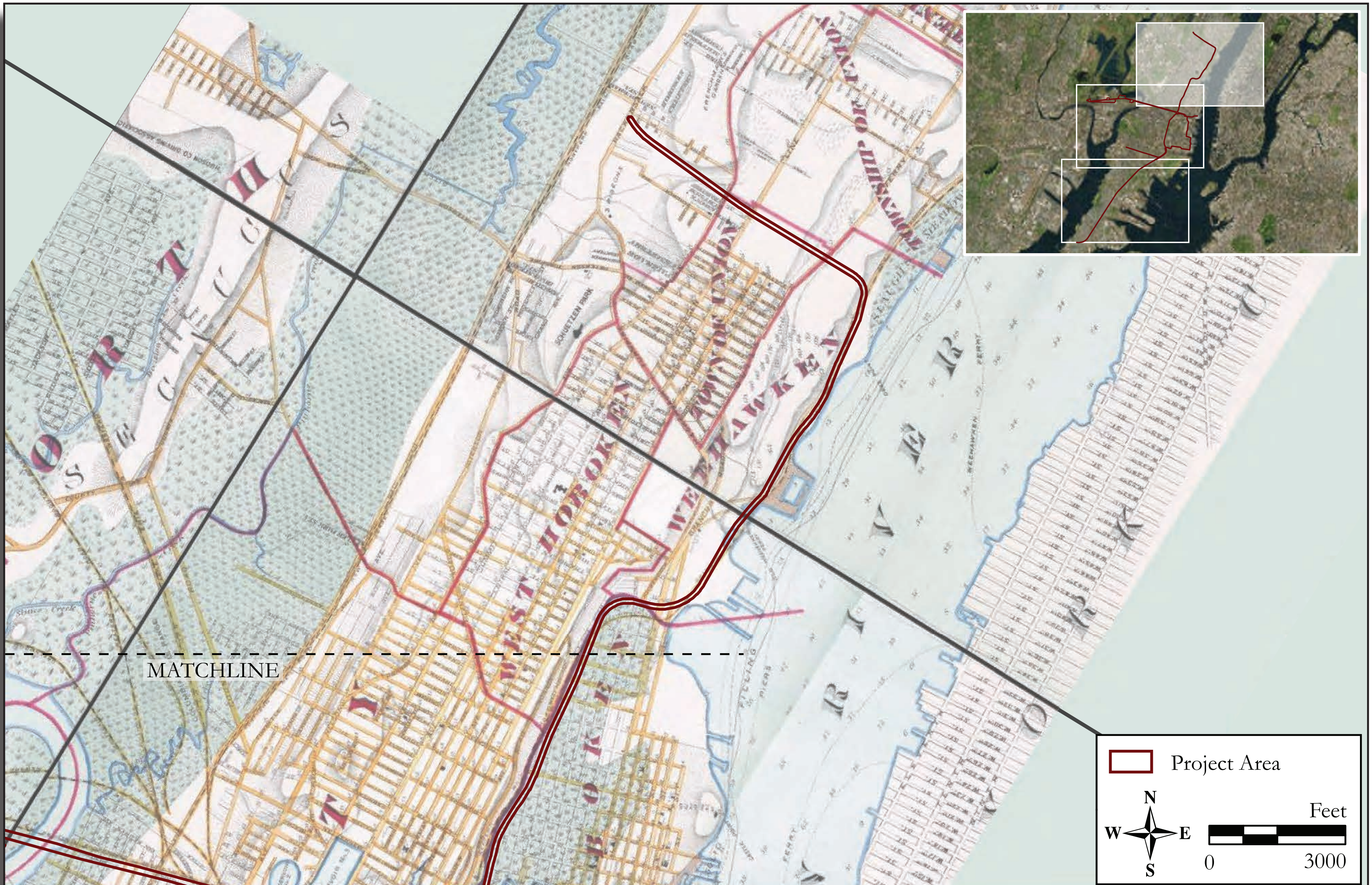

Figure 4.5b: 1880 Spielman and Brush, Sanitary and Topographical Map of Hudson County, New Jersey.

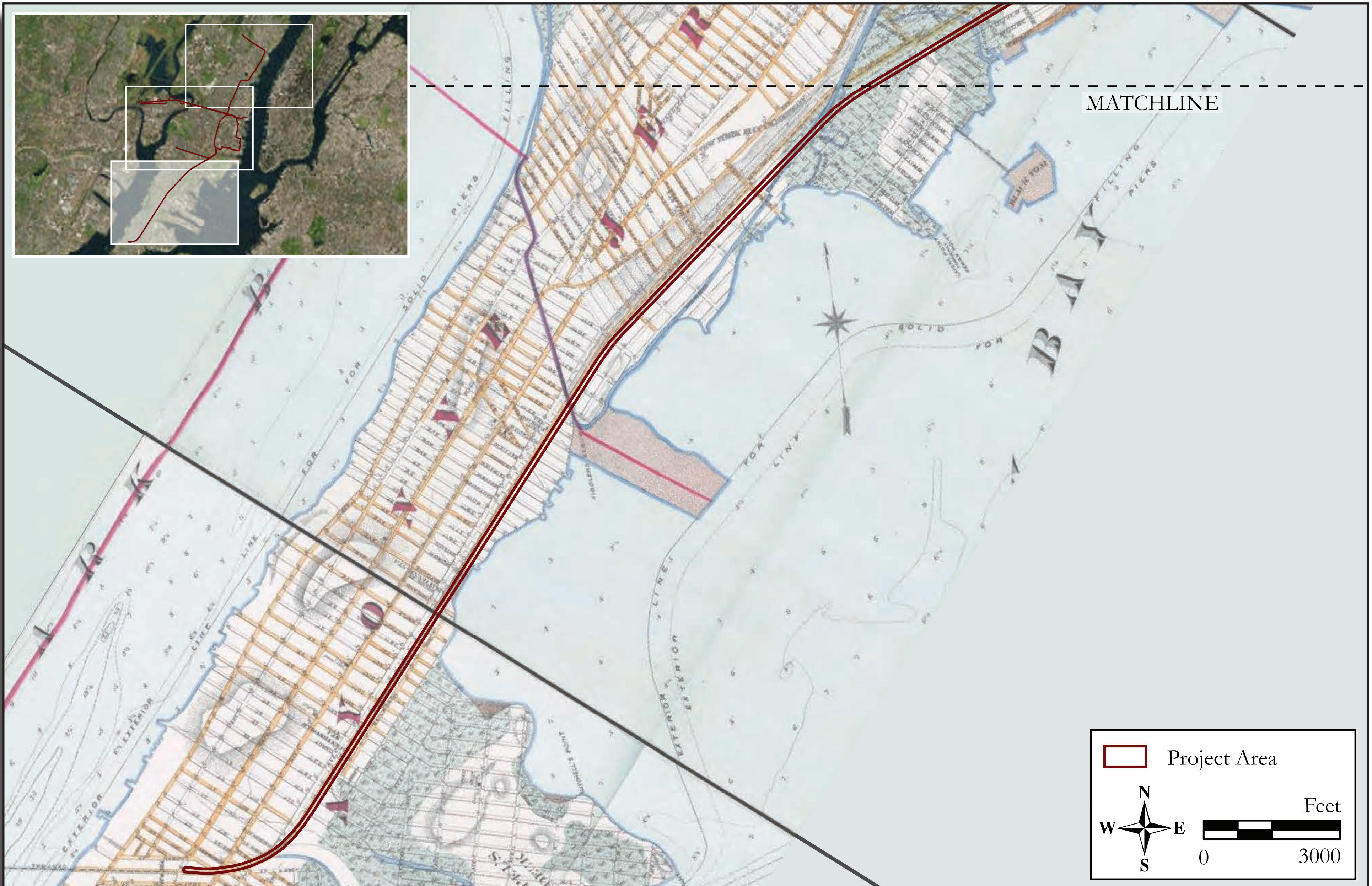

Figure 4.5c: 1880 Spielman and Brush, Sanitary and Topographical Map of Hudson County, New Jersey.

west of the terminal on the east side of the CRRNJ tracks at the intersection of Communipaw Avenue and Dudley Street (Hopkins 1873: Plate M).

With advances in rail transport, the Morris Canal eventually became obsolete, and by 1871 its ROW was acquired by the Lehigh Valley Railroad (LVRR). Through this acquisition, the LVRR, secured the Morris Canal's valuable terminal properties on the Hudson River at Paulus Hook. While the LVRR acquired the charters of the Perth Amboy and Bound Brook and the Bound Brook and Easton railroads and began construction of its New Jersey Division, it considered ways to maximize the productivity of the canal's ROW (Greenberg and Fischer 1997: 66-67). Initially, the railroad envisioned filling in the canal, erecting bridges over the Passaic and Hackensack Rivers, and running tracks into Jersey City on the old canal ROW (New York Times 1886: 2). Such a plan, however, required the abandonment of the waterway, for which state sanction was not forthcoming. In 1881 it allowed the installation of the Standard Oil Company of New Jersey's Olean-Bayonne Oil Pipeline. The LVRR also worked to develop the canal's water assets. The LVRR secured contracts with Newark, Bayonne, and other communities to deliver drinking water to local distribution systems (McAneny, Jr. 1891: 659). The LVRR conveyed its contracts to the East Jersey Water Company, established specifically to construct the necessary aqueducts (McAneny 1891: 656, 658-659). For the Bayonne contract, an East Jersey Water Company subsidiary called the New York & New Jersey Water Company imbedded a 30-inch pipeline into the Morris Canal towpath in 1896 (McAneny 1891: 658; New York Times 1896). In 1889, the LVRR built a terminal in Jersey City adjacent to the CRRNJ terminal.

The growth of Jersey City prompted improvements to its infrastructure, including the construction of a new network of stormwater and sewer lines under the city streets, together with sewer outfalls into the Hackensack River (Hopkins 1908). Among proposals for the development of Jersey City was an extensive land reclamation plan for marsh land along Newark Bay (Muirhead 1910). Public health concerns in the late nineteenth and early twentieth centuries resulted in an extensive drainage infrastructure constructed in the Meadowlands tidal marsh by the Bergen and Hudson County Mosquito Commissions. The drainage system included the excavation of a network of ditches and the installation of tide gates at the confluences of creeks or ditches emptying into the Hackensack River (Hunter Research, Inc. 2009: 5-52). Early twentieth century viewpoints on the Meadowlands focused on land reclamation through filling and land making methods designed to raise the land above the high-tide level (Marshall 2004:10). River dredging programs begun in the late nineteenth century by the U.S. Army Corps of Engineers provided some material for in-filling of marsh lands; municipal garbage, construction debris, and excavation spoils provided other material (Marshall 2004:10). These efforts resulted in the creation of made land in eastern Bergen and western Hudson counties along the lower Hackensack and lower Passaic rivers. Portions of the Kearny Peninsula were reclaimed as a result of these efforts. In the late nineteenth century, the Paterson & Newark Railroad, the DL&WRR, and the Pennsylvania Railroad crossed the Kearny Peninsula en route to Jersey City; however, most of the reclaimed land remained undeveloped (Figure 4.6; Hopkins 1909).

Along the Hudson River waterfront, improvements of the DL&WRR terminal were underway when two fires destroyed the southern third of the freight yard and the passenger terminal in 1904 and 1905, respectively. The disasters gave the railroad the opportunity to rebuild and reconfigure both the freight and passenger yards (Taber and Taber 1981: 436). The Long Slip bulkheads were repaired and reconstructed using the railroad's signature material of concrete. The south side of the canal was equipped with Mac Miler moving cranes used for shifting large bulk machinery and freight (particularly lumber products) from rail cars to ships or lighters for distribution around the Port of New York (Taber and Taber 1981: 425). The new passenger terminal opened on February 25, 1907, and the rebuilding of the yard facilities was substantially completed by 1912 (Taber and Taber 1980: 29: 29). Later relevant changes to the facility included construction of a new electric power generating plant on the site of the old cement storage house at the head of the Long Slip (Sanborn Map Company 1927; Lynn Drobbin and Associates 1997: 22). The old produce company buildings located along Henderson Street were taken over, demolished, and replaced with facilities and offices for the Pullman Company's fleet of luxury rail cars, including a set of concrete bumper blocks at the ends of the yard stub tracks (Sanborn Map Company 1927). This section of the terminal retains the name "Pullman

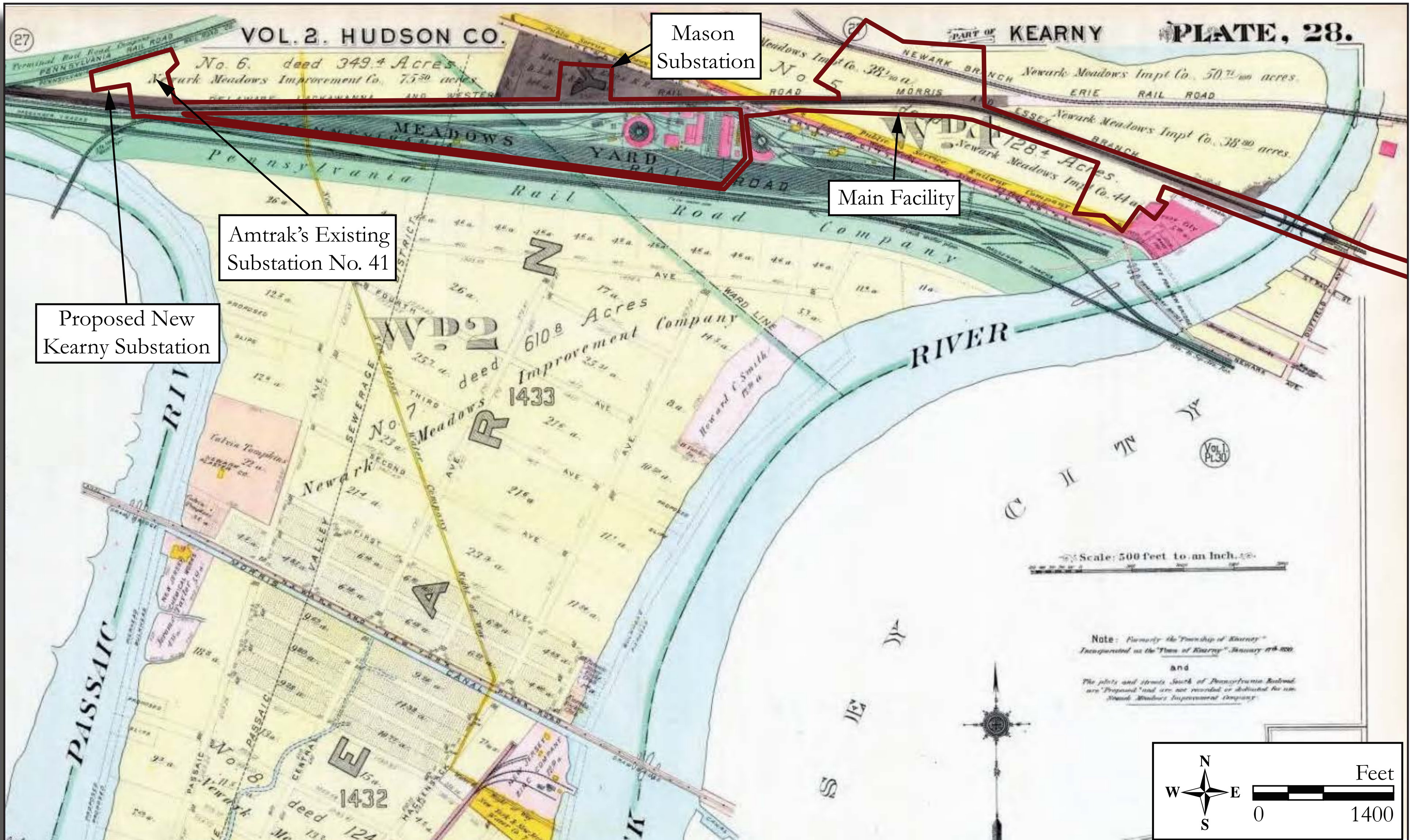

Figure 4.6: 1909 G. M. Hopkins Co., Atlas of Hudson County, New Jersey.

Yard." By 1908, a new ferry terminal was constructed; now owned by the DL&WRR (Hopkins 1909). The former terminal burned in 1905 (Richard Grubb & Associates, Inc. 1996) and was replaced by a several ferry concourses and a new train concourse.

Development of the tidal marsh areas in western Hoboken continued through the early 1890s, as additional areas of the meadows were filled in and railroad development projects were completed. An 1891 map of the region depicts land created by draining portions of the marsh (Bien 1891). As late as the 1890s northern Hudson County and southern Bergen County remained primarily rural, with woodlots covering the northeastern half of Fairview Borough and northeastern North Bergen Township (Beers 1891; Bien and Vermeule 1891; U.S.G.S. 1888, 1898; Vermeule 1889). Subdivisions had been planned but not yet constructed during the late nineteenth century (Richard Grubb & Associates, Inc. 1995:6-10). In the 1900s, while the DL&WRR was improving and rebuilding its terminal facilities, the Hudson & Manhattan Railroad (H&MRR) was busy boring a tube beneath the Long Slip and adjoining rail yards for an underground connection between the Hoboken and Erie railroad terminals. This section of the H&MRR (present-day Port Authority Trans-Hudson Corporation [PATH]) tubes opened in February 1908 (New York Times 1909: 3), providing rapid transit links between the various Jersey City passenger rail stations and Manhattan.

Industrial and commercial development of the northeastern portion of the Kearny Peninsula began in the early 1900s with the construction of the Koppers Seaboard Coke and Byproducts Company. The Koppers facility operated from 1917 to 1974 and conducted coke production, by-product recovery, and gas cleaning/conditioning (Figures 4.7a, 4.8; Hopkins 1934; NETR 1953, 1954, 1966, 1979; NJDEP 1930; Leir 2012; Hornsby and Sawchuck 1999). The post-World War I commercial, residential, and industrial development in Kearny and Jersey City was influenced by rapidly expanding automotive transportation. The opening of the Holland Tunnel in 1927 marked the beginning of a complex road network in and around Jersey City to provide access to New York City. Anticipated completion of the Holland Tunnel required construction of new routes to feed the tunnel, such as U.S. Routes 1 & 9 and the Pulaski Skyway. The Lincoln Tunnel opened in 1937 providing a direct route between Weehakwen and Manhattan. Following a short period of improved business conditions brought about by World War II, the DL&WRR experienced increasing financial losses during the 1950s (Taber and Taber 1981: 425). A deepening economic recession in 1957 and 1958 was especially hard, eroding freight revenues for all eastern carriers (Baer, et al 1994: 368). In April 1959, the DL&WRR petitioned the New Jersey Board of Public Utilities to stop passenger service on all but its Boonton Branch (Grow 1979: 83). Management also approved a merger with the rival Erie Railroad in 1959. The consolidation of the two lines took effect on October 17, 1960, forming the Erie-Lackawanna Railroad (E-LRR).

In 1952, the New Jersey Turnpike was constructed through northeastern New Jersey. Construction of the New Jersey Turnpike through the marshes of the New Jersey Meadowlands progressed slowly. Low-lying and inundated areas that ranged in depth from five to 250 feet had to be filled and the roadway constructed above the water table. The contemporary landscape of Kearny and Jersey City reflects the continued impacts of highway construction, mass transit systems including the HBLR, and expansion in the New York City metropolitan area.

4.3 Summary of Prior Cultural Resources Investigations

Registered Archaeological Sites

A review of site files at the NJSM and standard references (Skinner and Schrabisch 1913; Cross 1941) indicated that nine registered archaeological sites (28-Hd-1, 28-Hd-15, 28-Hd-17, 28-Hd-18, 28-Hd-19, 28-Hd-44, 28-Hd-47, 28-Hd-49, and 28-Hd-53) are located within or adjacent to the APE (see Table 4.2). The Constable Hook site (28-Hd-1) is a camp site for which limited information is available (Skinner and Schrabisch 1913:42; Spier 1913). Sites 28-Hd-15, 28-Hd-17, and 28-Hd-18 are undated prehistoric sites recorded by the Indian Site Survey (ISS) of New Jersey during the 1930s for which very little information is available. The Standard Chlorine Chemical Company Site (28-Hd-44) is a deeply buried prehistoric site identified during archaeological monitoring conducted as part of a

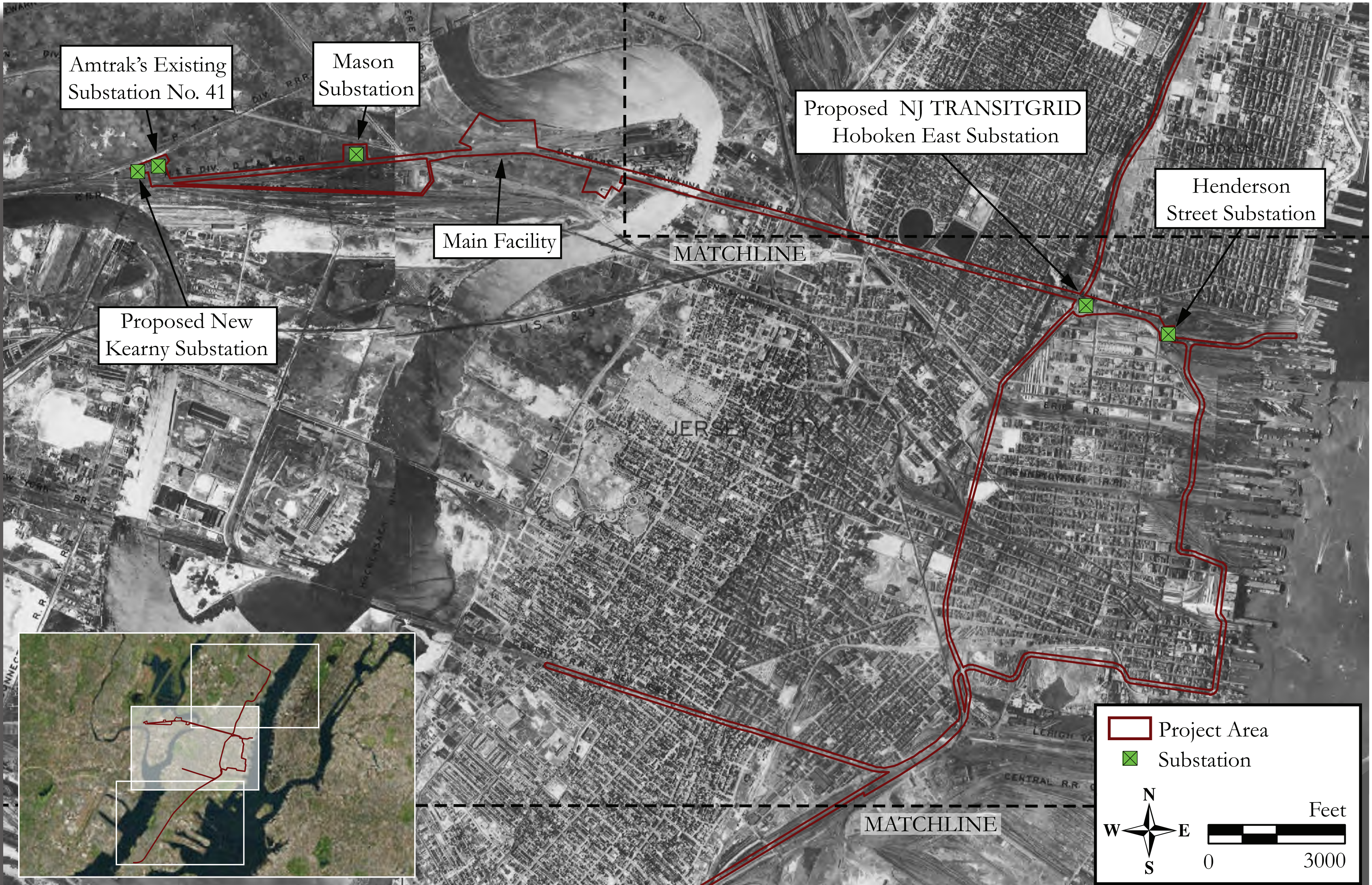

Figure 4.7a: 1930 Aerial photograph of the APE.

Figure 4.7b: 1930 Aerial photograph of the APE.

Figure 4.7c: 1930 Aerial photograph of the APE.

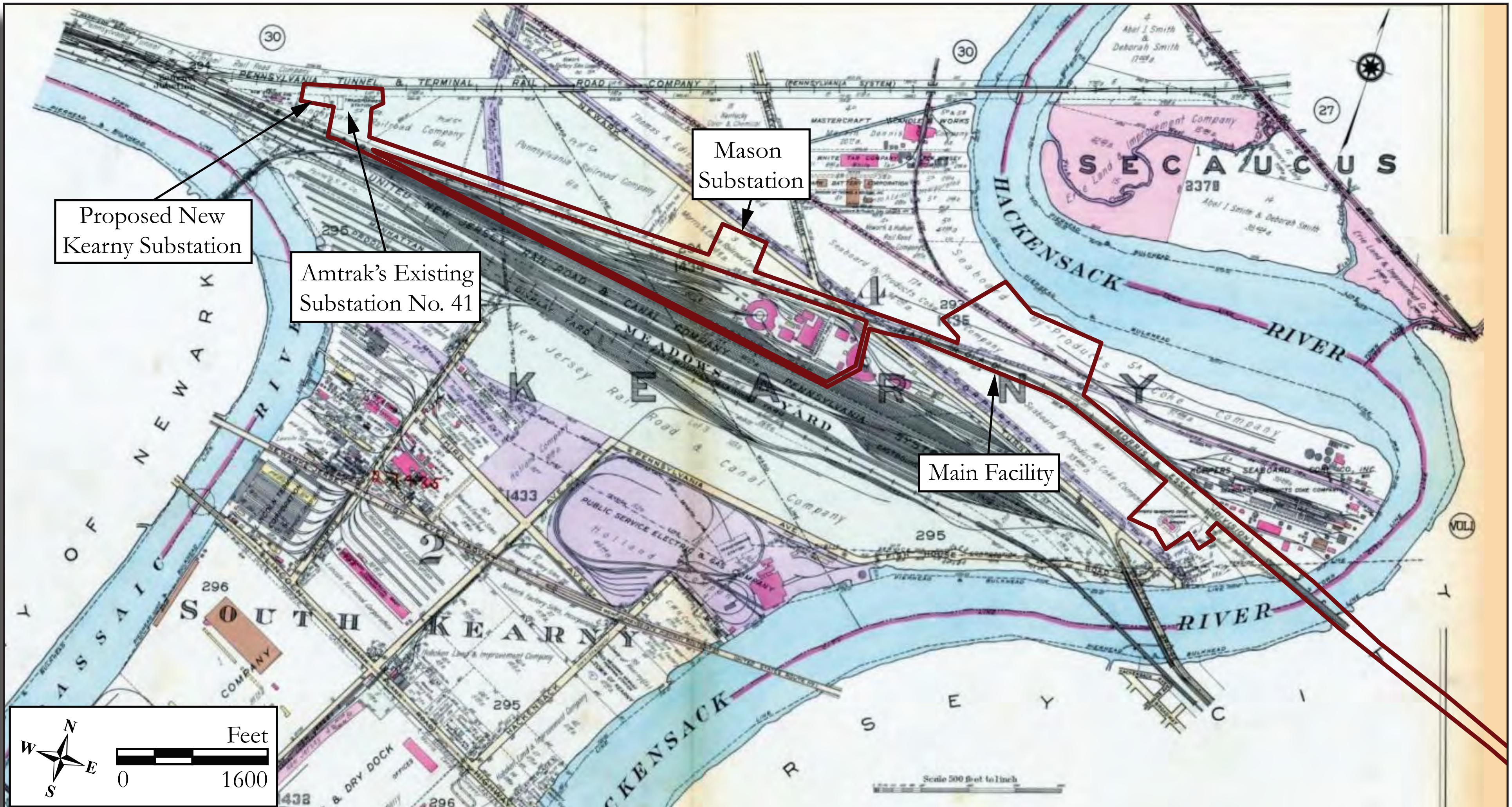

Figure 4.8: 1934 G.M. Hopkins Co., Atlas of Hudson County, New Jersey.

Table 4.2: Archaeological sites in or within one-half mile of the APE.

Site Number	Site Name	Period	Type	Reference
28-Hd-1	Constable Hook	Prehistoric	Unknown	Spier 1913; Skinner and Schrabisch 1913:42; ISS:6
28-Hd-3	Greenville	Woodland	Unknown	Skinner and Schrabisch 1913:42; ISS:6
28-Hd-5	Bayonne	Prehistoric	Unknown	Skinner and Schrabisch 1913:42; ISS:6
28-Hd-8	Jersey City	Prehistoric	Unknown	ISS:6
28-Hd-9	Jersey City, Western Shore (Site #3)	Prehistoric	Unknown	ISS:6
28-Hd-10	Jersey City, Western Shore (Site #4)	Prehistoric	Unknown	ISS:6
28-Hd-12	Jersey City, Western Shore (Site #5a)	Prehistoric	Unknown	ISS:6
28-Hd-13	Jersey City, Interior Points (Site #6)	Prehistoric	Unknown	ISS:6
28-Hd-15	Jersey City, Interior Points (Site #8)	Prehistoric	Unknown	ISS:6
28-Hd-16	Jersey City, Eastern Shore (Site #9)	Prehistoric	Unknown	ISS:6
28-Hd-17	Jersey City, Eastern Shore (Site #10)	Prehistoric	Unknown	ISS:6
28-Hd-18	Jersey City, Eastern Shore (Site #11)	Prehistoric	Unknown	ISS:6
28-Hd-19	Exchange Place Landfill	1845 – 1890	Landfill	Kardas and Larrabee 1979
28-Hd-20	73/75 Larch Avenue	Mid- to late 19th c.	Residence	RBA Group 2000
28-Hd-21	77 Larch Avenue	Mid- to late 19th c.	Residence	RBA Group 2000
28-Hd-22	79 Larch Avenue	Mid- to late 19th c.	Residence	RBA Group 2000
28-Hd-23	85 Larch Avenue	Mid- to late 19th c.	Residence	RBA Group 2000
28-Hd-24	23 Seaman	Mid- to late 19th c.	Residence	RBA Group 2000
28-Hd-25	25 Seaman	Mid- to late 19th c.	Residence	RBA Group 2000
28-Hd-26	Constable Hook 1	Prehistoric	Unknown	ISS:6
28-Hd-30	Hudson County Potter's Field Burial Ground	Late 19th to mid-20th c.	Cemetery	NJSM
28-Hd-31	Whitlock Mills	Mid-19th – early 20th c.	Zinc Processing Plant & Hemp Cordage Mill	Cultural Resource Consulting Group 2005
28-Hd-32	HBLR: Smith Family House	Early – late 19th c.	Domestic	Geismar 1995a
28-Hd-33	Radcliff/Oechel/Bauer House	Mid- to late 19th c.	Residence	RBA Group 2000
28-Hd-34	Walter/Sauter House	Mid- to late 19th c.	Residence	RBA Group 2000
28-Hd-35	Lipfert House	Mid- to late 19th c.	Residence	RBA Group 2000
28-Hd-36	Radcliff/Stewart House	Mid- to late 19th c.	Residence	RBA Group 2000
28-Hd-37	Apple Tree House	18th – 19th c.	Residence	NJSM
28-Hd-39	Croxton Yard Engine Maintenance Facility Complex Archaeological Site	1910 – 1950	Railroad roundhouse and terminal	RBA Group 2003, 2007
28-Hd-41	Hoersch Tenant House	Mid- to late 19th c.	Residence	RBA Group 2000
28-Hd-42	Rebhan/Jaeger House/Store	Mid-19th to early 20th c.	Residence	RBA Group 2000
28-Hd-43	Covert Street Lots	Mid-19th to early 20th c.	Residential	RBA Group 2000
28-Hd-44	Standard Chlorine Chemical Company Site	Prehistoric	Unknown	Langan Engineering Services, Inc. 2012
28-Hd-45	Jersey Eagle	Woodland, 18th - 20th c.	Multicomponent	Public Archaeology Laboratory, Inc. (PAL) 2010, 2011a, 2013a

Table 4.2; cont.

Site Number	Site Name	Period	Type	Reference
28-Hd-47	Morris Canal Fiddler's Elbow Segment Archaeological Site	1920 - 1940	Morris Canal prism	Dewberry Engineers, Inc. 2011
28-Hd-48	New York, Susquehanna and Western RR Engine Repair Site	Late 19th to early 20th c.	Industrial	RBA Group 2015
28-Hd-49	Jersey Central Railroad Roundhouse North	1914 – 1950	Railroad roundhouse and terminal	Public Archaeology Laboratory, Inc. 2010, 2012a
28-Hd-50	Liberty State Park Historic Vessel 01	19th c.	Wooden shop	Dewberry Engineers, Inc. 2013
28-Hd-51	Mill Creek Retaining Wall	Mid-19th c.	Retaining Wall	RGA, Inc. 2015
28-Hd-52	Mill Creek Plank Board	Ca. 1880 – early 20th c.	Possible bridge	RGA, Inc. 2015
28-Hd-53	Fulton's Landing	Historic	Canal cribbing	Geismar 2004a

ISS – Indian Site Survey
NJSM - New Jersey State Museum

mitigation program for the Standard Chlorine Chemical Company. Located approximately 900 feet west of the proposed Main Facility site, the Standard Chlorine Chemical Company Site was located in a sandy alluvial layer approximately nine to 17 feet below ground surface (Langan Environmental Services, Inc. 2012). Fill deposits and compressed marsh mat deposits overlie the sandy alluvium. The Standard Chlorine Chemical Company Site was determined eligible for NRHP listing under Criterion D for its potential to provide important information on Woodland period Native American exploitation of the Hackensack River (NJHPO Opinion 5/22/12).

The Exchange Place Landfill (28-Hd-19) is a nineteenth century site that contains secondary context deposits used to extend the Jersey City waterfront at Paulus Hook into the western margins of the Hudson River during the mid- to late nineteenth century (Kardas and Larrabee 1979). Two Morris Canal-related sites, the Morris Canal Fiddler's Elbow Segment Archaeological Site (28-Hd-47) and Fulton's Landing (28-Hd-53), represent locations where a section of the canal prism and the canal cribbing were identified in Jersey City (Geismar 2004; Dewberry Engineers, Inc. 2011). The Jersey Central Railroad Roundhouse North site (28-Hd-49) contains archaeological components related to an early twentieth century railroad roundhouse and terminal documented in 1981 (Historic Conservation and Interpretation, Inc. 1981; Public Archaeology Laboratory, Inc. 2013).

In addition, 32 previously registered prehistoric or historic archaeological sites are located within one-half mile of the APE (see Table 4.2). Nine of these are registered prehistoric archaeological sites identified in the early twentieth century for which very little information is available. One multicomponent site (28-Hd-45) that contains both prehistoric and historic cultural material is located within one-half mile of the APE. The remaining 22 registered archaeological sites are historic sites occupied between the eighteenth and late twentieth centuries and represent domestic/residential, industrial, and transportation related archaeological resources. Historic archaeological resources registered within one-half mile of the APE include a group of domestic sites occupied in the second half of the nineteenth century and part of the Covert/Larch Historic District (see discussion below), a late nineteenth to mid-twentieth century burial ground, and a late nineteenth to early twentieth century industrial site related to the New York, Susquehanna and Western (NYS&W) Railroad (see Table 4.2).

Historic narratives documented Native American habitations on the west shore of the Hudson River during the Contact period, which have not been identified archaeologically. Castle Point, a hill adjacent to the Hudson River, is located east of the APE on what is now the campus of the Stevens Institute of Technology. Historically, this was the site of a Late Woodland-Early Historic period Native American settlement (perhaps with an Archaic component) known as Hobokan or Hobakan-hackingh. Described as a trading location, trails led inland from this location toward the mountain regions north and west, and towards Sapohanikan, a cove on the Manhattan side of the Hudson River (now known as Greenwich Village), where goods were exchanged between the island and the New Jersey mainland (Historic Sites Research 1980:9, 20). An 1874 description of Hobokan-hackingh included the local tradition that the name translated as "the land of the tobacco pipe" because Native Americans came to this location to collect stone from which they carved their pipes. This stone was likely serpentine, located in an outcrop in Hoboken (Winfield 1874 in Historic Sites Research 1980:20). A native village known as Harsimus or Ahasimus is recorded in historic documents between Hoboken and Paulus Hook. This village is also recorded as H'shim-muck, translated as "the place where there is a spring of drinking water" (Bolton 1922: 293 in Historic Sites Research 1980: 21).

National/State Register of Historic Places

Eight historic properties with archaeological components that are listed on or determined eligible for listing on the State and NRHP are located within the APE. In addition, eight previously identified historic properties or historic districts within 1,000 feet of the APE have archaeological components (Table 4.3).

Cultural Resources Surveys

More than 200 previous cultural resources surveys have been completed within 1,000 feet of the APE. Of these, 28 cultural resources surveys included archaeological assessments within or adjacent to Project Components A – E of the APE (Cultural Resource Management Services [CRMS] 1978a;

Table 4.3: Previously identified historic properties or historic districts in or within 1,000 feet of the APE.

Property Name/Address	Municipality	NRHP Current Status
Old Main Delaware, Lackawanna and Western Railroad Historic District	Multiple	Eligible (NJHPO Opinion: 9/24/1996)
Pennsylvania Railroad New York to Philadelphia Historic District	Multiple	Eligible (NJHPO Opinion: 10/2/2002)
Jersey City Water Works Historic District	Multiple	Eligible (NJHPO Opinion: 1/20/2003)
Delaware, Lackawanna and Western Railroad Boonton Line Historic District	Multiple	Eligible (NJHPO Opinion: 9/18/2008)
Erie Railroad Main Line Historic District	Multiple	Eligible (NJHPO Opinion: 2/20/2003)
Morris Canal	Multiple	NR: 10/1/1974; SR: 11/26/1973
Pennsylvania Railroad New York Bay Branch Historic District	Multiple	Eligible (NJHPO Opinion: 4/22/2005)
Lehigh Valley Railroad Historic District	Multiple	Eligible (NJHPO Opinion: 3/15/2002)
Jersey City Water Works Pipeline	City of Jersey City	Eligible (NJHPO Opinion: 5/7/1999)
St. Peter's Cemetery	City of Jersey City	Eligible (NJHPO Opinion: 6/18/1996)
Old and New Bergen Tunnels	City of Jersey City	Eligible (NJHPO Opinion: 5/8/1998)
Erie Railroad Bergen Hill Tunnel [aka Long Dock Tunnel]	City of Jersey City	Eligible (NJHPO Opinion: 4/27/2000)
Covert/Larch Historic District	City of Jersey City	Eligible (NJHPO Opinion: 3/10/1999)
Jersey City Reservoir 2 and 3 Complex	City of Jersey City	NR: 8/27/2012; SR: 4/10/2012; Eligible (NJHPO Opinion: 10/15/1991)
New York, Susquehanna and Western Railroad Engine Repair Site (28-Hd-48)	City of Jersey City	Eligible (NJHPO Opinion: 1/30/2015)
Standard Chlorine Chemical Company Site (28-Hd-44)	Kearny Town	Eligible (NJHPO Opinion: 5/22/2012)

NRHP - National Register of Historic Places
NJHPO - State Historic Preservation Officer
SR - State Register of Historic Places

Federal Transit Authority [FTA] 2008; Geismar 1992, 1998a; Historic Conservation & Interpretation, Inc. [HCI] 1978a; Hunter Research, Inc. 1986, 1998a, 1998b, 2009; Hunter Research, Inc. et al. 2006; Kardas and Larrabee 1975, 1980, 1982; Langan Engineering and Environmental Services, Inc. 2009, 2010a, 2010b, 2012; New Jersey Department of Transportation-Bureau of Environmental Analysis [NJDOT-BEA] 1980a; New Jersey Turnpike Authority 1986; RBA Group, Inc. 2000, 2001, 2007, 2015; Richard Grubb & Associates, Inc. 2002a, 2008, 2010a, 2012; Transit Link Consultants 2008).

In 1986, the New Jersey Turnpike Authority (NJTA) conducted a technical study of two New Jersey Turnpike segments - Interchange 8A to Interchange 9 and Interchange 11 to Route 46 - in advance of proposed turnpike expansion. This technical study assessed the portion of the Exits 15E and 15W segment of the proposed turnpike expansion proximate to the APE with low prehistoric and historic archaeological sensitivity (NJTA 1986: Figure 24e). No further archaeological survey was recommended in this area.

Langan Engineering and Environmental Services, Inc. (2009, 2010a, 2010b) completed a series of archaeological and geomorphological surveys west of the APE in Kearny as part of the remediation of the Standard Chlorine Chemical Company Site. A Phase IA archaeological survey (Langan Engineering and Environmental Services, Inc. 2009) considered the Standard Chlorine Chemical Company project area to have low to moderate sensitivity for prehistoric archaeological resources and low sensitivity for historic archaeological resources. The report highlighted the potential for deeply buried prehistoric archaeological resources. A geomorphological assessment (Langan Engineering and Environmental Services, Inc. 2010a) of geotechnical borings for the proposed remediation measures subsequently was completed. The geomorphological assessment determined that three to eight feet of sandy alluvial deposits existed at a depth of nine to 18 feet below ground surface beneath an approximately six- to 10-foot thick mantle of historic fill underlain by approximately three to seven feet of compressed estuarine marsh deposits (Langan Engineering and Environmental Services, Inc. 2010a:12-13). These alluvial deposits were interpreted as an Early to Middle Holocene in age and were considered to have a "potential to contain in-situ, possibly stratified, cultural materials" (Langan Engineering and Environmental Services, Inc. 2010a:19). A peat layer overlying the sandy upland was radiocarbon dated to AD 1160 to AD 1260. The Standard Chlorine Chemical Company project area was interpreted as a former terrestrial peninsula surrounded by developing marsh during the Early to Middle Holocene that was vegetated by sedges, grasses, and birch trees (Langan Engineering and Environmental Services, Inc. 2010a:20). A program of archaeological monitoring during construction activities was recommended.

In 2010, Langan Engineering and Environmental Services, Inc. (2010b) completed a Phase IB archaeological survey to determine if features related to nineteenth century schemes to drain the Meadowlands would be impacted by the proposed construction of a slurry wall. Three areas where late nineteenth to early twentieth century gates and dikes were documented within the Standard Chlorine Chemical Company remediation project area were investigated through a series of five backhoe trenches (Langan Engineering and Environmental Services, Inc. 2010b:6). No historic artifacts or cultural materials related to nineteenth century drainage structures were identified and no further archaeological survey was recommended. Archaeological monitoring of the slurry wall construction was conducted in 2010 and early 2011 to sample the sandy alluvium within the Standard Chlorine Chemical Company slurry wall trenches (Langan Engineering and Environmental Services, Inc. 2012). Prehistoric artifacts, composed of diabase, quartz, quartzite, and chert debitage and one core fragment, were recovered at eight of the 21, 500-foot and 250-foot interval sample stations, all of which were located in the western (Route 7) and eastern (Hackensack River) segments of the slurry wall trench (Langan Engineering and Environmental Services, Inc. 2012:24-33). A majority (84 percent) of the prehistoric artifacts were recovered in samples in the eastern segment of the slurry wall trench (Langan Engineering and Environmental Services, Inc. 2012:44). No prehistoric cultural material was recovered in the southern segment of the slurry wall trench in the western periphery of the Koppers Company property (Langan Engineering and Environmental Services, Inc. 2012:44). The archaeological site was registered with the NJSM as the Standard Chlorine Chemical Company Site (28-Hd-48) and recommended eligible for listing on the NRHP under Criterion D for its potential to add important information on Woodland period Native American exploitation of the Hackensack River drainage.

Two cultural resources surveys (Hunter Research, Inc. 2009; Hunter Research et al. 2006) were completed for the Hackensack Meadowlands Restoration project. A cultural resources investigation (Hunter Research, Inc. et al. 2006) and subsequent historic context development (Hunter Research, Inc. 2009) summarized the environmental and land use history of the Meadowlands and provided recommendations for further research. These surveys highlighted the potential for buried land surfaces and historic land reclamation structures to exist within the Meadowlands. All of the 2006 survey's study areas were located north and northwest of the APE (Hunter Research et al. 2006). The 2009 historic context studied an extensive drainage infrastructure constructed in the Meadowlands tidal marsh in the late nineteenth and early twentieth centuries by the Bergen and Hudson County Mosquito Commissions. Construction included the installation of tide gates at the confluences of creeks or ditches emptying into the Hackensack River (Hunter Research, Inc. 2009: 5-52). The study identified drainage features constructed between 1850 and 1912 west and east of the proposed Main Facility site within the Koppers Koke Site (Hunter Research, Inc. 2009: Figure 5.9).

A Phase IA archaeological survey was conducted in Jersey City for the Roseland to Marion overhead transmission line project (Richard Grubb & Associates, Inc. 2012). No areas of the transmission line ROW in Jersey City were assessed as having a high sensitivity for archaeological resources (see Richard Grubb & Associates, Inc. 2012: Figure 5.1d). A cultural assessment along U.S. Routes 1 & 9/ Tonnelle Avenue was conducted in association with proposed widening of the roadway in Hudson and Bergen counties (NJDOT-BEA 1980a). The survey was reconnaissance level and identified areas of prehistoric and historic sensitivity. Areas of prehistoric sensitivity were broadly defined as locations that were "relatively undisturbed," such as backyards, fields, wooded areas, and cemeteries (NJDOT-BEA 1980a:31). The only area of historic sensitivity identified by the survey near the APE was the Erie-Lackawanna Railroad corridor (NJDOT-BEA 1980a:32).

Kardas and Larrabee (1982) completed a cultural resources reconnaissance of the Hackensack River tidal barrier in Kearny Town and Jersey City, Hudson County for the U.S. Army Corps of Engineers. This study assessed the project area's sensitivity for archaeological resources as low based on the documented presence of marsh soils and industrial landfill. The Koppers Coke Peninsula Redevelopment Area area was categorized as a "heavy industrial landfill" area that contained mixed fill deposits emplaced behind a 15-foot high dike in which brick and concrete masonry fragments, pieces of wood, and sections of pavement were observed. The study noted that the area had been "artificially raised to about 10 feet above the river with material like that in the dike" (Kardas and Larrabee 1982:44). Two subsurface tests (Tests 4 and 5) excavated in the Koppers Coke Peninsula Redevelopment Area area, east of the APE, documented fill deposits that contained architectural debris (Kardas and Larrabee 1982:46).

A Phase IA cultural resources survey was completed for Wittpenn Bridge (Route 7 Section 2) over the Hackensack River in Kearny Town, Hudson County (Richard Grubb & Associates, Inc. 2002a). This survey included an assessment of archaeological sensitivity. The sensitivity for prehistoric archaeological resources was considered low due to extensive disturbance from previous construction and industrial activities. Portions of the National Register-eligible Jersey City Water Works Pipeline were identified within the project area, and these areas were considered sensitive for historic archaeological resources.

An assessment level (Stage IA) survey was conducted within the impact area for a proposed Secaucus Interchange for the New Jersey Turnpike (Geismar 1992). This survey abuts the APE for the current project where it crosses Tonnelle Avenue near Utica Street. St. Peter's Roman Catholic Cemetery, which dates to the mid-nineteenth century, is proximate to the APE along Utica Street and was located within the impact area for the proposed interchange project, and additional archaeological survey was recommended. Additional archaeological survey was also recommended in the northwestern part of the interchange project area, where a Potter's Field was documented, and along the banks of Penhorn

Creek, which was determined to be sensitive for prehistoric and/or early historic remains. The Potter's Field and Penhorn Creek are not located near the APE for the current project.

Kardas and Larrabee (1975) completed a Phase I historic survey for the U.S. Routes 1 & 9 Freeway project. This survey included a surface reconnaissance of the project area and background research. The survey identified several areas with potential for prehistoric and historic archaeological resources; however, none of these archaeologically sensitive areas is located within or near the APE for the current project. The southern portion of the proposed freeway, where it crosses the APE, was determined to have low prehistoric archaeological sensitivity.

Hunter Research, Inc. conducted a survey for proposed improvements to Tonnelle Avenue (U.S. Routes 1 & 9), which included a portion of the APE for the current project (Hunter Research, Inc. 1986). Geotechnical borings completed within the project area documented fill deposits near St. Peter's Cemetery up to 19 feet below ground surface (Hunter Research, Inc. 1986:6-2). Pedestrian reconnaissance in the vicinity of St. Peter's Cemetery observed extensive cutting and filling related to railroad and highway construction. As a result, the area in the vicinity of St. Peter's Cemetery was considered to have low archaeological sensitivity, and no further archaeological survey was recommended.

In 2000, the RBA Group, Inc. completed a Phase I/II archaeological survey for proposed improvements to U.S. Routes 1 & 9 Truck that included a bridge replacement, construction of a new alignment, approach roadways and ramps in the Marion area of Jersey City, immediately south of the APE for the current project (RBA Group, Inc. 2000:1–5). The survey identified three archaeological resources near the APE that are considered NRHP eligible: the St. Peter's Cemetery, the Jersey City Water Works Pipeline, and the Covert/Larch Historic District (RBA Group, Inc. 2000:6). Six archaeological sites contribute to the Covert/Larch Historic District: the Beck/Thorpe/Altvatter House Sites (28-Hd-20), the Gavenesch/Balbo House/Store Site (28-Hd-21), the Gavenesch/D'Amato House/Saloon Site (28-Hd-22), the Gavanesch/Sarno House Site (28-Hd-23), the Radcliffe/Hoersch House Site (28-Hd-24), and the Moore/Bukowski House Site (28-Hd-25). The Covert/Larch Historic District was determined eligible for NRHP listing under Criterion D for its potential to yield important information regarding late nineteenth century working class community behaviors. Archaeological data recovery was recommended for the six contributing archaeological sites within the Covert/Larch Historic District to mitigate adverse effects from the proposed project (RBA Group, Inc. 2000: 120). A Phase II archaeological survey was recommended for the Jersey City Water Works Pipeline if project impacts would entail the excavation or removal of sections of the pipeline (RBA Group, Inc. 2000: 119). No adverse effects were identified for the St. Peter's Cemetery. In 2001, a cultural resources survey was completed for the Jersey City Water Works Pipeline in the U.S. Routes 1 & 9 Truck Improvements project area that included archaeological monitoring of test trenches (RBA Group, Inc. 2001). The 2001 survey located and documented a section of 20-inch cast iron pipe installed during the initial period of pipeline construction in 1852 (RBA Group, Inc. 2001: 12). The survey included a detailed documentary study of the Jersey City Water Works Pipeline's construction, operation, and maintenance from 1851 to 1873, which mitigated adverse effects to the 20-inch pipeline. A more comprehensive documentary study and historic architectural survey of the Jersey City Water Works Historic District was completed in 2007 that reconstructed the history of the Jersey City Water Works from its inception through to the present-day (RBA Group, Inc. 2007). The 2007 documentary study stated that archaeological monitoring related to the U.S. Routes 1 & 9 Truck Improvements project would be undertaken when the circa 1861 to 1863, 36-inch iron pipeline that parallels the 20-inch pipeline is exposed and relocated (RBA Group, Inc. 2007:61). The 2007 documentary study recommended archaeological investigation of the circa 1871-1872 cement-encased 36-inch pipeline between Belleville and Jersey City as well as Reservoir #2 and Reservoir #3, both of which are north of the APE for the current project (RBA Group, Inc. 2007:61). The Jersey City Water Works Pipeline is individually eligible for listing in the NRHP for its potential to yield important information regarding mid-nineteenth century public works engineering and construction. The pipeline consists of a 20-inch pipe built in 1854 and a 36-inch pipe built in 1863 from the Passaic River to Jersey City, both of which are original components of the NRHP-eligible Jersey City Water Works Historic District. The

Jersey City Water Works Historic District, which includes Reservoir #2 and Reservoir #3 in Jersey City, was determined eligible for NRHP listing under Criteria A, C and D for its associations with the early twentieth century urban reform movement, its engineering significance, and its potential to yield important historical information on nineteenth century civil engineering technology and construction. The Jersey City Water Works Pipeline bisects Components C and D where the Morris & Essex Line crosses underneath the Newark-Jersey City Turnpike (Route 7). The Jersey City Water Works Historic District enters Project Component A near the Route 7 off ramp and runs east-southeast toward the Morris & Essex Line then follows a nearly parallel route along the northern boundary of Project Component E to the Jersey City Reservoir 2 and 3 Complex in Jersey City.

A cultural resources survey completed for the U.S. Routes 1 & 9 Truck Improvements, St. Paul's Avenue to Secaucus Road project identified two areas of historic archaeological sensitivity, one of which (the NYS&W Railroad Engine Repair Facility and Yard) is located proximate to the APE for the current project (RBA Group, Inc. 2015). The NYS&W Railroad Engine Repair Facility and Yard is documented on maps dating between the early 1880s and 1913 at the northeast corner of St. Paul's Avenue and West Side Avenue south the of the Old Main Delaware, Lackawanna and Western Railroad Historic District (RBA Group, Inc. 2015: 47-48). Three backhoe trenches were excavated in this area to identify cultural material and features associated with an engine repair house, a turntable, and related structures. Test Trenches 1 and 2 identified structural remains of the engine repair building (RBA Group, Inc. 2015:58). Test Trench 3 was excavated approximately 100 feet south of the APE to identify the southern perimeter of the turntable (RBA Group, Inc. 2015:58). While structural remains of the turntable were not recovered, stratified fill deposits documented in the northern section of Test Trench 3 were interpreted as "correspond[ing] to the location of the turntable's southern rim" (RBA Group, Inc. 2015:63). The New York Susquehanna and Western RR Engine Repair Site was registered as 28-Hd-48, and recommended NRHP eligible (RBA Group, Inc. 2015:97). Additional archaeological investigation of inaccessible portions of the site and mitigation was recommended for the New York Susquehanna and Western RR Engine Repair Site (28-Hd-48) (RBA Group, Inc. 2015:97).

An archaeological survey conducted for the Erie-Lackawanna Improvements Project determined that cultural resources could be impacted by proposed improvements at the site of the Hoboken train yards, which were part of a historic district being nominated to the NRHP (CRMS 1978). The remains of a nineteenth century roundhouse and a nearby structure were known to exist at the site where the improvements were proposed, and a Phase II survey was recommended to assess the archaeological integrity of these resources and to determine if they were an integral part of the historic district (CRMS 1978:120). The locations of proposed substations and a signal power control house in Jersey City and Kearny were assessed as very intensively disturbed by prior railroad construction and heavy industry use. No further survey was recommended at these locations (CRMS 1978).

In 1980, Kardas and Larrabee completed a cultural resources survey for a proposed four-lane service road, a portion of which was located in Jersey City east of Palisade Avenue (Kardas and Larrabee 1980). The 1980 survey summarized prehistoric and historic land uses within the proposed service road project area and mapped the approximate locations of Contact period Native American settlements. Kardas and Larrabee emphasized the extensive filling and land modification within the project area, which was defined as traversing former salt marsh within the Jersey City segment of the proposed service road alignment. Favorable locations for prehistoric habitation on the west side of the Hudson River were defined as locations near streams and "elevations of land above tidal marsh" (Kardas and Larrabee 1980:23). Limited subsurface testing was completed within the proposed service road project area, which documented primarily historic fills.

In 2008, Richard Grubb & Associates conducted a cultural resources investigation associated with improvements to Conrail's Bergen Tunnel/Waldo Tunnel in Jersey City (Richard Grubb & Associates, Inc. 2008). Based upon the results of background research and environmental setting, the Bergen Tunnel/Waldo Tunnel project area was assessed with low prehistoric sensitivity; however, the historic sensitivity of the project area was considered moderate to high in an area west of the Erie Bergen Hill Tunnel where a late nineteenth century Erie Railroad roundhouse and turntable was once located.

Archaeological monitoring during clearing and grading was recommended at this location to document and record remnants of the roundhouse and turntable, if present, that could potentially contribute to the significance of the Erie Railroad Main Line Historic District. Subsequent archaeological monitoring of clearing and grading activities did not identify artifacts, features or structures associated with the Erie Railroad roundhouse and turntable (Richard Grubb & Associates, Inc. 2010: 4-1).

In 1998, Hunter Research, Inc. completed Phase I historic archaeological surveys for proposed modifications to the Twelfth and Fourteenth Street Viaducts on Route 139 (Hunter Research, Inc. 1998a). The Twelfth and Fourteenth Street Viaducts project area was assessed with low archaeological sensitivity due to large-scale land modifications related to the urbanization of Jersey City beginning in the mid-nineteenth century. Background research and a pedestrian reconnaissance on the north side of the Fourteenth Street Viaduct indicated that below ground cultural resources would retain very little integrity due to railroad and highway construction (Hunter Research, Inc. 1998a: 5-9). No further archaeological survey was recommended on the north side of the Fourteenth Street Viaduct. A Phase I archaeological survey was also completed for proposed modifications to the Contrail and Hoboken Viaducts on Route 139 (Hunter Research, Inc. 1998b). Background research indicated that potential prehistoric archaeological resources would be "very unlikely to retain integrity" due to large-scale land modifications related to the urbanization of Jersey City since the mid-nineteenth century (Hunter Research, Inc. 1998b). No potentially significant prehistoric or historic archaeological resources were identified as a result of the Phase I survey, and no further survey was recommended (Hunter Research, Inc. 1998b: 6-1).

Transit Link Consultants (2008) conducted a Phase IA archaeological survey as part of an Environmental Impact Statement for New Jersey Transit's Access to the Region's Core (ARC) project. This survey identified several areas of high sensitivity for historic archaeological resources; however, none of these areas is located within the APE for the current project. The survey assessed the potential for prehistoric archaeological resources throughout the New Jersey portion of the ARC project area as low. A Final Environmental Impact Statement for New Jersey Transit's issued for the ARC project agreed with these assessments (FTA 2008).

A Stage IA cultural resources survey was completed as part of a facilities report for the Hudson County Sewerage Authority 201 Wastewater Facilities Plan (Historic Conservation & Interpretation, Inc. [HCI] 1978). This study developed a social and physical context for the project and identified areas of sensitivity where archaeological testing was recommended. The survey concluded that Penhorn Creek and a portion of Kearny on the opposite side of the Penhorn Creek/Hackensack River confluence had low sensitivity for archaeological resources over the last 4,000 years due to the development of the Hackensack Meadowlands (HCI 1978a).

Another 62 cultural resources surveys included archaeological assessments within or adjacent to Project Components F and G of the APE, of which 30 were Phase IA surveys (Amy S. Greene Environmental Consultants 1995; CRMS 1978b; DeLeuw, Cathers/Parsons 1979; Dewberry 2011; Dresdner Associates, Inc. 1986; Geismar 1995a, 1995b, 1998b, 1998c; HCI 1978a, 1978b, 1978c; Historic Sites Research 1978; Hunter Research, Inc. 2012; Kraft 1978, 1979; Louis Berger Associates, Inc. 2001; NJDOT-BEA 1980b; NJDEP 1990; PAL 2010, 2011b, 2011c, 2011d; Raber Associates 1986, 1988; Richard Grubb & Associates, Inc. 1996, 1999, 2004; Trans-Hudson Express [THE] Partnership 2009; URS Corporation 2014). The remaining 32 surveys included subsurface excavations (Cultural Resources Consulting Group [CRCG] 2001; Dewberry Engineers, Inc. 2013; Federal Highway Administration and the New Jersey Department of Transportation 1976; Geismar 1995c, 1997, 2002a, 2002b, 2004a, 2004b, 2004c, 2004d, 2006a, 2006b; HCI 1979, 1980; Historic Sites Research 1979; Hunter Research, Inc. 1991, 2001, 2014; Kardas and Larrabee 1979; Louis Berger Associates, Inc. 1992; Parsons Brinckerhoff 1992; PAL 2011a, 2011e, 2011f, 2012, 2014a, 2014b; Richard Grubb & Associates, Inc. 2002b, 2010b; THE Partnership 2010; U.S. Army Corps of Engineers [USACE] 1995).

Previous HBLR Surveys
Fifteen IA and IB surveys and related investigations were completed for the construction of the HBLR and related facilities (Geismar 1995a, 1995b, 1998a, 1998b, 1995c, 2002a, 2002b, 2004b, 2004c, 2004d,

2006a, 2006b; Hunter Research, Inc. 1991; Louis Berger Associates, Inc. 1992; Parsons Brinckerhoff 1992).

A 1992 historical and archaeological investigation for the proposed Gateway Transit Hub identified two partly superimposed structures related to the CRRNJ terminal built in Communipaw in 1865 (Louis Berger Associates, Inc. 1992). Structural remains of an 1865 engine house built on filled land approximately 300 feet northeast of historic Communipaw Avenue were uncovered in mechanically excavated tests pits. Structural remains of a second engine house, built in 1900 were identified in fill deposits overlying the 1865 structural remains (Louis Berger Associates, Inc. 1992: 16). The circa 1865 and circa 1900 archaeological features were sampled, documented, and assessed with low to moderate archaeological integrity. No further archaeological investigations were recommended.

Hunter Research, Inc. undertook an archaeological sensitivity study in 1991 for New Jersey Transit's Hudson River Waterfront Transportation Project (HRWTP) in the area of Jersey City, Hoboken, and Weehawken (Hunter Research, Inc. 1991). The HRWTP project area represented a wide set of improvements, including much of the present the HBLR alignment. Multiple zones of prehistoric sensitivity and potential archaeological sites were highlighted in this study, though not all sites are documented at the NJSM. In 1992, Parsons Brinckeroff integrated this research into an Environmental Impact Statement for the Hudson River Waterfront Transportation Alternatives (Parsons Brinckerhoff 1992). In early 1995, this research project was refined as part of the archaeological studies for the Hudson-Bergen Light Rail System (HBLR) (Geismar 1995a, 1995b). The Phase IA reports for the Jersey City to the Vince Lombardi Park-Ride section of the HBLR (Geismar 1995b and the Bayonne Extension of the HBLR (Geismar 1995a) collectively identified 15 areas of potential prehistoric sensitivity and 19 historic sites.

Later in 1995, a Phase IB survey was undertaken to address potential archaeological sensitivity as identified in both the Phase IA survey of the Jersey City to the Vince Lombardi Park-Ride and the Phase IA survey for the Bayonne Extension of the HBLR (Geismar 1995c). The Phase IB survey largely consisted of soil borings along the 21 linear miles of the project alignment, as well as at 13 Park-and-Ride locations and five stations. The soil borings were largely coordinated with construction-related testing, with only five drilled solely to address archaeological sensitivity. Machine-assisted field testing was also undertaken at four locations in addition to limited shovel testing. Two sites recommended for boring and machine-assisted testing were eliminated from the testing plans as the locations were no longer part of the project alignment. The only National Register resource which was known to cross the HBLR alignment was the Morris Canal, which crossed at four locations and could be potentially infringed upon in two additional locations.

Geismar's findings indicated that in many areas of potential prehistoric sensitivity, a layer of fill was present which was underlain by "natural soils where original ground surfaces had previously been destroyed by construction or grading activities" (Geismar 1995c:16). The depth of the fill varied, extending between 2 and 25 feet below ground surface. Borings relevant to the Morris Canal documented fill layers as well. The depths of the canal bed beneath these crossings were as shallow as 7.3 feet below ground surface (bgs) (in the case of Richard Street Station) and as deep as 19 feet bgs in the area of Marin Boulevard and Van Vorst Street in Jersey City. The depth of the canal bed was not encountered in one of the bores (Newark & New York Railroad Embankment, Jersey City) which was terminated at 18 feet bgs due to contamination.

Geismar made recommendations for testing, monitoring, or mitigation at 18 locations along the HBLR alignment (Geismar 1995c: 43). Of these, six were locations where the Morris Canal crossed project components or was in proximity to those components. Geismar recommended that at these six sites, disturbance to the resource be avoided through redesign. Details of the testing at these sites were summarized in Geismar 2002a (see below). Eight additional prehistoric and historic areas of archaeological concern were identified. Specific recommendations for testing or monitoring were made with reference to each sensitive area (Geismar 1995c: 44).

The three locations potentially sensitive for prehistoric resources included:

- 440 Park-Ride Access, Jersey City. Sensitive for prehistoric resources along original west side shoreline and the historic Morris Canal. Recommended testing through borings (see Geismar 1995b: 182-192).

- Aetna Street Alignment, Jersey City. Sensitive for prehistoric resources at the mouth of Harsimus Creek. Recommended testing through borings;

- Bellman's Creek Bridge, North Bergen. Sensitive for environmental reconstruction data. Recommended testing through borings.

Six locations, outside of crossings with the Morris Canal, were highlighted as potentially sensitive for historic resources. These include:

- 440 Park-Ride Access, Jersey City. Sensitive for prehistoric resources along original west side shoreline and the historic Morris Canal. Recommended testing through borings (see Geismar 1995b: 182-192).

- 35 Hudson Street, Jersey City. Sensitive for historic backyard feature (privy), Recommended mitigation through excavation if impacted by construction;

- 435 Bergenline Ave., North Bergen. Sensitive for historic backyard features (1900-1901). Recommended for testing through excavation;

- Tonnelle Ave. Park-Ride, North Bergen. Sensitive for historic resources (1841 residence or earlier). Recommended testing through excavation;

- Stevens Steam-Battery Dry-Dock, Hoboken. Sensitive for historic resources. Recommended monitoring or excavation;

- Section of the Edgewater Branch of the New York and Susquehanna & Western Railroad line west of Bellman's Creek, North Bergen. Sensitive for historic railroad resources. Recommended monitoring.

During fieldwork, several soil bores were "moved out of potentially sensitive areas to accommodate road work or underground utilities," thus rendering them archaeologically invalid (Geismar 1995c: 34). At these four locations soil bore testing was recommended when they become accessible to address sensitivity for prehistoric resources and evidence of the original shoreline. These locations include two soil borings along Observer Highway in Hoboken (Observer Highway at Henderson Street and Observer Highway at Park Street), one at Hudson & Essex Street in Jersey City, and one at Hudson and Grand Street in Jersey City.

Between 1996 and 1998, further testing was undertaken at several of the locations identified in the 1995 HBLR Phase IB report. In 2002, Geismar compiled three letter reports on this testing in a "Compendium of Evaluations of MOA Archaeological Items" for Segment 1 of the Minimum Operating System (MOS) of the HBLR (Geismar 2002a).

In a March 2002 letter report, Geismar described 1996 soil bore testing at the Aetna Street Alignment (Geismar 2002a). This testing identified evidence of late nineteenth century disturbance on a hill just west of the HBLR alignment, which would have destroyed both historic and prehistoric deposits at that site (Geismar 2002a). The HBLR alignment in this area was historically part of a marsh; however, in prehistoric times lower sea levels may have been associated with fast land in this area. Five soil borings were conducted and all showed evidence that the area was prehistorically an established marsh with no evidence of fast land. No further archaeological work at the Aetna Street Alignment was recommended. The 2002 letter report also noted that the 440 Station and Park and Ride in

Jersey City, which had also been assessed as having potential for prehistoric resources and the historic Morris Canal was excluded from testing as it was not part of the Minimum Operating System (MOS) segments under consideration at that time (Geismar 2002a).

A second letter report from March 2002 described testing at the 35 Hudson Street house lot (Geismar 2002a). The privy's location was identified during the 1995 Phase IB survey when a grab sample of the privy was recovered and a cistern was excavated in its entirety. The 1998 testing plan at the house lot was initially directed at data recovery of the privy. However, the relocation of the Essex Street HBLR platform resulted in the avoidance of the privy feature. No further testing was undertaken and the artifacts recovered during the Phase IB survey were analyzed and are curated by the Jersey City Museum (Geismar 2002a). No further archaeological work was recommended at the site for the HBLR project.

A third March 2002 letter report on the implementation of the MOA for the HBLR project detailed testing at the six locations of the Morris Canal crossing the project alignment (Geismar 2002a). Geismar reported on the soil borings taken during the Phase IB testing, an additional bore at the Main Track Alignment near 52nd Street, and mechanical trenching at the Marin and Van Vorst Street crossing in Jersey City. At two sites, the Richard Street Park-Ride and the Main track alignment at Bidwell Avenue, no evidence of the canal prism was detected during the 1995 soil bores and the canal appeared to have utilized natural waterways or swamp. No testing was undertaken at the 440 Park-Ride in Jersey City, as it was beyond the scope of the project. The canal at Garfield Avenue was subject to borings during 1995 Phase IB testing and did not detect the canal prism, but were terminated at a depth of 18 feet bgs due to contamination. Testing at the Main Track Alignment near 52nd Street was undertaken after the Phase IB testing was completed, and while it revealed no evidence of the canal prism at a depth of 18 feet bgs, testing went well below the water table and the expected depth of the canal. Finally, testing between Marin Boulevard and Van Vorst Street in Jersey City was the only site to reveal definitive evidence of the canal prism. This testing occurred during both the 1995 Phase IB and follow-up mechanical trenching in 1998. Excavations in two east-west test trenches approximately 85 - 90 feet north of the intersection of Essex and Van Vorst Street identified elements of the Morris Canal. Wood planking, part of the canal's cribbing, was detected in two trenches, at a depth of approximately 7 feet bgs and 6.75 feet bgs respectively. No further archaeological work at the Marin Boulevard and Van Vorst Street site was recommended due to the shallow depth of planned disturbance for that project.

In 2002, an archaeological monitoring program was undertaken for portions of the HBLR Minimum Operating System (MOS) in Jersey City as part of the implementation of the Memorandum of Agreement resulting from the Final Environmental Impact Statement (FEIS) for the HBLR project (Geismar 2002b). This monitoring program focused on excavations for utilities in two recognized historical areas of Jersey City: Essex Street between Washington and Greene streets in the Paulus Hook Historic District; and Jersey Avenue and Canal Street near the Morris Canal. Additional locations were monitored associated with the Paulus Hook Historic District. Research focused on the Morris Canal trestle at Jersey Avenue, Essex Street Sidewalk Vaults, and the Essex Street Sewer, the first of its kind in the nation. After documenting the trestle, sidewalk vaults, and sewers, the authors recommended that no further archaeological work was warranted in this segment of the light rail (an east-west section from Jersey Ave in the west to Hudson Avenue in the east).

In 2004, archaeological monitoring of construction took place at HBLR MOS-2 Outfall 5, located near Port Imperial Boulevard, south of Weehawken Tunnel, in Weehawken, New Jersey (Geismar 2004c). This area had been identified as having potential for prehistoric resources related to the former shoreline of the Hudson River in the original Phase IA study for the project (Geismar 1995b) and was subject to soil bore testing during the Phase IB study (Geismar 1995c). The 1995 analysis of a soil bore test revealed no signs of an original submerged shoreline. The geological profile was interpreted as evidence that the shoreline was located farther west of the HBLR alignment and no further testing was recommended. However, a subsequent letter in 1998 indicated that Geismar had determined the area needed archaeological monitoring (Geismar 2004c). Monitoring the construction trench revealed that both the A and B soil horizons had been destroyed or disturbed and no trace of an original land surface was preserved. Based on the disturbed nature of the location, no further archaeological work was recommended.

In 2004, testing was undertaken at the HBLR Tonnelle Avenue Park-Ride, as recommended in the 1995 Phase IB survey and subsequent 1999 MOA for the HBLR project (Geismar 2006b). The investigation focused on proposed ground disturbance associated with a temporary driveway and parking and the historical location of backyard features at the Baker-Smith house. Mechanical testing did not locate a privy feature, though a historical drawing of the circa 1841-house had shown a small wooden structure in the yard. Archaeological evidence indicated that the wooden structure was a well house and the well was filled in the 1920s. No further work at the site was recommended.

No further testing reports are available for the balance of the recommended testing proposed by Geismar in the HBLR Phase IB for Jersey City to the Vince Lombardi Park-Ride and the Bayonne Extension (Geismar 1995c). The archaeological items for which no further information is available include: recommended soil bore tests to identify the original shoreline along Observer Highway and along Hudson Street in Jersey City; excavations or monitoring recommended to test for historic resources at 435 Bergenline Avenue, North Bergen; bore tests recommended to recover environmental data at Bellman's Creek Bridge, North Bergen; monitoring or excavation at Stevens Steam-Battery Dry-Dock, Hoboken; and monitoring of construction work in a section of the Edgewater Branch of the New York and Susquehanna & Western Railroad line west of Bellman's Creek, North Bergen. Two of these locations are proximate to the current APE: the corner of Hudson Street and Essex Street, Jersey City (soil bore testing recommended) and the corner of Hudson Street and Grand Street, Jersey City (see Geismar 1995c: 13,43). Also notably, the area between Marin Boulevard and Van Vorst Street, just north of Essex Street in Jersey City identified evidence of the Morris Canal prism at 7 feet bgs (Geismar 2002a). Sensitivity remains for those deposits at a depth of 6.75 feet or greater.

In February 1998, alignment modifications to the HBLR Project, for the New Boulevard and Long Slip alignments, were addressed in a Phase IA study in accordance with the project MOA (Geismar 1998b). The New Boulevard Alignment was proposed to run just east of Greene Street (along present-day Hudson Street), between Christopher Columbus Drive and First Street, in Jersey City. As the New Boulevard Alignment represented the site of late nineteenth century landfill which had been subject to intensive railroad development, no prehistoric or historical archaeological sensitivity was assessed for this alignment. The Long Slip Alignment was proposed to run east from Washington Boulevard in Jersey City along the northern line of Eighteenth Street, into the NJ TRANSIT Terminal Yard, and southeastward across the Long Slip ship canal. The Long Slip Alignment was determined to be a part of the Eire Lackawanna Railroad and Ferry Terminal and Yard and contributing resource to the Old Main Delaware, Lackawanna, and Western Railroad Historic District (SHPO 1997). Geismar recommended comprehensive documentation of Long Slip canal as a mitigation measure through documentary research and analysis of fill samples (Geismar 1998: 35).

In 2004, a testing program was undertaken at the Long Slip alignment to address recommendations made during a 1998 Phase IA assessment (Geismar 2004b). This testing involved documenting the landfill, analyzing selected landfill structures used to create Long Slip in the late nineteenth century, and a comparison of these findings with existing archaeological data from other local landfills. Log cribbing and fill material for the canal was identified, documented, and compared to other slips and wharves, including several in Manhattan. Geismar concluded that the design of the cribbing reflected the function it served - that of creating a rail yard and canal - whereas more substantive cribbing and piles would be expected in areas where dockage and future dense development was anticipated. The fill identified in the study was made up of relatively clean (low amount of organic matter) fill which had been brought in to create land. This finding is in contrast to the thesis that New Jersey's waterfront served as a repository for New York's garbage (Geismar 2004a: 11; Rutsch et al. 1977:51). No further archaeological work was recommended for the Long Slip Alignment.

In August 1998, further changes to the HBLR alignment were proposed. To address these changes, a Phase IA study of the Hoboken West Side Alignment of the HBLR (Geismar 1998a) was undertaken which served as an addendum to the Phase IA report prepared for the project's FEIS (Geismar 1995a, 1995b). The Hoboken West Side Alignment project area began south of the Hoboken railroad terminal, extended west to a wye junction, then further west to the base of the Bergen Ridge and north along the west side of Hoboken (Geismar 1998a: 1). As the portion of the alignment west of the wye is coincident with or adjacent to long-established active rail for much of its length, that portion of the alignment was considered to have low potential for significant archaeological resources. In order to confirm this, soil borings were recommended in four locations: the Jersey Avenue Bridge, the Eighteenth Street Extension, The Second Street Station, and the Ninth Street Station (Geismar 1998a: 27). In addition to these areas, Geismar also recommended in-ground testing at the south end of the Second Street Station site to locate evidence of the 1894 Homestead Line's wooden incline trolley trestle at Second Street. Finally, Geismar reiterated the recommendations for the Hoboken east side alignment which called for soil borings along Observer Highway (Geismar 1995a) and preconstruction excavation or monitoring in the vicinity of the R.L. Stevens Dry-Dock and Steam Battery site (Geismar 1998a: 26).

In 2004, Phase IB testing was undertaken at the Second Street station of the West Side Alignment in Hoboken, New Jersey (Geismar 2004d). This testing was directed at locating evidence of the foundations of a nineteenth-century trolley trestle. Two structural elements were located, one of which could have been a cement-faced foundation pier for the trestle. No soil boring was undertaken as part of this study. No additional information was recovered and no further archaeological work was recommended.

In 2006, a Phase IB survey was undertaken at the Jersey Avenue Viaduct in Jersey City, as recommended in the Phase IA assessment of the West Side Alignment of the HBLR (Geismar 2006a). This testing consisted of a single bore, taken for specifically archaeological purposes. The soil bore took continuous two-foot soil cores and was analyzed to assess the nature and age of the deposits, which included both a geoarchaeological analysis and radio-carbon dating four samples from the single bore. This analysis revealed near-surface deposits which suggest the historical use of the area as a possible railroad siding. Analysis undertaken by Geoarchaeology Research Associates revealed that between 13-15 feet bgs, a layer of grey silt and organics was present. At a depth of 40-42 feet, a layer of grey silt with shell fragments which was "commonly found on oozy, warm, mud flats" was present (Geismar 2006b: 2). At 60-62 feet bgs, a layer of peat was identified, which was underlain by glacial gravel at 70 feet bgs. The analysis also found that deeper deposits confirmed that the area had formerly been a swamp between 9,100 and 1,100 years ago and therefore had low archaeological potential (Geismar 2006b: 3). Notably, this analysis provided key information on the development of the estuarine environments in the area during the Early Holocene.

No further testing reports are available for the balance of the recommended testing proposed by Geismar in the HBLR Phase IB for the Hoboken West Site Alignment (Geismar 1998a). The archaeological items for which no further information is available include: recommended soil bore tests to identify the original shoreline along Observer Highway in Jersey City; monitoring or preconstruction testing at Stevens Steam-Battery Dry-Dock, Hoboken; and soil borings at the Eighteenth Street Extension, the Second Street Station, and the Ninth Street Station in Jersey City and Hoboken. Three locations fall within the present APE: the Eighteenth Street Extension, Jersey City; Second Street Station, Hoboken; and Ninth Street Station, Hoboken.

Two surveys were completed for Amtrak's Northeast Corridor that identified areas of prehistoric and historic sensitivity along the project ROW (CRMS 1978b; DeLeuw, Cathers/Parsons 1979). Three surveys associated with planning for the Access to the Region's Core (ARC) Trans-Hudson Express (THE) tunnel were completed in 2009 and 2010 along 18th Street in Hoboken (THE Partnership 2009, 2010; Richard Grubb & Associates, Inc. 2010). Geotechnical borings associated with the ARC project encountered concrete and asphalt at depths of 14 to 17 feet below grade, suggesting prior disturbance and twentieth-century filling activities to these depths. A red clayey silt was encountered at depths of 15 to 17 feet below grade (THE Partnership 2009). A 2010 archaeological field screening included soil borings that identified a potential for structural features associated with the early twentieth century Pierson & Goodrich Iron Works and the mid-twentieth century Detroit Steel Products Co. to exist approximately two feet below ground surface. Coal pockets associated with the Detroit Steel Products Co. were also identified (THE Partnership 2010). Subsequent field testing did not identify intact structural features in four mechanically excavated trenches. No additional archaeological survey was recommended (THE Partnership 2010; Richard Grubb & Associates, Inc. 2010).

Eleven surveys were completed for wastewater facility planning (HCI 1978a, 1978b, 1978c, 1979, 1980; Kraft 1978, 1979; and sewage systems (Richard Grubb & Associates, Inc. 1996, 1999, 2002b, 2004) in Hudson County. A series of Stage IA and IB surveys for combined sewer overflow (CSO) systems assessed CSO locations along the Hudson River as filled land created in the late nineteenth century as part of waterfront development (Richard Grubb & Associates, Inc. 1996, 1999, 2002b, 2004). Two mechanically excavated trenches at one CSO location in Weehawken contained multiple layers of mixed fill sediments that contained late nineteenth through twentieth century cultural material and were underlain by fine alluvial soils (Richard Grubb & Associates, Inc. 2002b: 1-6).

Six surveys were completed in support of road and highway improvements (Amy S. Greene Environmental Consultants 1995; Dewberry Engineers, Inc. 2011, 2013; Federal Highway Administration and the New Jersey Department of Transportation 1976; Hunter Research, Inc. 2001; NJDOT-BEA 1980b; NJDEP 1990). Phase IA and Phase IB surveys in support of proposed improvements to NJ Turnpike Exit 14A identified early to mid-twentieth century fill deposits in test trenches completed within a segment of the former Morris Canal. The early to mid-twentieth century fill deposits were registered as the Morris Canal Fiddler's Elbow Segment Archaeological Site (28-Hd-47) (Dewberry Engineers, Inc. 2011, 2013).

Sixteen surveys were completed for private development projects, public works projects, freight yard improvements, pipeline installation, facilities management, watershed management (CRCG 2001; Dresdner Associates, Inc. 1986; Geismar 1997, 1998c, 2004a; HCI 1981; Historic Sites Research 1978, 1979; Hunter Research, Inc. 2012, 2014; Kardas and Larrabee 1979; Louis Berger Associates, Inc. 2001; Raber Associates 1986, 1988; U.S. Army Corps of Engineers 1995; URS Corporation 2014). A 1979 cultural resources survey investigated mid-nineteenth century landfilling practices at the former locations of the Exchange Place and Pavonia Avenue ferries (Kardas and Larrabee 1979). A series of mechanically excavated trenches at Exchange Place contained fill layers that contained cultural material contemporaneous with land fill operations rather than older material that could be interpreted as household or commercial garbage and considered a potentially significant archaeological resource registered as the Exchange Place Landfill (28-Hd-19) (Kardas and Larrabee 1979: 32-33). Trench profiles at Pavonia Avenue contained gravel, cinder, or clinker fill interpreted as railroad ballast and was not considered a potentially significant archaeological resource (Kardas and Larrabee 1979: 31).

Phase IA cultural resources assessments for the proposed redevelopment of Lincoln Harbor in Weehawken identified areas of potential prehistoric and historic archaeological sensitivity proximate to the HBLR (Raber Associates 1986, 1988). Soil boring data indicated two to 16 feet of late nineteenth through early twentieth century miscellaneous fill deposits mixed with demolition debris overlying the Lincoln Harbor project area beneath which were gradually to steeply sloping fluvial and glacial outwash soils underlain by lacustrine sediments (Raber Associates 1986: 2-5). Marsh and fast land documented on historic maps, as well as an approximately 100-foot fringe of nearshore riverbed, were identified as areas of prehistoric archaeological sensitivity (Raber Associates 1986: 5). The southern portion of the Lincoln Harbor project area, near 19th Street, was identified as an area where prehistoric archaeological resources may be present beneath approximately two to four feet of fill (Raber Associates 1986: 13). The northern portion of the Lincoln Harbor project area, east of the Lincoln Tunnel helix, was identified as an area where historic archaeological resources associated with the circa 1740 to 1775 Weehawken Ferry may be present beneath late nineteenth century fill emplaced during construction of the Erie Railroad terminal (Raber Associates 1986: 13).

A Phase IA survey and program of archaeological monitoring completed in 2012 for the development of Berry Lane Park documented late twentieth century fill deposits overlying a portion of the former CRRNJ railyard between Garfield Avenue and Woodward Street in Jersey City (Hunter Research, Inc. 2012, 2014). Deep, layered fill interpreted as nineteenth century deposits emplaced over marsh land extended to approximately 15 feet below ground surface and were profiled as part of archaeological monitoring for soil remediation work completed within a segment of the Morris Canal that bisected the western side of Berry Lane Park (Hunter Research, Inc. 2012, 2014).

An archaeological assessment was completed for the installation of an underground pipeline in a segment of the Morris Canal proximate to the Bayonne and Jersey City municipal boundary (Geismar 1997). Located approximately 600 feet east of the former CRRNJ ROW, this segment of the Morris Canal contained utility-related disturbance from the installation of a circa 1937, 12-inch water pipeline and a circa 1964, 54-inch storm sewer pipeline (Geismar 1997: 3-4). The assessment noted that "other active utility lines comprising cables and ducts" could exist within that section of the Morris Canal (Geismar 1997: 4). Two map-documented late nineteenth century railroad bridges and one pipeline-related metal truss bridge spanned this segment of the Morris Canal. Photographic documentation of structural remains related to one railroad bridge and the pipeline bridge was recommended. In addition, archaeological monitoring during installation was recommended to identify buried canal components and artifacts, if any, related to the Morris Canal (Geismar 1997: 4).

Archaeological monitoring completed in 2001 for proposed walkway construction identified timber cribbing associated with the Little Morris Canal Basin along Washington Street in the Paulus Hook section of Jersey City (CRCG 2001). Seven piling locations were monitored and recorded 10-inch diameter rounded and squared stacked logs at 2.5 feet below ground surface that were tied with logs set perpendicular to the wall at 15-foot intervals. A plank floor was encountered between three and four feet below ground surface (CRCG 2001: 12). The structural remains were interpreted as part of the canal cribbing constructed in 1838 for the Morris Canal's basin.

A series of archaeological investigations was completed between 1998 and 2004 for proposed residential development construction in the Paulus Hook section of Jersey City (Geismar 1998c, 2004a). Located along Essex Street between Van Vorst and Dudley streets, the project area was adjacent to the Morris Canal basin. Background research indicated that the Essex Street segment of the Morris Canal was approximately 12 feet deep when it was filled in the 1920s. Approximately six feet of fill was deposited over the Morris Canal's former route (Geismar 1998c: 29). Test trenches identified vertical plank cribbing supported by log cross pieces and piles along the south bank of the canal, nine feet beyond which were deposits of boulder rip-rap and a strip of boulder-free fill interpreted as the former towpath. Test trenches indicated that the canal's north bank was supported by 20-inch diameter cut log cribbing (Geismar 1998c: 20). Additional test trenching completed in 1999 identified a 40-foot section of the north bank's log cribbing and collected samples of historic artifacts incorporated into the canal fill as secondary deposits (Geismar 2004a). The recovered artifact assemblage contained predominately kiln furniture and pottery wasters interpreted as refuse from the nearby Jersey City Pottery, which operated until 1892 (Geismar 2004a: 14). Trenching in the northeast portion of the project area documented approximately 6.4 feet of fill interpreted as a deposit emplaced on the margins of Communipaw Cove during construction of the Morris Canal (Geismar 2004a: 22).

Ten Phase IA, IB, and II surveys were completed adjacent to the APE for the expansion of an interstate natural gas pipeline system (PAL 2010, 2011a, 2011b, 2011c, 2011d, 2011e, 2011f, 2012, 2014a, 2014b). A series of archaeological overview surveys for the proposed pipeline identified several areas of prehistoric and/or historic archaeological sensitivity east of the HBLR ROW and recommended Phase IB archaeological surveys for these areas (PAL 2010, 2011b, 2011c, 2011d). Subsequently, geoarchaeological borings were completed for the proposed pipeline, which included locations proximate to the HBLR ROW in the Communipaw section of Jersey City and in Bayonne (PAL 2011a, 2011e, 2011f, 2012). A series of geoarchaeological borings completed proximate to the HBLR ROW between 41st and 45th streets in Bayonne identified a buried land surface between 0.6 feet and two feet below ground surface. One boring in this series contained soil stratigraphy similar in composition and inclusions to shell midden deposits observed northeast of the HBLR ROW and described as a 1.4-foot thick buried A horizon that contained clam and oyster shell fragments underlain by a 1.3-foot thick reddish brown to dark gray sand subsoil and a 4.4-foot thick stratum identified as glacial till (PAL 2011a: 12). A second series of geoarchaeological borings located east of the HBLR and State Route 440 identified a buried land surface along the former upland margins of the Bayonne shoreline between 32nd and 38th streets. Four borings in this series documented a 1.6- to 2.1-foot thick buried A horizon beneath 8.4 to 12.3 feet of modern fill. Two of these borings documented a 2.0- to 3.3-foot thick subsoil between the buried A horizon and basal deposits of glacial till (PAL 2011a: 10-11). The buried A horizon and subsoil were interpreted as Holocene period soils and assessed with high historic and/or prehistoric archaeological sensitivity (PAL 2011a: 10). A third series of geoarchaeological borings located east of the HBLR and State Route 440 identified a buried land surface along the former Bayonne shoreline between 37th and 42nd streets. Two borings in this series documented a 0.6- to 0.7-foot thick buried A horizon beneath 4.8 to 7.4 feet of modern fill. The series of borings documented gravelly sand beach deposits beneath buried A horizon or fill deposits between 4.8 and 8.2 feet below ground surface that transitioned to a 0.8- to 5.7-foot thick organic-rich silt to sandy loam stratum interpreted as a possible prehistoric estuary deposit (PAL 2011a: 20). The buried A horizon and subsoil strata were interpreted as Holocene period soils and assessed with high historic and/or prehistoric archaeological sensitivity (PAL 2011a: 11). A geoarchaeological boring completed proximate to Wilson Street recorded 12.5 feet of stacked fill deposits underlain by salt marsh and peat deposits interpreted as a Late Holocene depositional sequence that was dated from circa 2500 to 800 B.P. (PAL 2011f). A geoarchaeological boring completed proximate to Johnston Avenue recorded 5.9 feet of fill deposits underlain by a two-stage succession of Pleistocene deposits considered to lack a potential for prehistoric cultural material (PAL 2011f). In 2012, three geoarchaeological borings were completed near the intersection of Wilson Street and Jersey City Boulevard in the Communipaw section of Jersey City due to its potential for intact archaeological remains associated with the CRRNJ roundhouse, an NRHP-eligible resource that was constructed in 1914 (PAL 2012). The geoarchaeological borings identified a stratigraphic profile described as 7.8 to 14.5 feet of fill underlain by an intact peat sequence dated between 4260 and 750 B.P. (PAL 2012: 8). Possible foundation or girder remains associated with the CRRNJ roundhouse were identified in the borings at depths of eight to 10 feet below ground surface (PAL 2012: 8). Further archaeological investigation was recommended to locate, expose, and document archaeological structural remains associated with the CRRNJ roundhouse (PAL 2012: 9). In 2013, mechanically excavated trenches completed within the proposed pipeline project area identified foundation remains, 16 inspection pits, concrete floor sections, concrete roof column support footings, wood posts/pilings, and ceramic and cast iron pipes associated with the 1914 CRRNJ northern roundhouse (PAL 2014a, 2014b).

5.0 ASSESSMENT OF ARCHAEOLOGICAL SENSITIVITY

The assessment of archaeological sensitivity considers the presence of environmental correlates within the APE identified in regional settlement models in order to identify locations likely to contain prehistoric and historic archaeological sites. In areas where no sites are documented, the sensitivity assessment for prehistoric resources is based primarily on environmental setting: topography, proximity to water, availability of resources, and soil permeability. Geotechnical and geomorphological data provide information on paleoenvironmental setting. The sensitivity of an area for historic resources is usually determined through analysis of historic documents and cartographic materials. The presence of structures and roads on historic maps near the APE increases the potential for historic archaeological sites to be discovered. A visual reconnaissance of the APE was completed in 2016 and 2017 to assess the environmental setting and assess existing land use of Project Components A-G (see Figures 5.1a-5.1c; Plates 5.1-5.30).

<u>Prehistoric Archaeological Sensitivity</u>

Previous archaeological investigations and regional settlement pattern studies indicate that in New Jersey, and elsewhere in the Middle Atlantic region, areas of well-drained soils in proximity to a perennial water source are highly favored locations for prehistoric sites (Chesler 1982; Cavallo and Mounier 1982; Grossman-Bailey 2001: 136; Kinsey 1972; Kraft 1986, 2001; Ranere and Hansell 1985, 1987; Wall et al. 1996; Walwer and Pagoulatos 1990). Areas closest to wetlands are considered zones of highest sensitivity for the location of prehistoric archaeological resources (Hasenstab 1991). Other possible zones of sensitivity for prehistoric occupation include locations with well-drained soils, level topography, historic trails, and a good vantage point, particularly on drainage divides, and upland areas farther from water that may contain key exploitable technological or subsistence resources (Cavallo and Mounier 1982; Pagoulatos and Walwer 1991).

The greater Piedmont Region contains archaeological evidence for human habitation from the Paleo-Indian period to the present (Chesler 1982). The majority of prehistoric sites in this region consist of open-air campsites in proximity to wetlands or watercourses (Hasenstab 1991). Prehistoric sites often lie within 500 feet of water and wetlands (Hasenstab 1991; Ranere and Hansell 1987). Site locations beyond 500 feet of water typically fall on drainage divides and upland areas, but represent significantly less than those near watercourses.

The APE is located within the tidal marsh floodplain of the Hackensack River. Soils mapped in this area consist of very poorly drained, very frequently flooded mucky peat and human-transported fill sediments overlying marshy soils. Nine known prehistoric archaeological sites are within or adjacent to the APE. In addition, 10 registered prehistoric or multicomponent archaeological sites are located within one-half mile of the APE. The most intensively studied of these sites is the Standard Chlorine Chemical Company Site (28-Hd-44), which is a deeply buried prehistoric site located approximately 900 feet west of Project Component A. The Standard Chlorine Chemical Company Site was identified during archaeological monitoring in a sandy alluvial layer approximately nine to 17 feet below ground surface, capped by fill deposits and compressed marsh mat deposits (Langan Environmental Services, Inc. 2012). Based on stratigraphic position, the sandy alluvium was interpreted as Early to Middle Holocene in age. The Standard Chlorine Chemical Company Site was determined eligible for NRHP listing under Criterion D for its potential to add important information on Woodland period Native American exploitation of the Hackensack River (NJHPO Opinion 5/22/2012). While previous cultural resources surveys offer conflicting opinions on the potential for prehistoric archaeological resources in tidal marsh land bordering the Hackensack and Hudson rivers, investigation of the Standard Chlorine Chemical Company Site demonstrates that upland landforms may survive intact beneath Late Holocene estuarine deposits and historic and modern fills. As such, marsh land within portions of the APE should be considered archaeologically sensitive for deeply buried Early to Middle Holocene sites. A review of previous geotechnical borings completed in the Koppers Koke Site indicates that the deeply buried stable land surface on which the Standard Chlorine Chemical Company Site is located extends into the western and central portions of Project Component A (see Attachment C). Fill deposits 11 to 19 feet thick overly one to five feet of peat or marsh mat deposits and three to 4.5 feet of sandy alluvium at the sample locations (see Attachment C: 10). How far this landform extends into the eastern section of Project Component A is unknown due to the lack of deep soil bores available for study. A similar stratigraphic profile was recorded in a series of borings completed over a distance of approximately 1,100 feet along the north side of the Morris & Essex Line beginning approximately 300 feet from the east boundary of Project Component A (see Attachment C: 15). This segment of Project Component E is assessed with moderate prehistoric archaeological sensitivity due to its distance from the Hackensack River.

Marsh land in Jersey City crossed by Project Components E and F is assessed with low to moderate sensitivity for prehistoric archaeological resources. Paleoenvironmental reconstructions of the east bank of the Hackensack River suggest that intact Early to Middle Holocene land surfaces may not be preserved beneath Late Holocene peat/marsh deposits (see Attachment C). Limited geotechnical and archaeological data from previous surveys proximate to the Morris & Essex Line suggest that historic fills as thick as 19 feet may exist (Hunter Research, Inc. 1986: 6-2). East of Bergen Hill, Project Component E crosses land extensively modified by construction of the Morris Canal and its basins and land created by landfilling in the mid- to late nineteenth century.

In Project Component G, previous research identified areas of prehistoric sensitivity in Bayonne and Weehawken. Data from geotechnical borings completed in support of natural gas pipeline construction in Bayonne identified a zone of high prehistoric archaeological sensitivity between 32nd and 45th streets (PAL 2011a). A buried land surface capped by historic and modern fills was recorded between 0.6 and 12.3 feet below ground surface and assessed as Holocene soil with high sensitivity for historic and/or prehistoric archaeological resources.

In Weehawken, previous research provides conflicting assessments of geomorphology with and proximate to the APE and the potential for intact prehistoric archaeological resources. Soil borings conducted at Lincoln Harbor in Weehawken recorded stratigraphy that suggests that marsh and fast land documented on historic maps, as well as an approximately 100-foot fringe of nearshore riverbed, have prehistoric archaeological sensitivity (Raber Associates 1986: 5). In the southern portion of the Lincoln Harbor project area, near 19th Street, soil profiles recorded two to four feet of fill overlying natural soils. This area of Lincoln Harbor was noted as a location where prehistoric archaeological resources may be present (Raber Associates 1986: 13). Surveys associated with construction of the HBLR recorded soil boring data and archaeological monitoring data that indicate that the prehistoric shoreline does not exist as an intact land surface in this part of Weehawken (Geismar 1995c; 2004c). One soil boring completed in 1995 did not identify the original shoreline, which was interpreted to be west of the HBLR (Geismar 1995c). Two mechanically excavated construction trenches contained extensively disturbed soil stratigraphy that lacked A and B horizons (Geismar 2004c). Based on the conflicting geotechnical data available, this segment of the APE is assessed with moderate archaeological sensitivity.

The APE has low to high sensitivity for prehistoric resources (see Figures 5.1a-5.1c). Portions of the APE where extensive ground disturbance has occurred have low sensitivity for prehistoric archaeological resources. Portions of the APE located within 500 feet of a perennial water source, on terrain documented historically as uplands or where a potential for deeply buried uplands exists, and where limited ground disturbance has occurred have high sensitivity for prehistoric archaeological resources. In particular, the western and central portions of Project Component A have high sensitivity for prehistoric archaeological resources based on the presence of a deeply buried Early to Middle Holocene upland landform that contains an NRHP-eligible prehistoric archaeological resource (see Sections 3 and 4.3; Attachment C; Langan Engineering Services, Inc. 2012).

Historic Archaeological Sensitivity

Historic site probabilities, which are based on Colonial, Federal, and Early Industrial period land uses, are ranked as high near documented historic occupation and as low in areas with little record of historic land development. The presence of standing historic structures indicates a high probability for associated historic archaeological sites. Information obtained from cartographic evidence also contributes to assessments of historic site probability. While early historic maps do not depict historic structures with accuracy, nineteenth-century maps often record details of settlement pattern, ownership and occupation. From an environmental perspective, the factors contributing to prehistoric sensitivity often apply to early historic sensitivity as well.

Late eighteenth and early nineteenth century maps show the APE as sparsely developed land composed of islands of uplands surrounded by marsh (see Figures 4.1 – 4.3; Hills 1781; Hassler 1844; U.S. Coast Survey 1837). The Hackensack Meadowlands is depicted in 1844 as unaltered, except for a block of drained fields that extended south from the road to Newark and from the Passaic River east to the Hackensack River (see Figure 4.3; Hassler 1844). An extensive drainage infrastructure was constructed in the Meadowlands' tidal marshes between the late nineteenth and early twentieth centuries by the Bergen and Hudson County Mosquito Commissions. Drainage ditches and tide gates constructed as part of this effort were located west and east of the APE in the Koppers Koke Site (Hunter Research, Inc. 2009: 5-52).

The 1844 map shows the villages of Bergen and Cross Roads (which developed into Hudson City) as developing communities on Bergen Hill, and Hoboken as an expanding settlement fronting the Hudson River (see Figure 4.3). In present-day Bayonne, east of the HBLR line, structures depicted in 1844 include two dwellings proximate to the 22nd Street Station, one dwelling between present-day 30th and 31st streets, one dwelling at 52nd Street, and two dwellings south of Caven's Point east of present-day Princeton Avenue between Linden and Lembeck avenues (see Figure 4.4b; Hassler 1844). Between present-day Chapel and Fulton avenues, the HBLR line is proximate to the former west bank of the Morris Canal, then crosses the mapped course of the Morris Canal farther north between present-day Woodlawn Avenue and Richard Street (see Figure 4.4b). The HBLR headquarters is located south of the former road to Communipaw, as depicted in 1844, and one dwelling is depicted where an HBLR stockyard now exists (see Figure 4.4b). The HBLR crosses the mapped course of the Morris Canal again at present-day Garfield Avenue south of its intersection with present-day Union Street (see Figure 4.4a). In Paulus Hook, the HBLR crosses the former course of the Morris Canal at two locations: present-day Morris Boulevard proximate to the current Boys & Girls Club building and west of the HBLR's Marin Avenue Station (see Figure 4.4a). Essex Street Station is located where the Jersey City waterfront is depicted in 1844, and all Jersey City and Hoboken stations north of this are situated at locations depicted as either shallow open water or marsh land (see Figure 4.4a).

The southern Hoboken and northern Jersey City waterfront was dramatically altered in the 1860s, when Harsimus Cove, along with portions of the marshy meadow between Hoboken and the Palisades, were filled for the construction of a large rail yard servicing the DL&WRR in Hoboken and the Erie Railroad in Jersey City. The 1873 Hopkins Atlas of the State of New Jersey and the County of Hudson depicts the Erie's freight depots along the north side of Harsimus Cove (Hopkins 1873: Plate B). Morris Canal structures are depicted south of Harsimus Cove at the intersection of Essex and Van Vorst Streets on the west side of the canal and rowhouses are shown along both sides of Essex Street between Van Vorst and Warren Streets proximate to the location of the HBLR Marin Boulevard Station (Hopkins 1873: Plate C). Further east along Essex Street, buildings associated with the Mathiesson & Wiechers Sugar Refinery, the J.J. Gautier & Co. Fire Brick Manufactory, Thomas & Haley, and John Cahill are depicted between Warren and Hudson streets (Hopkins 1873: Plate A). Buildings along the east side of Hudson Street, near the Paulus Hook waterfront, included Took & Seurs, the Wm. C. Hutton Boiler Works, the First National Bank, and several buildings owned by the Jersey City Associates (Hopkins 1873: Plate A). The HBLR route is proximate to all of these late nineteenth century properties. Between Montgomery and Steuben streets, the HBLR route passes through the former NJRR depot and railyard (Hopkins 1873: Plate A). In Bayonne, near the former route of the Morris Canal, between Centre and Grand streets and east of Avenue E, dwellings are depicted along the west side of the CRRNJ tracks (Hopkins 1873). In the Greenville section of Jersey City, land surrounding the CRRNJ is depicted as undeveloped in 1873 (Hopkins 1873). The CRRNJ is depicted crossing the Morris Canal's Fiddler's Elbow on the Bayonne/Greenville boundary (Hopkins

1873). In 1889, the CRRNJ built a new terminal at Communipaw to replace its existing terminal. Several buildings are depicted in 1873 west of the terminal on the east side of the CRRNJ tracks at the intersection of Communipaw Avenue and Dudley Street (Hopkins 1873: Plate M).

Early twentieth century viewpoints on the Meadowlands focused on land reclamation through filling and land making methods designed to raise the land above the high-tide level (Marshall 2004:10). River dredging programs begun in the late nineteenth century by the U.S. Army Corps of Engineers provided some material for in-filling of marsh lands; municipal garbage, construction debris and excavation spoils provided other material (Marshall 2004:10). These efforts resulted in the creation of made land in eastern Bergen County and western Hudson County along the lower Hackensack and lower Passaic rivers. Industrial and commercial development of the northeastern portion of Kearny Peninsula began in the early 1900s with the construction of the Koppers Seaboard Coke and Byproducts Company (see Figures 4.6 – 4.7; Hopkins 1934; NETR 1953, 1954, 1966, 1979; NJDEP 1930). Extensive areas of filled marsh land are located within the APE. In addition, construction of the DL&WRR resulted in extensive ground disturbance in upland areas that could have been utilized during the early nineteenth century. Historic archaeological deposits within the APE pre-dating the construction of the railroad are likely to have compromised integrity.

The results of background research and a field reconnaissance indicate that the APE contains uplands and in-filled marsh land that were undeveloped until the mid-nineteenth to early twentieth century. While extensive land modifications have occurred as a result of the urbanization of Jersey City, previous archaeological surveys have identified intact historic archaeological sites near the APE. In 2001, a cultural resources survey was completed for the Jersey City Water Works Pipeline in the U.S. Routes 1 & 9 Truck Improvements project area that located and documented a section of 20-inch cast iron pipe installed during the initial period of pipeline construction in 1852 (RBA Group, Inc. 2001: 12). Six archaeological sites that contribute to the Larch/Covert Historic District (the Beck/Thorpe/Altvatter House Sites [28-Hd-20], the Gavenesch/Balbo House/Store Site [28-Hd-21], the Gavenesch/D'Amato House/Saloon Site [28-Hd-22], the Gavanesch/Sarno House Site [28-Hd-23], the Radcliffe/Hoersch House Site [28-Hd-24], and the Moore/Bukowski House Site [28-Hd-25]) are located proximate to the APE in the Marion section of Jersey City (RBA Group, Inc. 2000). These archaeological sites contained intact features that retained a high degree of integrity despite ground disturbance from later land use proximate to the Covert/Larch Historic District. The NRHP-eligible New York Susquehanna and Western RR Engine Repair Site (28-Hd-48) is located nearby, south of the APE (RBA Group, Inc. 2015:97). Investigation of Site 28-Hd-48 identified the disturbed southern perimeter of a turntable, which once extended into the APE (RBA Group, Inc. 2015). Additional archaeological investigation of inaccessible portions of the site and mitigation was recommended for the New York Susquehanna and Western RR Engine Repair Site (28-Hd-48) (RBA Group, Inc. 2015:97).

Intact Morris Canal-related features and temporally discrete fill deposits related to its closure have been identified at several locations. Recent subsurface testing in northern Bayonne identified early to mid-twentieth century fill deposits in trenches completed within a segment of the former Morris Canal. The early to mid-twentieth century fill deposits were registered as the Morris Canal Fiddler's Elbow Segment Archaeological Site (28-Hd-47) (Dewberry Engineers, Inc. 2011, 2013). Archaeological monitoring completed in 2001 for proposed walkway construction identified timber cribbing associated with the Little Morris Canal Basin along Washington Street in the Paulus Hook section of Jersey City (CRCG 2001). Seven piling locations were monitored and recorded 10-inch diameter rounded and squared stacked logs at 2.5 feet below ground surface that were tied with logs set perpendicular to the wall at 15-foot intervals. A plank floor was encountered between three and four feet below ground surface (CRCG 2001: 12). The structural remains were interpreted as part of the canal cribbing constructed in 1838 for the Morris Canal's basin. Test trenches completed in 1998 identified vertical plank cribbing supported by log cross pieces and piles along the south bank of the canal at Essex Street, nine feet beyond which were deposits of boulder rip-rap and a strip of boulder-free fill interpreted as the former towpath. Test trenches indicated that the canal's north bank was supported by 20-inch diameter cut log cribbing (Geismar 1998c: 20). Subsurface testing completed in 1995 for the construction of the HBLR identified the Morris Canal prism near the Richard Street Station and Marin Boulevard and Van Vorst Street (Geismar 1995c). Subsurface testing between Marin Boulevard and Van Vorst Street, just north of Essex Street in Jersey City, identified evidence of the Morris Canal prism at seven feet below ground surface (Geismar 2002a). A series of mechanically excavated trenches at Exchange Place contained fill layers that contained cultural material contemporaneous with land fill operations rather than older material that could be interpreted as household or commercial garbage and considered a potentially significant archaeological resource (Exchange Place Landfill [28-Hd-19]) (Kardas and Larrabee 1979: 32-33). A 1992 historical and archaeological investigation for the proposed Gateway transit hub identified two partly superimposed structures related to the CRRNJ terminal built in Communipaw in 1865 (Louis Berger Associates, Inc. 1992). Structural remains of an 1865 engine house built on filled land approximately 300 feet northeast of historic Communipaw Avenue were uncovered in mechanically excavated tests pits. Structural remains of a second engine house, built in 1900 were identified in fill deposits overlying the 1865 structural remains (Louis Berger Associates, Inc. 1992: 16). The circa 1865 and circa 1900 archaeological features were sampled, documented and assessed with low to moderate archaeological integrity. In 2012, three geoarchaeological borings were completed near the intersection of Wilson Street and Jersey City Boulevard in the Communipaw section of Jersey City due to its potential for intact archaeological remains associated with the CRRNJ roundhouse, an NRHP-eligible resource that was constructed in 1914 (PAL 2012). Possible foundation or girder remains associated with the CRRNJ roundhouse were identified in the borings at depths of eight to 10 feet below ground surface (PAL 2012: 8). In 2013, mechanically excavated trenches completed within the proposed pipeline project area identified foundation remains, 16 inspection pits, concrete floor sections, concrete roof column support footings, wood posts/pilings, and ceramic and cast iron pipes associated with the 1914 CRRNJ northern roundhouse and registered as the Jersey Central Railroad Roundhouse North (28-Hd-49) (PAL 2014a, 2014b).

Areas of historic archaeological sensitivity that may warrant further investigation also were identified as a result of previous research. Two locations assessed with historic archaeological sensitivity during surveys related to HBLR planning and construction do not appear to have been further investigated: the corner of Hudson Street and Essex Street, Jersey City (soil bore testing recommended) and the corner of Hudson Street and Grand Street, Jersey City (see Geismar 1995c: 13,43). A series of geoarchaeological borings completed proximate to the HBLR ROW between 32nd and 45th streets in Bayonne identified a buried A horizon that transitioned to a subsoil that were interpreted as Holocene period soils and assessed with high historic and/or prehistoric archaeological sensitivity (PAL 2011a). The northern portion of the Lincoln Harbor project area, east of the Lincoln Tunnel helix, was identified as an area where historic archaeological resources associated with the circa 1740 to 1775 Weehawken Ferry may be present beneath late nineteenth century fill emplaced during construction of the Erie Railroad terminal (Raber Associates 1986: 13).

The APE has low to high sensitivity for historic archaeological resources (see Figures 5.1a-5.1c). Portions of the APE located where extensive ground disturbance has occurred have low sensitivity for historic archaeological resources. Portions of the APE where limited ground disturbance has occurred have moderate sensitivity for historic archaeological resources. In addition, portions of the APE located in Project Component A have moderate sensitivity for historic archaeological resources related to dikes and tide gates associated with late nineteenth through early twentieth century land development and mosquito control initiatives. Locations within and adjacent to the APE where mapped documented historic structures or historic archaeological sites have been identified has high sensitivity for historic archaeological resources.

Figure 5.1a: Aerial photograph showing the APE, areas of archaeological sensitivity, and photograph locations and directions (World Imagery, ESRI 2014).

Figure 5.1b: Aerial photograph showing the APE, areas of archaeological sensitivity, and photograph locations and directions (World Imagery, ESRI 2014).

Figure 5.1c: Aerial photograph showing the APE and areas of archaeological sensitivity (World Imagery, ESRI 2014).

Plate 5.1: Overview, Town of Kearny, looking across Cedar Creek Marsh toward the Old Main DL&WRR Historic District, now the Morris & Essex line, with the Passaic River, the PRR New York Bay Branch Historic District, the US Route 1 Extension Historic District, the US Route 1&9 Historic District, and the PSE&G Kearny-Essex-Marion Interconnection Historic District in the background.

Photo view: Southwest

Photographer: Allee Davis

Date: October 15, 2015

Plate 5.2: Overview, Town of Kearny, looking across the Koppers Coke Peninsula Redevelopment Area and the proposed Main Facility Site toward the Hackensack River.

The Old Main DL&WRR Historic District, where the proposed transmission line will travel east to Jersey City is visible at right. The Jersey City Water Works Historic District and Jersey City Water Works Pipeline are located below ground at the center of the image. Numerous historic properties are visible in the background, including the Hackensack River Lift Bridges Historic District and the PSE&G Kearny-Essex-Marion Interconnection Historic District. The Manhattan skyline is visible in the distance.

Photo view: South

Photographer: Lynn Alpert

Date: June 23, 2016

Plate 5.3: Overview of Main Facility Electric Yard.

Photo view: West

Photographer: Jennifer B. Leynes

Date: April 14, 2014

Plate 5.4: Overview of Project Component B.

Note the Morris & Essex Line in background

Photo view: Northwest

Photographer: Jennifer B. Leynes

Date: April 14, 2014

Plate 5.5: Overview of Eighth Street Station Platform, the southern terminus of the HBLR, City of Bayonne.

Photo view: West

Photographer: Teresa D. Bulger

Date: February 22, 2017

Plate 5.6: Overview of the ground surface at Eighth Street Station, the southern terminus of the HBLR, City of Bayonne.

Photo view: Southwest

Photographer: Teresa D. Bulger

Date: February 22, 2017

Plate 5.7: View of HBLR from the intersection of Avenue E and East 14th Street, City of Bayonne. Taken from the approximate location of Site 28-Hd-1.

Photo view: South

Photographer: Teresa D. Bulger

Date: February 22, 2017

Plate 5.8: Existing conditions at approximate location of Site 28-Hd-26, City of Bayonne.

Photo view: South

Photographer: Teresa D. Bulger

Date: February 22, 2017

Plate 5.9: Overview of HBLR tracks at Thirty-fourth Street Station, City of Bayonne.

Photo view: North

Photographer: Teresa D. Bulger

Date: February 22, 2017

Plate 5.10: Overview of HBLR and approximate location of Site 28-Hd-47 and the site of the historic Morris Canal where it crosses the HBLR at Fifty-Second Street, City of Bayonne.

Embankment for HBLR visible on the middle-distance on left side of photo. Taken from the foot of East Fifty-First Street, City of Bayonne.

Photo view: Northeast

Photographer: Teresa D. Bulger

Date: February 22, 2017

Plate 5.11: Overview of zone of prehistoric sensitivity in approximate area of Site 28-HD-17, Chapel Avenue, City of Jersey City.

Photo view: South

Photographer: Teresa D. Bulger

Date: February 22, 2017

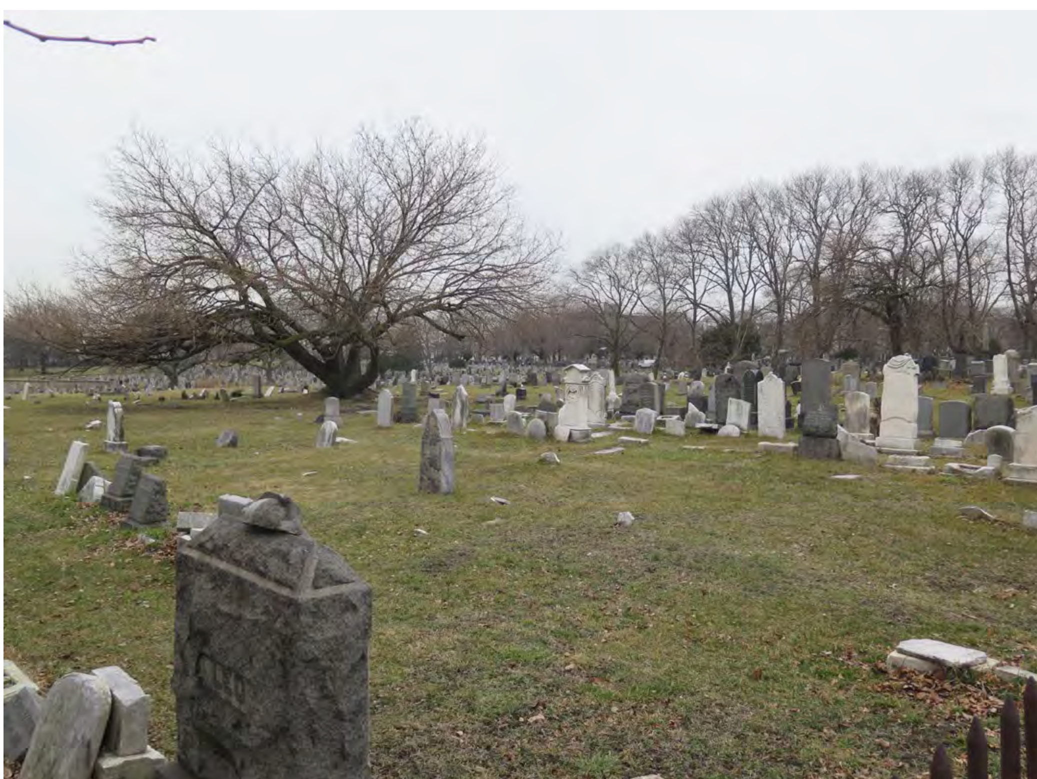

Plate 5.12: Overview of Bayview Cemetery, approximate location of Site 28-Hd-17, City of Jersey.

Photo view: Southwest

Photographer: Teresa D. Bulger

Date: February 22, 2017

Plate 5.13: View of approximate location of the Morris Canal at its crossing with the HBLR near Chapel Avenue, City of Jersey City.

Photo view: North

Photographer: Teresa D. Bulger

Date: February 22, 2017

Plate 5.14: View of approximate location of the Morris Canal at its crossing with the HBLR near Richard Street Station, City of Jersey City.

Photo view: Southeast

Photographer: Teresa D. Bulger

Date: February 22, 2017

Plate 5.15: View of approximate location of the Morris Canal at its crossing with the HBLR near foot of East Bidwell Avenue, City of Jersey City.

Photo view: Southeast

Photographer: Teresa D. Bulger

Date: February 22, 2017

Plate 5.16: View of approximate location of the Morris Canal at its crossing with the HBLR near the intersection of Union Street and Garfield Avenue, City of Jersey City.

Photo view: Southeast

Photographer: Teresa D. Bulger

Date: February 22, 2017

Plate 5.17: Overview of West Side Station, the western terminus of the Jersey City Extension of the HBLR, City of Jersey City.

Photo view: Northeast

Photographer: Teresa D. Bulger

Date: February 22, 2017

Plate 5.18: View of HBLR from the foot of Communipaw Avenue at the Liberty State Park Station, City of Jersey City.

Taken from the approximate location of Site 28-Hd-15.

Photo view: Southwest

Photographer: Teresa D. Bulger

Date: February 22, 2017

Plate 5.19: Existing conditions at approximate location of Site 28-Hd-49, City of Jersey City.

Photo view: East

Photographer: Teresa D. Bulger

Date: February 22, 2017

Plate 5.20: View toward HBLR and Interstate 78 from the approximate location of Site 28-Hd-18, City of Jersey City.

Photo view: West

Photographer: Teresa D. Bulger

Date: February 22, 2017

Plate 5.21: View toward HBLR and Interstate 78 from the approximate location of Site 28-Hd-52, City of Jersey City.

Photo view: West

Photographer: Teresa D. Bulger

Date: February 22, 2017

Plate 5.22: Existing conditions at approximate location of Site 28-Hd-51, City of Jersey City.

Photo view: East

Photographer: Teresa D. Bulger

Date: February 22, 2017

Plate 5.23: Existing conditions at approximate location of Site 28-Hd-53, Corner of Warren Street and Essex Street, City of Jersey City.

Photo view: Southeast

Photographer: Teresa D. Bulger

Date: February 22, 2017

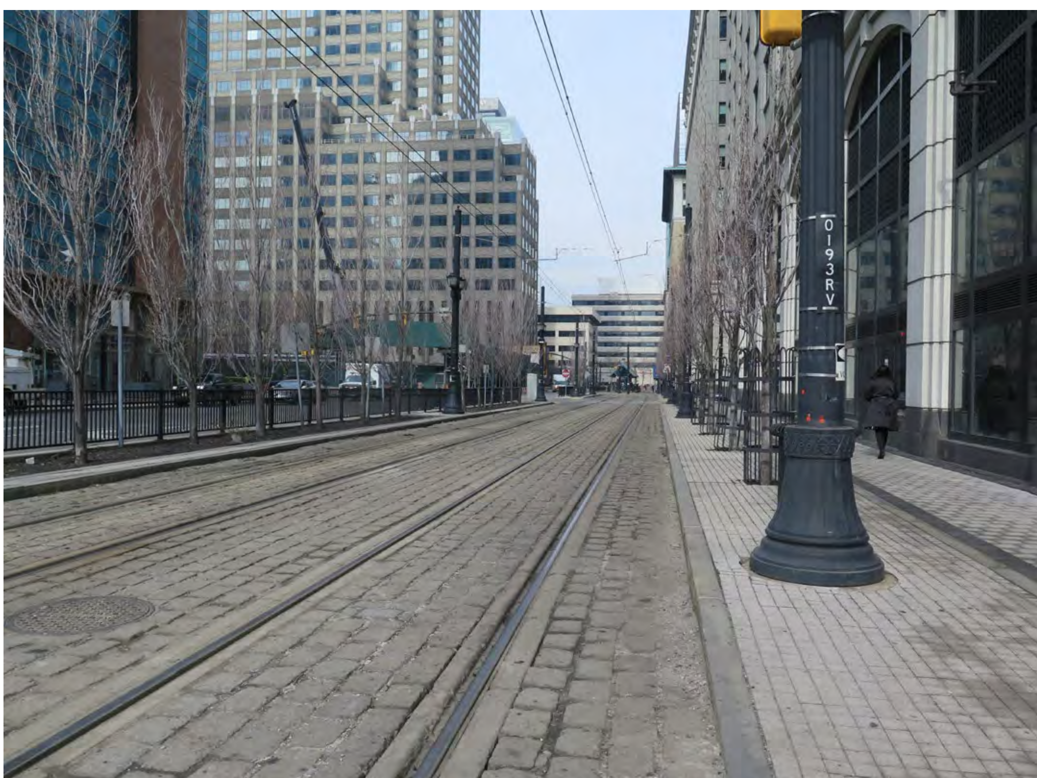

Plate 5.24: Overview of zone of historic sensitivity in approximate area of Site 28-HD-19, corner of Sussex Street and Hudson Street, City of Jersey City.

Photo view: North

Photographer: Teresa D. Bulger

Date: February 22, 2017

Plate 5.25: Overview of zone of historic sensitivity in approximate area of Site 28-HD-19, corner of Christopher Columbus Drive and Hudson Street, City of Jersey City.

Photo view: Northwest

Photographer: Teresa D. Bulger

Date: February 22, 2017

Plate 5.26: Overview of Eighteenth Street Extension of HBLR, City of Jersey City.

Photo view: East

Photographer: Teresa D. Bulger

Date: February 22, 2017

Plate 5.27: Overview of proposed site of Hoboken East Substation, City of Hoboken.

Photo view: West

Photographer: Lynn Alpert

Date: February 16, 2016

Plate 5.28: Overview of the HBLR near the Lincoln Harbor Station.

Taken at the intersection of Waterfront Terrace and Riverview Drive, Township of Weehawken.

Photo view: North

Photographer: Teresa D. Bulger

Date: February 22, 2017

Plate 5.29: View of eastern end to the HBLR's West Shore Tunnel.

Photo view: West

Photographer: Teresa D. Bulger

Date: February 22, 2017

Plate 5.30: Overview of the ground surface at Tonnelle Avenue Station, the northern terminus of the HBLR, Township of North Bergen.

Photo view: Northwest

Photographer: Teresa D. Bulger

Date: February 22, 2017

6.0 CONCLUSIONS AND RECOMMENDATIONS

RGA, Inc. completed a Phase IA archaeological survey for the proposed NJ TRANSITGRID TRACTION POWER SYSTEM project to be constructed in the Town of Kearny, Cities of Jersey City, Hoboken, Bayonne, and Union, and Townships of North Bergen and Weehawken, Hudson County, New Jersey. The Federal Transit Administration (FTA) and New Jersey Transit Corporation (NJ TRANSIT) plan to construct a natural gas fired electric power generating plant, a natural gas line connection, electrical line improvements, and two new substations. Supporting electrical lines will run within the existing route of the Morris & Essex Line and the Hudson-Bergen Light Rail (HBLR) line and may be hung on existing poles in NJ TRANSIT's right-of-way (ROW), on new poles to be constructed within the ROW, and/or installed in at-grade or underground duct banks.

The Phase IA archaeological survey determined that the Area of Potential Effects (APE) has low to high sensitivity for prehistoric archaeological resources and low to moderate sensitivity for historic archaeological resources. Portions of the APE located where extensive ground disturbance has occurred have low sensitivity for prehistoric and historic archaeological resources. Proposed construction at the Main Facility site (Project Component A) and related natural gas pipeline and sanitary sewer connections may directly impact the previously identified Jersey City Water Works Pipeline, Jersey City Water Works Historic District, and Standard Chlorine Chemical Company Site, or undocumented prehistoric or historic archaeological resources, if any, within the APE. Project Component A has high sensitivity for prehistoric archaeological resources, due its proximity to the Standard Chlorine Chemical Company Site, and moderate sensitivity for historic archaeological resources related to the late nineteenth to early twentieth century drainage infrastructure construction of the Bergen and Hudson County Mosquito Commissions. Locations where new substations and a natural gas pipeline interconnection (Project Component B) are proposed have low prehistoric and historic archaeological sensitivity.

The proposed electrical line routes (Project Components C through G) have low to high sensitivity for prehistoric and historic archaeological resources. Portions of Project Components C through G located where extensive ground disturbance has occurred have low sensitivity for prehistoric and historic archaeological resources. No areas of archaeological sensitivity were identified in Project Component F. Known archaeological resources are located along Project Component E, and have archaeological sensitivity. Areas of Project Component E where prehistoric archaeological resources or deeply buried prehistoric land surfaces have been reported, and where limited ground disturbance has occurred, have moderate to high sensitivity for prehistoric archaeological resources. Areas along Project Component E proximate to documented historic archaeological resources, including the Covert/Larch Historic District, the New York, Susquehanna, and Western Railroad Engine Repair Site, the Morris Canal, St. Peter's Cemetery, and locations along Project Component G where archaeological resources exist associated with the Morris Canal, the Central Railroad of New Jersey (CRRNJ), and nineteenth century landfilling have moderate to high sensitivity for historic archaeological resources. Locations where Project Component G intersects the former route of the Morris Canal have high sensitivity for historic archaeological resources. In Bayonne and Weehawken, portions of Project Component G where geoarchaeological borings identified stable buried land surfaces are assessed with historic archaeological sensitivity. Locations in the Jersey City portion of Project Component G assessed with historic archaeological sensitivity during previous surveys not subjected to further investigation retain historic archaeological sensitivity. The installation of at-grade duct banks located along the length of the proposed electrical line would have no effect on archaeological resources within the APE.

Avoidance of direct impacts is recommended for areas of moderate to high prehistoric and/or historic archaeological sensitivity as described in Section 5 of this report. Proposed direct impacts related to archaeological resources, if any, within the APE include the construction of underground duct banks, a natural gas pipeline, monopole foundations, and pile-driven structure foundations within Project Component A and the proposed new Kearny Substation. Installation of pile-driven foundations would have no adverse effect on the Standard Chlorine Chemical Company Site or undocumented prehistoric or historic archaeological resources, if any, within the APE, since no soil removal via excavation would result from the installation. Deeply buried Early to Middle Holocene upland landform soils associated with a documented prehistoric archaeological resource may extend into the new Kearny Substation portion of the APE based on available geotechnical data from previous studies of the Koppers Koke Site. Installation of pile-driven foundations would have no adverse effect on any archaeological resources that may be present in the deeply buried upland soils since no soil removal would result from the installation. No further archaeological survey is recommended in areas within the APE where pile-driven foundations are proposed. Proposed construction at Project Component A and related natural gas pipeline and sanitary sewer connections within the utility easement may directly impact the previously identified Jersey City Water Works Pipeline and Jersey City Water Works Historic District. Project Components C and D bisect the Jersey City Waterworks Pipeline at Route 7. Project Component E runs parallel to the Jersey City Waterworks Historic District from east of Route 7 to the Bergen Tunnel West Portal.

Avoidance of the Jersey City Water Works Pipeline and Jersey City Water Works Historic District could be achieved if no ground disturbing activities, including trenching and shaft drilling, are undertaken in the mapped route of the Jersey City Water Works Pipeline and the Jersey City Water Works Historic District. Construction plans would depict the location of the Jersey City Water Works Pipeline and Jersey City Water Works Historic District within Project Components A, C, D, and E and stipulate that no excavation or drilling occur within 25 feet of those locations. Underground duct banks or monopole foundations have the potential to adversely affect the Jersey City Water Works Pipeline and Jersey City Water Works Historic District. Duct banks located at grade would have no adverse effect on archaeological resources within Project Components C, D, and E.

The installation of underground duct banks or construction of foundations for new monopoles in areas of archaeological sensitivity in Project Components E and G would have direct impacts on prehistoric and historic archaeological resources, if any exist in the APE. Avoidance of direct impacts in these Project Components may include alterations to monopole placement, selection of installation options that involve shallow, rather than deep, ground disturbance, and the installation of at-grade duct banks. The installation of at-grade duct banks located along the length of the proposed electrical line routes would have no adverse effect on archaeological resources, if any, within the APE since no disturbance of subsurface soil strata would occur. The placement of monopoles or underground duct banks outside the archaeological sensitivity areas would minimize the likelihood that archaeological resources, if any, would be directly impacted by the proposed construction. Where sensitivity areas cannot be avoided through project design, selection of a construction option that will minimize ground disturbance that damages or destroys archaeological resources, if any, within the APE is recommended. Where archaeological resources may be deeply buried beneath thick historic and/or modern fill deposits, the installation of duct banks with shallow subsurface ground disturbance (i.e. no more than five feet below the existing ground surface) would conserve archaeological resources, if any, in deeply buried contexts. Recommendations for specific archaeological sensitivity zones within the APE address each of these avoidance options. An area of prehistoric archaeological sensitivity extends from east of Project Component A to near the western limit of Project Component B along the northern boundary of Project Component E. A potential for deeply buried upland soils exists in this sensitivity area. Installation of monopole foundations along the north side of Project Component E have the potential to adversely affect any prehistoric archaeological resources that may exist in this prehistoric archaeological sensitivity zone. Shallow underground duct banks no deeper than five feet below existing ground surface would have no adverse effect on archaeological resources within the APE since construction activities would not disturb deeply buried natural soils. Areas of Project Component E proximate to documented historic archaeological resources, including the Covert/Larch Historic District, the New York, Susquehanna, and Western Railroad Engine Repair Site, and St. Peter's Cemetery, have moderate sensitivity for historic archaeological resources. Installation of monopole foundations along the south side of Project Component E has the potential to adversely affect any historic archaeological resources related to the Covert/Larch Historic District and the New York, Susquehanna, and Western Railroad Engine Repair Site that may exist in this historic archaeological sensitivity zone. Installation of monopole foundations along the north side of Project Component E proximate to St. Peter's Cemetery has the potential to adversely affect any historic archaeological resources that may exist in this portion of the historic archaeological sensitivity zone. Installation of shallow underground duct banks no deeper than five feet below existing ground surface would have no adverse effect on archaeological resources within the APE provided that ground disturbing activities do not disturb natural soils underlying surficial fill layers. Duct banks installed at grade would have no adverse effect on archaeological resources within the APE.

Where areas of archaeological sensitivity cannot be avoided through project design, archaeological monitoring may be warranted to identify archaeological resources at locations where subsurface ground disturbance will penetrate secondary fill deposits and reach depths at which archaeological resources have been reported proximate to the APE. Due to the depth of the culturally sensitive strata beneath historic and modern fill layers up to 25 feet thick and the limited nature of the construction impacts, few prudent and feasible approaches are available for archaeological identification and evaluation surveys. Conventional archaeological identification approaches, such as shovel test pits and remote sensing, are unlikely to fully penetrate fill deposits and provide adequate characterization of the APE. Monitoring and/or assessment of geotechnical borings by a qualified geoarchaeologist/archaeologist would be completed in archaeologically sensitive areas proximate to locations where monopole installations are proposed. Depending on the results of the geotechnical borings, archaeological monitoring and sampling during construction would be considered a prudent and feasible approach to archaeological survey where trench excavations deeper than five feet below ground surface are proposed or where drilled shafts will penetrate fill layers so that soil stratigraphy in the drilled shaft may be inspected by the archaeologist. For drilled shafts, where natural soils are deeply buried beneath fill layers, archaeological monitoring is unlikely to result in significant recovery of archaeological data.

As project plans develop and the locations, nature, and extent of direct project impacts are refined, locations where further archaeological survey is warranted can be identified through continued consultation. In order to satisfy the FTA's Section 106 responsibilities, a Programmatic Agreement (PA) will be developed between the NJHPO, NJ TRANSIT, FTA and the Advisory Council on Historic Preservation in order to provide for the identification, evaluation, and appropriate treatment of historic properties. Stipulations can include the following tasks: Archaeological Monitoring; Phase II Archaeological Investigations; Effects Assessment; Mitigation; Curation; and Reporting. The stipulations within the PA will outline in detail all of the potential actions necessary to carry out the requirements of the Section 106 process as project plans develop and are finalized.

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ATTACHMENT A: QUALIFICATIONS OF THE PRINCIPAL INVESTIGATOR

SHARON D. WHITE
SENIOR ARCHAEOLOGIST (36 CFR 61)

YEARS OF EXPERIENCE:
With this firm: 2009-Present
With other firms: 8

EDUCATION:
Ph.D. 2001
The Pennsylvania State University Anthropology

MA 1994
The Pennsylvania State University Anthropology

BA 1992
The Pennsylvania State University Anthropology

PROFESSIONAL TRAINING:
CRM Essentials: Restoring Your Skills, Trenton, NJ, October 2007

Section 106 Workshop, Washington, DC, May 2007

40-Hour Health and Safety Training for Hazardous Waste Operations and Emergency Response (OSHA 29 CFR 1910.120), August 2015; 8-Hour HAZWOPER Refresher, August 2015

PROFESSIONAL REGISTRATION:
Register of Professional Archaeologists

Professional Experience Summary:

Sharon D. White, Ph.D. is a Senior Archaeologist at RGA and provides project design, supervision and analysis for archaeological investigations. Dr. White has served as a Principal Investigator on a variety of archaeological investigations, including Phase IA, I, II, and III archaeological investigations and archaeological monitoring, and specializes in prehistoric archaeology. She has prepared and directed cultural resources surveys in accordance with Section 106 of the National Historic Preservation Act, NEPA, and other relevant state and municipal laws. Dr. White exceeds the qualifications set forth in the Secretary of Interior's Standards for Archaeologists [36 CFR 61].

Representative Project Experience:

<u>Heritage Village at Duffy Manor</u>, Florence Township, Burlington County, NJ (Sponsor: United States Department of Housing and Urban Development) Principal Investigator, Senior Archaeologist for cultural resources investigation for a proposed apartment building containing 66 age-restricted residential units on the site of the former Florence Public School No. 1 (a.k.a. Marcella L. Duffy School [hereafter Duffy School] located at 208 West Second Street (Block 45, Lot 8; formerly known as Lots 8, 13, 14, and 15), in Florence Township. The results of background research and a visual inspection of the APE-Archaeology indicated that portions within the footprint of the existing Duffy School have a low potential to contain prehistoric or historic archaeological sites due to extensive prior disturbance. The eastern and western portions of the APE-Archaeology retained a moderate potential for prehistoric or historic archaeological sites.

<u>Bordentown Waterfront Community</u>, Bordentown and Mansfield Townships and Borough of Fieldsboro, Burlington County, NJ (Sponsor: Princewood Properties) Principal Investigator, Senior Archaeologist for a Phase IB/II archaeological survey for the proposed Bordentown Waterfront Community high density residential development in Bordentown and Mansfield Townships and the Borough of Fieldsboro. During the Phase IB archaeological survey, two potentially significant prehistoric sites, designated the Hilltop House site (28-Bu-733) and the Hilltop Bluff site (28-Bu-734) were identified. Due to the extensive previous disturbance, the lack of discrete, intact cultural deposits, and the absence of diagnostic materials and cultural features, the Hilltop House site (28-Bu-733) and the Hilltop Bluff site (28-Bu-734) were considered not eligible for listing on the National Register of Historic Places.

<u>Mill Creek Solar, Block 123, Lot 5</u>, Burlington Township, Burlington County, NJ (Sponsor: PSE&G) Principal Investigator, Senior Archaeologist for a Phase IA historical and archaeological survey for a proposed solar energy generation facility in Burlington Township, Burlington County. The results of background research and a visual inspection indicated a high potential for the APE to contain significant prehistoric and historic archaeological resources. The New Jersey Department of Environmental Protection (NJDEP) requested completion of a Phase I archaeological survey.

ATTACHMENT B: PROJECT PLANS

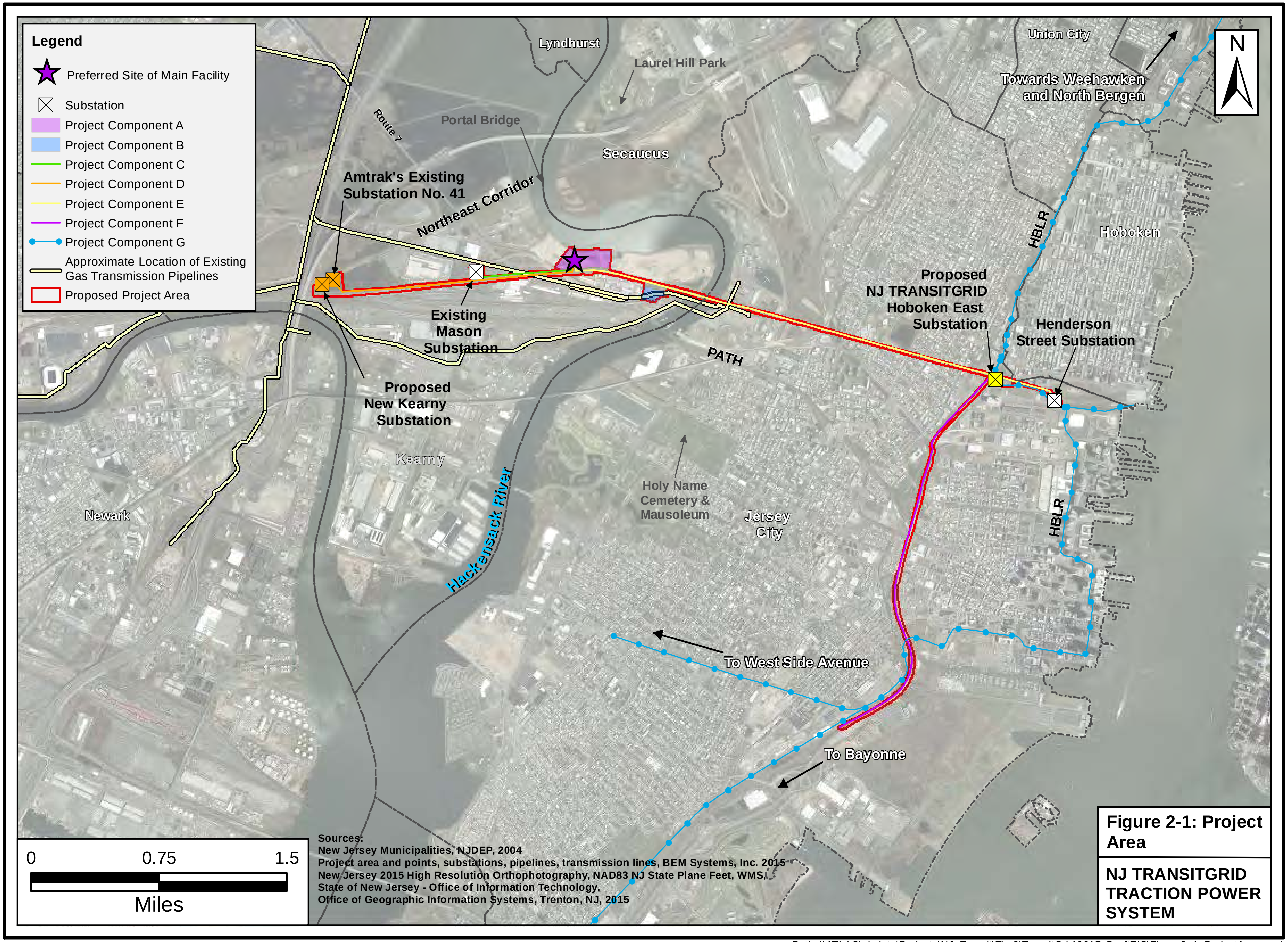

Figure 2-1: Project Area

NJ TRANSITGRID TRACTION POWER SYSTEM

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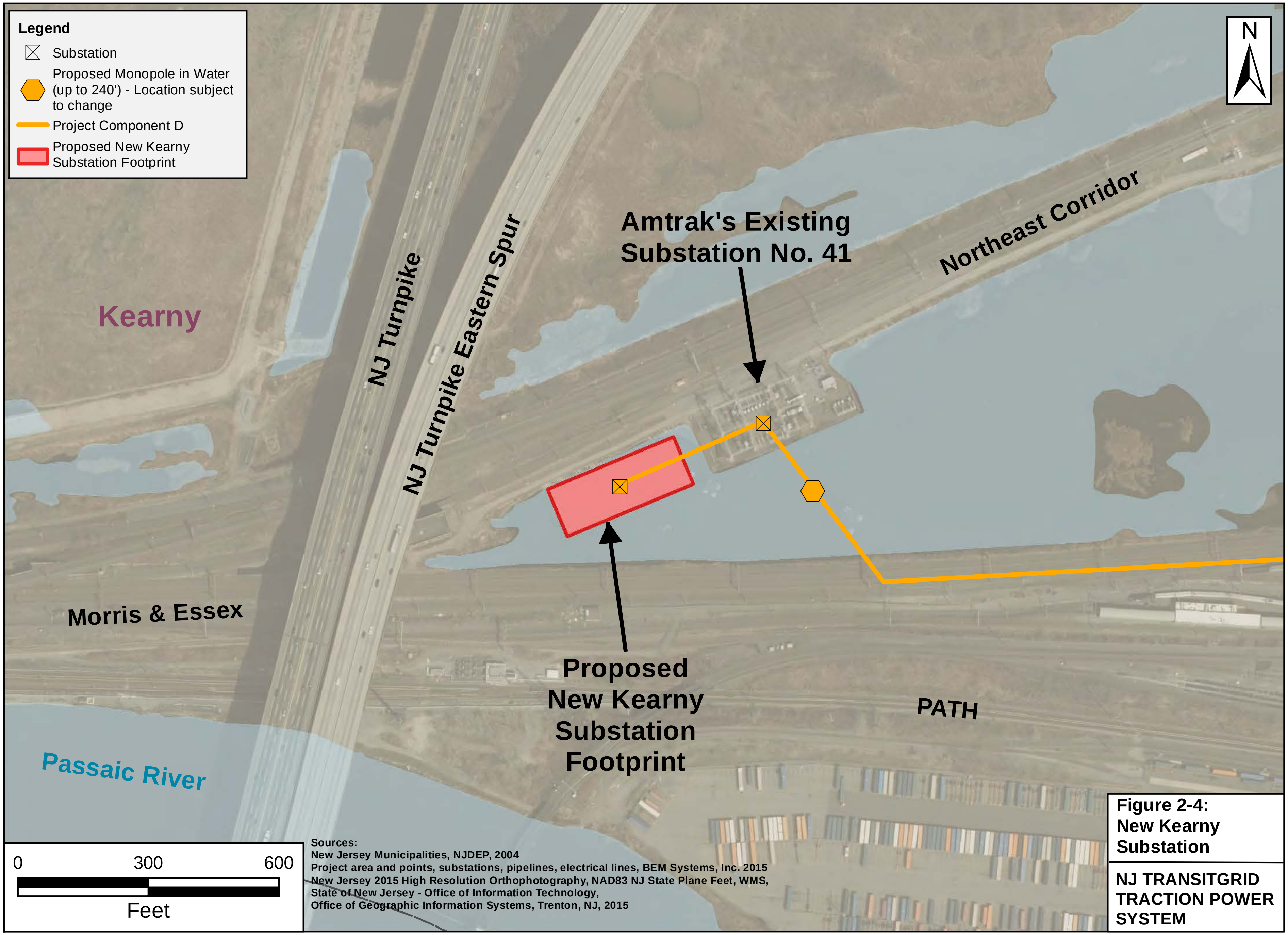

Figure 2-4: New Kearny Substation

NJ TRANSITGRID TRACTION POWER SYSTEM

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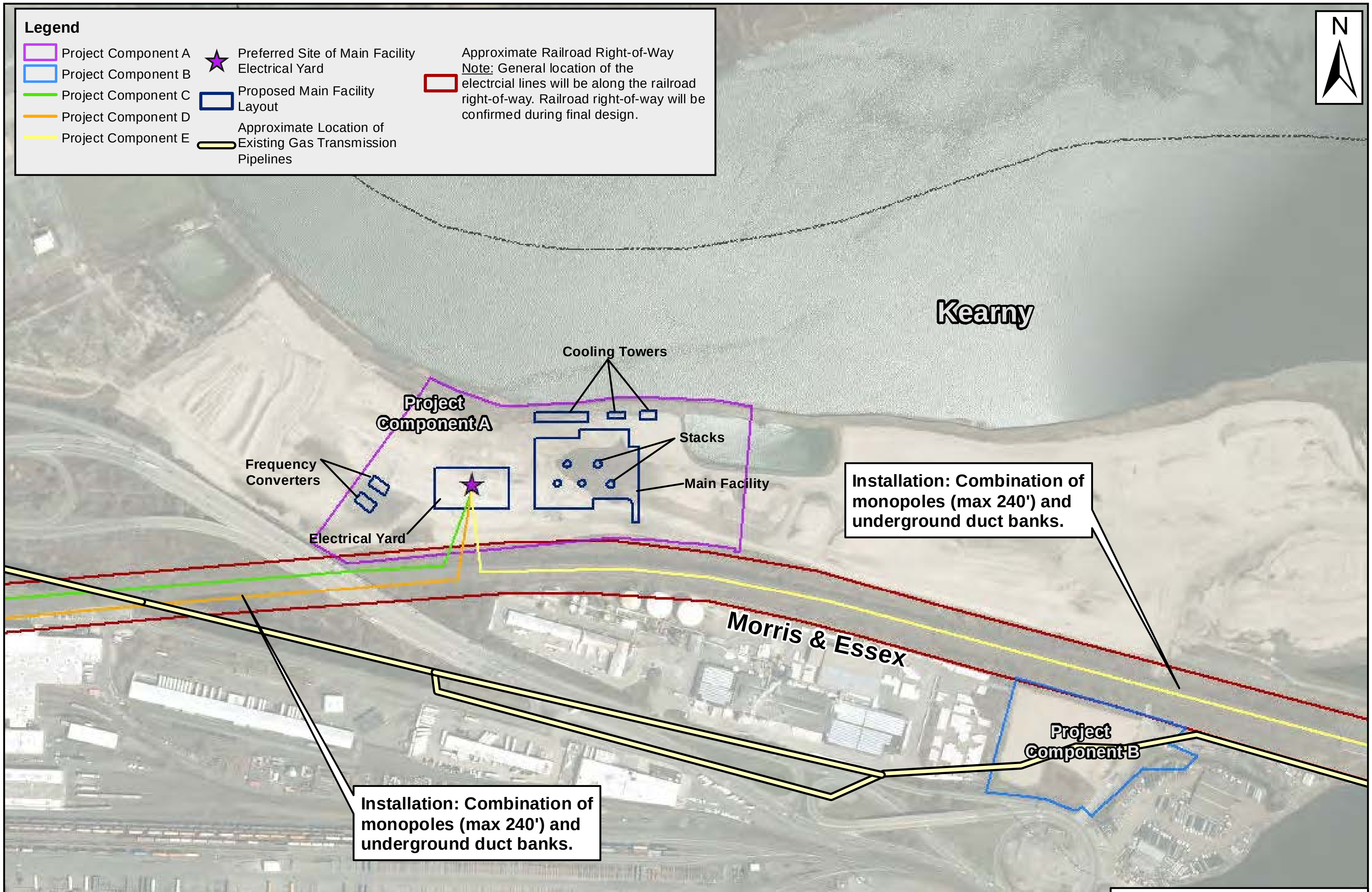

Sources:
Project area and points, substations, electrical line routes, BEM Systems, Inc. 2015/2016/2017, derived from NJT and Jacobs input
New Jersey 2015 High Resolution Orthophotography, NAD83 NJ State Plane Feet, WMS, State of New Jersey - Office of Information Technology, Office of Geographic Information Systems, Trenton, NJ, 2015

Figure 2-2: Project Components A/B

NJ TRANSITGRID TRACTION POWER SYSTEM

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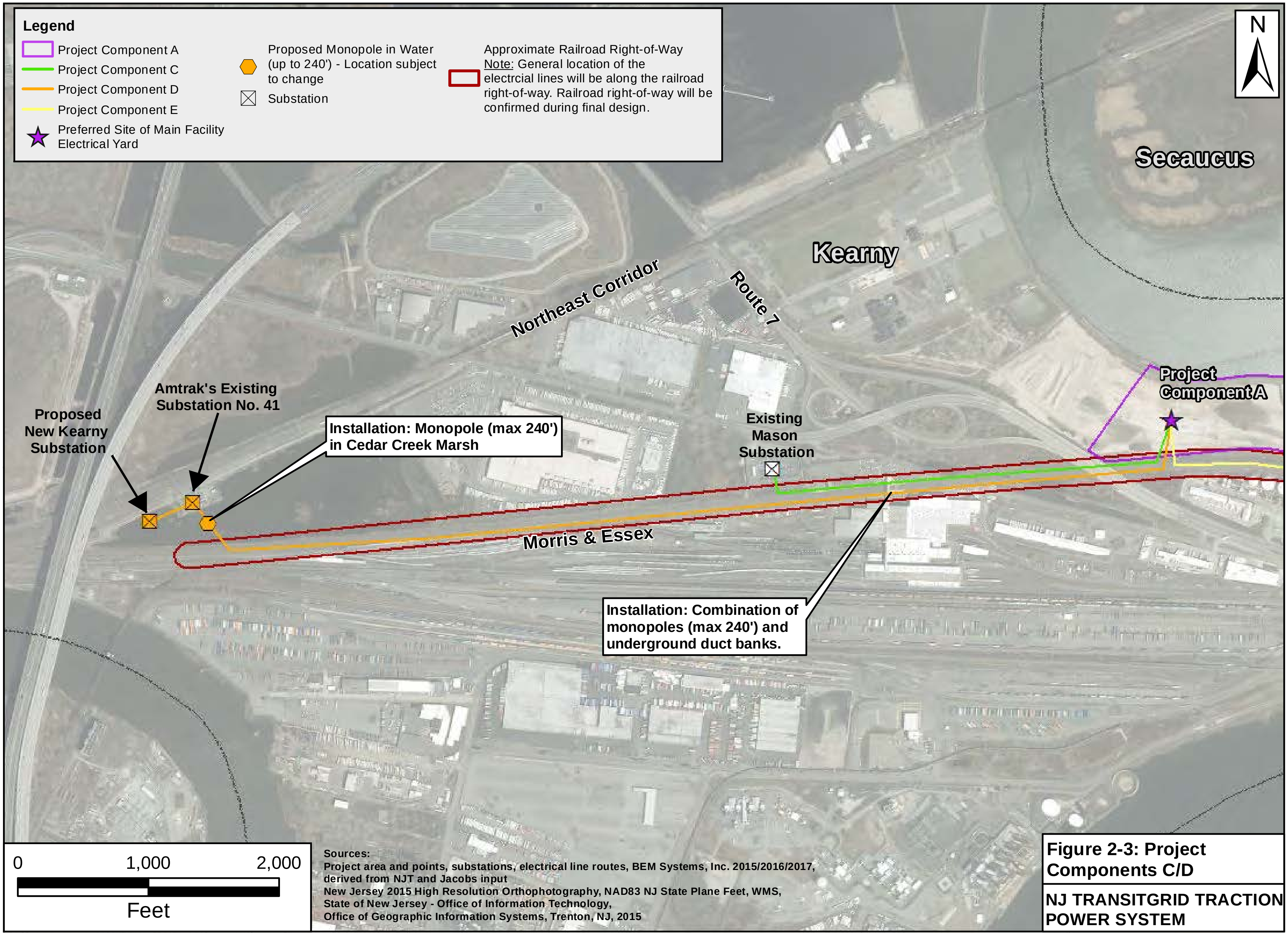

Sources:
Project area and points, substations, electrical line routes, BEM Systems, Inc. 2015/2016/2017, derived from NJT and Jacobs input
New Jersey 2015 High Resolution Orthophotography, NAD83 NJ State Plane Feet, WMS, State of New Jersey - Office of Information Technology, Office of Geographic Information Systems, Trenton, NJ, 2015

Figure 2-3: Project Components C/D

NJ TRANSITGRID TRACTION POWER SYSTEM

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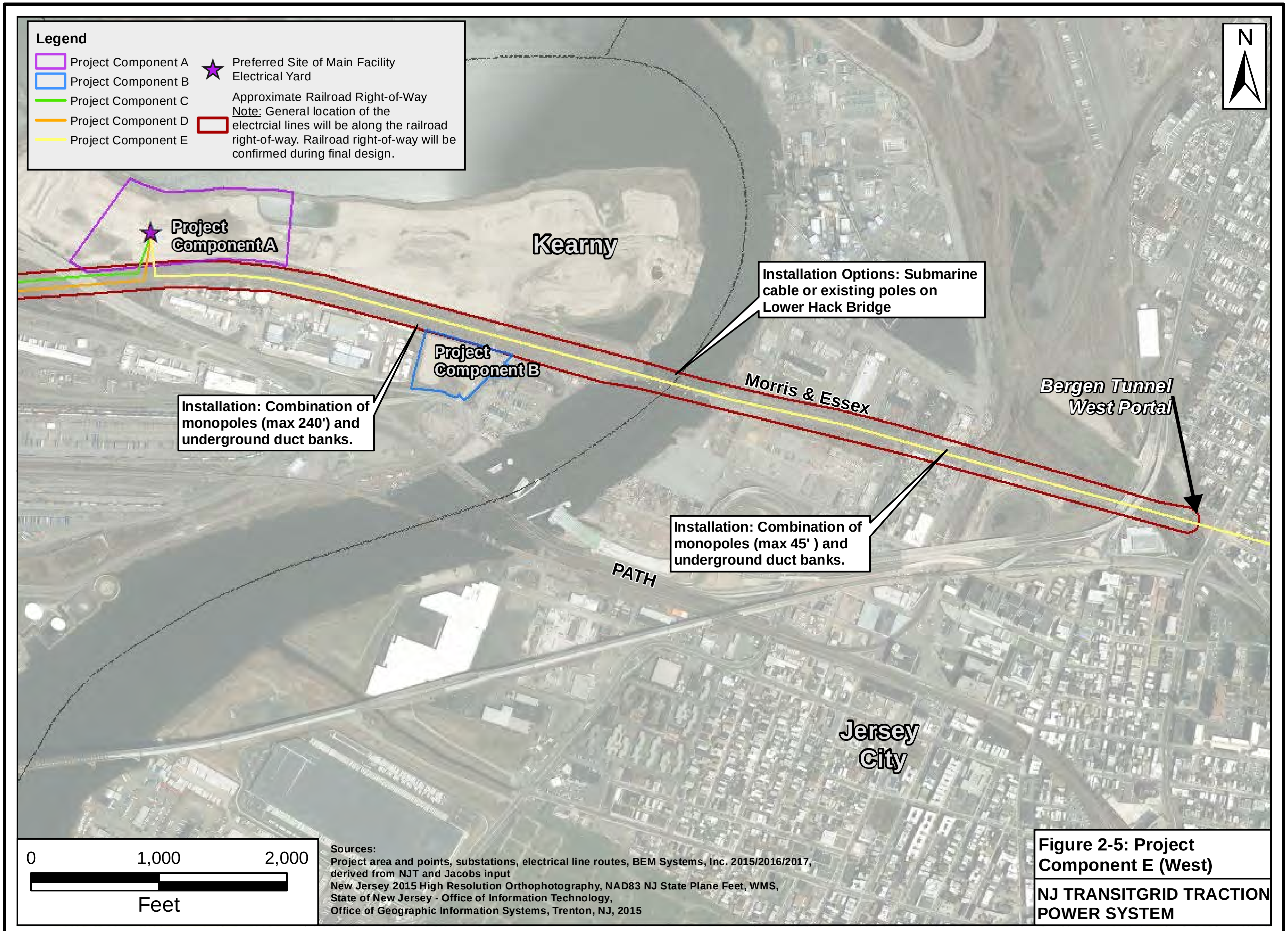

Sources:
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Figure 2-5: Project Component E (West)

NJ TRANSITGRID TRACTION POWER SYSTEM

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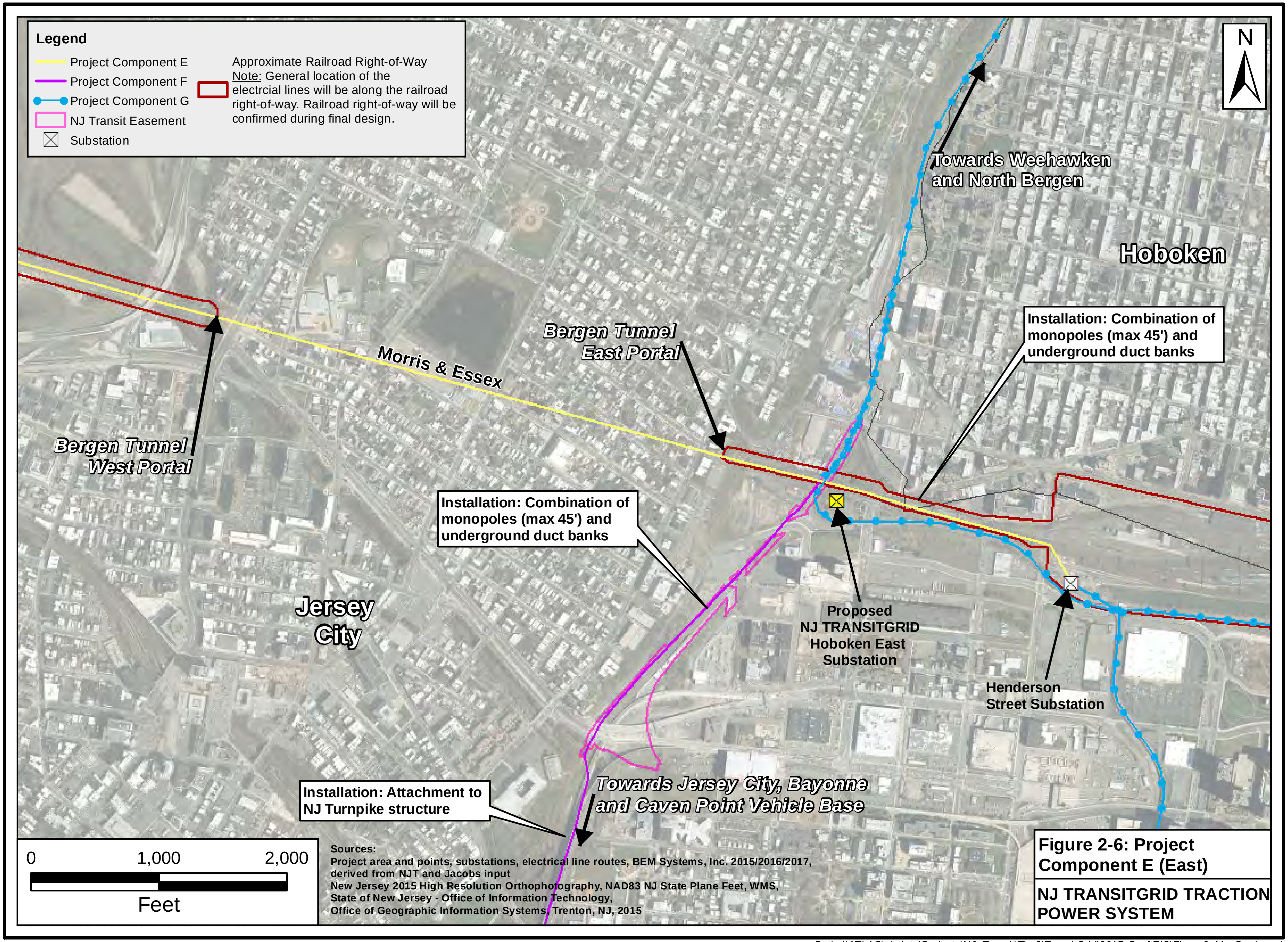

Figure 2-6: Project Component E (East)

NJ TRANSITGRID TRACTION POWER SYSTEM

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Sources:
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New Jersey 2015 High Resolution Orthophotography, NAD83 NJ State Plane Feet, WMS, State of New Jersey - Office of Information Technology, Office of Geographic Information Systems, Trenton, NJ, 2015

Figure 2-7: Project Component F

NJ TRANSITGRID TRACTION POWER SYSTEM

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ATTACHMENT C: GEOTECHNICAL STUDY

Introduction

At the behest of Richard Grubb Associates (RGA) a study was conducted of the soils and geomorphology at the site of a proposed NJ TRANSIT development project (NJ TRANSITGRID TRACTION POWER SYSTEM) in the Town of Kearny, Hudson County, New Jersey. The area which is the focus of this study – slated as the location of a proposed power plant and lying between Proposed Buildings 3 and 4 – constitutes one portion of the overall proposed project area; this sub-area is referred to in this report as the APE (Area of Potential Effect). The overall proposed project area and nearby environs are referred to as the study area. The setting of the study area is a former industrial district on the right bank of the Hackensack River within the southern part of the Hackensack Meadowlands.

This study was conducted through analysis of 35 logs of previously conducted soil borings; no fieldwork was conducted as a part of the study.

Setting

The study area is located in the southern part of the Hackensack Meadowlands, an extensive area of brackish marshland and tidal estuary on the eastern and western banks of the Hackensack River in northern New Jersey. The setting of the APE is the right bank of the Hackensack River at the point of inception of the upstream reach of a large meander bend. The setting also lies a short distance downstream from the apex of an adjacent large meander bend. South and east of the APE, a large, narrow meander bend point bar extends for several thousand feet to the east.

The Meadowlands, bounded to the south by Newark Bay, comprise approximately 3360 hectares of very low relief landscape on the floor of the Hackensack River valley and is vegetated largely by phragmites. The Meadowlands is drained by the Hackensack River and its tributaries such as Mill, Bellmans, and Penhorn creeks, supplemented by excavated drainage channels of Historic age. The Passaic River enters the Hackensack River valley 2.5 miles west of the study area and joins the Hackensack River 2 miles downstream from the study area, at the head of Newark Bay.

The Hackensack Meadowlands lies within the Newark Basin portion of the Piedmont physiographic province of New Jersey. The Newark Basin is a northeast-trending Late Triassic-Early Jurassic rift basin filled with a thick sequence of Late Triassic sedimentary and Early

Jurassic intrusive igneous formations, each of which underlies the two major geographic features of the region, the Hackensack River valley and the Bergen Ridge. The Newark group of sedimentary deposits includes relatively soft, reddish brown shales and fine-grained sandstones that have eroded to form low-lying areas such as the Hackensack River valley and adjacent lowlands. More resistant diabase and basaltic sills and lava flows provide some topographic relief to the landscape, the largest of which includes the Palisades. The Bergen Ridge, a diabase outcrop which forms the lower southern end of the Palisades Sill, is a significant geologic feature within the county, as are Little Snake Hill and Laurel Hill. All three of these topographic features consist of a dark gray to black, fine- to coarse-grained diabase. The project area is located just southwest of Laurel Hill and Little Snake Hill and 2 miles west of the Bergen Ridge.

Quaternary History of the Meadowlands Region

Based on the known limits of Pleistocene glaciation to the west, the area now occupied by the Hackensack Meadowlands has been near or within the furthest extent of continental glacial ice three times over the last 2.4 million years. The most recent glacial advance to reach the area was that of the Late Wisconsinan (Woodfordian Stage), which reached its maximum extent at Perth Amboy, just south of the study area, between 20,000 and 22,5000 years BP. It is noted here that researchers are not in agreement on the exact timing, sequence, and mechanics of the events at the last glacial maximum and in the early stages of ice recession. Views on the timing of events such as release of water from glacial lakes may differ by thousands of years and there may be disagreement as to whether events such as certain glacial re-advances did in fact occur. The reconstruction given below attempts to integrate differing views but is by no means comprehensive.

The effects of continental glaciation go far beyond even the vast surface manifestations of erosion and deposition. Because immense volumes of global water were temporarily contained in world-wide continental ice masses at the last glacial maximum, eustatic sea level fell by as much as 410 feet (125 m) (Fairbanks 1989) and the exposed coastal plain in the area of New York City and northern New Jersey extended as much as 60 miles east of the present shoreline.

In the latter phase of the Wisconsinan glaciation, advancing glacial ice scoured the relatively soft sedimentary Newark Group rock from the ancestral Hackensack and Passaic River valleys and the Stockton Group from the lower Hudson River valley, while overriding and rounding the more resistant diabase of the Bergen Ridge, Laurel Hill, and Little Snake Hill. The scouring incised the Passaic River valley to as much as 100 feet below modern sea level (Stanford 1993) and the west side of the Hackensack River valley to as much as 300 feet below modern sea level (Stanford and Harper 1991). The resulting over-deepened trough of the Hackensack River valley in the vicinity of the current study area is bounded to the east by the diabase of the Bergen Hills and to the west by resistant sandstone and conglomerate of the upper Passaic Formation which forms the low, linear ridge on which the towns of Harrison, Kearny, and North Arlington are located.

A broad, high, continuous terminal moraine formed at the ice limit, a product of on-going delivery of sediment-laden ice to the wasting ice front. In the general vicinity of the current study area, the disparate remnants of the moraine make up an axial ridge on Staten Island, the long, high ridge of the Harbor Hill Moraine on Long Island, and are visible as prominent landforms in Perth Amboy and Metuchen. Recession of the ice margin from the Perth Amboy area commenced at around 20,000 BP (Stanford and Harper 1991). The resulting meltwater was confined between the terminal moraine and the receding ice front and formed a series of transient proglacial lakes which filled the scoured troughs of the Passaic, Hackensack, and Hudson River valleys. As the ice mass continued to recede to the north, low points in the ridges separating the parallel troughs were exposed and served as spillways, allowing water to move from one lake to another and ultimately to flow through eroded breaches in the moraine. The transitioning boundaries and water levels of the proglacial lakes over time is reflected in the names applied to the lakes.

The initial lake, which occupied the Arthur Kill, Newark Bay, and the upper New York Bay lowlands, has been designated Lake Bayonne. Waters of Lake Bayonne overtopped the moraine and created an outlet to the coastal plain at what is now the Richmond Valley on Staten Island and later near Perth Amboy in the position of what is now the Arthur Kill (Stanford and Harper 1991). Ongoing erosion of the outlet at Perth Amboy allowed creation of an outlet channel within what is now the Arthur Kill. At Tremley Point, the channel downcut through till, outwash, and recently deposited lake sediments until it encountered the diabase sill that forms the Bergen Hills and the Palisades. Downcutting of the outlet was effectively stopped at that level and the lake level stabilized upstream in the Hackensack trough, including the current study area. The proglacial lake which subsequently occupied the trough is referred to as Lake Hackensack.

Subsequent exposure of an outlet at Hell Gate allowed lowering of the lake level in the Hudson River valley, differentiating the meltwater body there as Lake Hudson. The water level in Lake Hudson was about 40 feet lower than that in Lake Hackensack and over time a spillway was eroded between the two bodies along the present course of Kill Van Kull, allowing some drainage from Lake Hackensack to Lake Hudson.

Throughout this period, silts and clays flushed from the glacial sediments within and under the ice were carried in suspension into the body of the lake while the coarser sediments – fine, medium, and coarse sand and rock fragments varying in size from gravel to boulders – formed deltas along the ice margin and at points where water drained in from smaller neighboring glacial lakes. The suspended silts and clays settled to the lake bottom in a near constant rain, forming varves. The classic varve consists of a couplet of thin to very thin light and dark strata with the light, slightly coarser-textured layer usually deposited in summer during accelerated ice melt. During winter months, when sediment input is reduced, fine clay-size sediment drops from suspension, forming the dark colored layers. In addition to seasonal variation of sedimentary processes and deposition, varve formation requires the absence of bioturbation and a relatively still depositional environment.

Eventually, ice recession northward up the Hackensack trough exposed a water gap at Sparkill, 21 miles north of the current study area, allowing relatively complete drainage of Lake Hackensack into the lower Hudson Valley (Stanford and Harper 1991). Averill et al. state that drainage took place both through the lowlands near Jersey City and through the Sparkill Gap, though they note that because of the isostatic tilt to the north most of the drainage was through the gap (Averill et al. 1980). Precise timing of the opening of the Sparkill Gap is uncertain but Stanford and Harper place it at or somewhat earlier than 17,000 radiocarbon years BP. This chronology in turn indicates that Lake Hackensack persisted for between 2000 and 3000 years, slowly expanding northward as the ice front receded. This range of age is supported by the counts of varves exposed in early 20th century clay pits at Little Ferry (Antevs 1928) and New Durham (Reeds 1933). Following drainage of Lake Hackensack, a smaller postglacial lake or set of lakes persisted on the lowest parts of the lake floor (Averill et al. 1980; Stanford and Harper 1991). Averill et al. describe a dynamic sequence of events including a minor readvance of glacial ice into the north end of the Hackensack Valley (following an interstade of approximately 1000 years), with the combined effects of moraine formation, meltwater production and isostatic tilt producing several smaller lakes. These smaller post-glacial lakes shallowed and tapered out to the south in the area of the base level dam formed by the isostatically elevated surface; south of Moonachie, 6 miles north of the current study area, the Lake Hackensack bed was exposed sub-aerially and subject to desiccation in the period following lake drainage (Stanford and Harper1991).

The presence of the enormous weight of a continental ice mass causes the surface of the Earth's crust to deform and warp downward, forcing the fluid mantle material to flow away from the loaded region. As the load is removed by ablation of the ice mass, the removal of the weight from the depressed land allows uplift or rebound of the surface (isostatic rebound) and the return flow of mantle material back under the deglaciated area. Due to the extreme viscosity of the mantle, it takes many thousands of years for the land to reach isostatic equilibrium, returning to more or less its pre-glacial state. Because of its position near the ice margin, the current study area was subject to crustal depression while the area to the south, beyond the glacial margin, was not and in fact may have experienced some uplift due to a forebulge effect.

The result of the crustal depression in northern New Jersey was that surface drainage in the Hackensack and Passaic valleys following exposure of the Lake Hackensack bed was temporarily reversed from its pre-glacial form. The smaller, shallow post-glacial lakes on the former lake bed drained to the north and through the Sparkill Gap (Averill et al. 1980; Stanford and Harper 1991), as did streams formed by runoff from the flanking uplands, all incising channels into the lake-bed silts and clays. The upstream reaches of the post-glacial Passaic River flowed east from the Garfield area to the Hackensack area, then followed the Hackensack Valley north to the same gap (Stanford 1993). Sandy post-glacial alluvium was deposited over the lake bottom sediments within and along these north- and northeast-flowing streams, including the Hackensack River. This sandy deposit laid down adjacent to the channels during the period of drainage toward the Sparkill Gap has been designated the Oradell terrace (Stanford and Harper 1991).

Drainage reverted to its pre-glacial north-south pattern as isostatic rebound slowly raised the north end of the basin, commencing by around 13,000 BP (Averill et al. 1980; Stanford and Harper 1991; Stanford 1993, 1996). Averill et al. set the earliest possible date for establishment of through-flowing southward drainage in the Hackensack River system at 11,000 years BP but note that it possibly occurred several millennia later than that (Averill et al., p 181). The initial stage of drainage reversal would have resulted in a renewed period of ponding on the low-relief former lake bed, producing freshwater swamp deposits overlying the desiccated surface clays in parts of the south-central and southern end of the Hackensack drainage (Stanford 1993; 1996). As reversal proceeded and the south-flowing drainage system became more well-established, sandy near-channel overbank deposits formed an alluvial terrace system similar to the Oradell terrace and consisted in part of material reworked from the Oradell terrace; these deposits are designated the Moonachie terraces in the Hackensack River system and the Lower Passaic terrace in the Passaic River drainage (Stanford and Harper 1991; Stanford 1993). Stanford and Harper (1991) reference a section described by Salisbury in a clay pit at Little Ferry that consisted of 8 feet of stream terrace sand over 2 to 3 feet of organic silt, sand, and clay with fragments of leaves and stems, in turn overlying laminated clay (Salisbury 1902). Stanford and Harper interpret this profile to reflect deposition of the Moonachie terrace sands over freshwater swamp deposits produced by ponding associated with the drainage reversal, all overlying the silts and clays of the Lake Hackensack bed.

By the Late Holocene ongoing post-glacial sea level rise slowly inundated the Hackensack River valley, including the current study area. The result was a transition over roughly a 3000 year period from a terrestrial environment to fresh-water swamp to an estuarine setting and finally to tidal marsh, particularly at the southern end. Radiocarbon dating of basal peats has generally put the inception of this process at around 3000 years ago, though a mid-Holocene date for the base of the peat column has been reported from North Arlington (Thieme and Schuldenrein 1996).

Previous Research within the Hackensack Meadowlands

A number of archaeological compliance projects as well as geoarchaeological, palynological, and geomorphological research projects have been carried out in the Hackensack Meadowlands. The synthesis below touches on some of the results of this research but is by no means intended to be comprehensive.

Some of the first work related to reconstruction of the Holocene environment was the investigation of a former cedar bog near Secaucus (Heusser 1949). Heusser's study employed macrofossil analysis on a column of peat to track plant (particularly tree) species succession from the onset of bog formation. In a follow-up study reported in 1963, Heusser sampled the Secaucus bog and two additional locations and obtained a radiocarbon date of 2025+/-300 yr BP from the base of a 3.3 m core at the Secaucus site (Heusser 1963). The cores from the 1963 study were subjected to both macrofossil and pollen analysis, employing the pollen zone system based on Deevey (1939, 1943, and 1958). Heusser's 1949 work showed that black ash was common at the base of the core, giving way to larch and spruce in the middle and white cedar – including whole tree trunks – in the upper portion. This succession was primarily attributed to rising water levels and increasing salinity over the last two millennia. Plants adapted to brackish water first appeared at a depth of six feet, within the larch and spruce forest. Pollen analysis in the 1963 study showed that alder and birch pollen were dominant in the lowest levels of the peat but that the fibrous mass of the basal peat was dominated by sedge. In the overlying cooler zone C3b, spruce was more common, confirming observations in the 1949 study. A presumably milder, late Holocene interval (C3b1) was identified during which white cedar invaded the area. Based on the radiocarbon date and 3.3 m thickness of the peat overlying lake clays, Heusser posited a 3 m rise in sea level over the last 2000 years.

Subsequently, Carmichael conducted pollen, spore, macrofossil, and foraminifera analysis on a 3.8 m core of peat from a sampling location 20 m west of the Hackensack River channel near the New Jersey Route 3 crossing of the Hackensack River, 6 mi north of the current study area. In addition to palynological information, the core yielded a radiocarbon date reported as 2610+/-130 yr BP from the contact with gray basal clay at the base – closely correlating with the date at Heusser's Secaucus site, 1.2 mi to the southeast – and a date of 2060+/-120 yr BP from a depth of about 2.8 m bs (Carmichael 1980). Birch was again prominent in the earliest peat. Subsequent changes (reflected by seven different plant assemblages) were ascribed to oscillating tidal influence, which became steadily more significant after about 1800 BP.

An east-west transect of borings was conducted in 1982 almost directly across the Hackensack River from the current study area, on the inside of a large meander bend (Historic Sites Research 1982, reported in Hunter Research, Inc. et al 2006, pp 1-5, 1-6). The transect extended from the east bank of Penhorn Creek to the Hackensack River and revealed profiles of up to 10 feet of peat and silt overlying clay. The upper 15 feet of peat, silt, and clay was interpreted to have accumulated over the last 2000 years while "(d)eeper clay deposits, down to

26 feet may be up to 5000 years old and reflect earlier deposition in this lower portion of the drainage"

In 1991-1992 Grossman and Associates, Inc. produced two map-based studies of prehistoric and historic archaeological sensitivity for the Meadowlands (Grossman 1991, Grossman and Associates, Inc. 1992a). The reports included a series of overlay maps incorporating a range of data from historic maps and other sources. The sources included a Civil War era map record of mud depths which suggested that the pre-marsh topography of the Meadowlands was not flat, but in fact varied in elevation with a range of as much as 30 feet near the Hackensack River channel. Using 19th-century topographic data, Grossman georeferenced the 19th-century mud-depth bathymetric readings and plotted the known depth of marsh deposits over the entire Meadowlands for the first time (Grossman and Associates, Inc. 1994: Figure 5b). The base of the marsh deposits was taken as marking the ground surface prior to inundation in the last few millennia. By relating this data to currently understood levels of sea level rise, Grossman and Associates delineated shifting shoreline levels through time as the sea level rose.

Geoarchaeological studies were conducted in the Meadowlands by Geoarcheology Research Associates in the early 1990s (Schuldenrein 1995; Thieme and Schuldenrein 1996). Schuldenrein 1995 describes the detailed stratigraphy from a boring adjacent to Bellman's Creek (NC-04) near Carlstadt. One meter of fluviatile sand encountered beneath approximately 2 m of peat or meadow mat was interpreted as localized deposition perhaps related to higher-energy inundations at the Bellmans Creek/Hackensack River confluence (Schuldenrein 1995) prior to inception of marsh formation. The fluviatile sands were underlain by limnic and organic clays. A date of 930+/-50 BP was obtained from a depth of 1.1 m bmsl within the meadow mat near Bellman's Creek (Schuldenrein 1995). A "very tentative assignment of an Early Holocene date" was assigned to the fluviatile sands "predicated on the stratigraphic ordering of the unit between the [underlying] lacustrine unconformity and the earliest dated peats at North Arlington at ca. 5500 BP" (Schuldenrein 1995).

The mid-Holocene date on the basal peat at North Arlington referred to in Schuldenrein 1995 is reported in Thieme and Schuldenrein 1996. In this study, conducted along the western boundary of the Hackensack Meadowlands, a date of 5030+/-160 yr BP was obtained from a depth of 3.0-3.7 m in an area where the transition from peaty material to varved clays occurs at 3.7 to 5.2 m (Thieme and Schuldenrein 1996).

Numerous authors (e.g., Heusser 1963; Carmichael 1980; Thieme and Schuldenrein 1996; Thieme 2003) make reference to a problematic gap in the sediment record of the Hackensack Meadowlands. Although sandy or silty deposits have been reported overlying the lake-bed clays (e.g., Heusser 1949; Schuldenrein 1995; Rue and Traverse 1997) these appear to be limited in lateral extent and thickness. In many cores obtained throughout the area, organic-rich estuarine marsh deposits directly overlie the varved clays of the Lake Hackensack bed. The marsh deposits – saturated, decomposed organic material containing varying amounts of silt and clay and described variously as meadow mat, peat, or organic muck – have yielded numerous radiocarbon dates, most pointing to formation over the last 2000-3000 years. Carmichael reported a date of 2610+/-130 yr BP from the contact with gray basal clay at the base of a 3.8 m core of peat and a date of 2060+/-120 yr BP from a depth of about 2.8 m bs (Carmichael 1980). Carmichael's sampling location was 20 m west of the Hackensack River channel near the New Jersey Route 3 crossing of the Hackensack River, 6 miles north of the current study area. Heusser had earlier obtained a date of 2025+/-300 yr BP from the base of the peat at a depth of 3.3 m (Heusser 1963) in a former cedar bog near Secaucus, 1.2 miles ESE of Carmichael's sampling site. As noted above, a date of 930+/-50 BP has been reported from a depth of 1.1 m bmsl from within the meadow mat near Bellmans Creek at Carlstadt (Schuldenrein 1995) and a date of 5030+/-160 yr BP was reported for the base of the peat deposit at a depth of 3.0-3.7 m bmsl at North Arlington, 2.4 miles northwest of the current study area (Thieme and Schuldenrein 1996).

Several hypotheses have been advanced to explain the relative lack of early and middle Holocene sediments in the Meadowlands. Heusser posited a mid-Holocene marine transgression that eroded any previously-emplaced alluvium and was followed by a regression that allowed the development of freshwater swamps and bogs before the late Holocene development of estuarine conditions (Heusser 1949, 1963). Carmichael supports the idea of erosion by a marine transgression but also puts forth the possibility of fluvial erosion of the surface by broad, south-flowing channels formed in the lake clays, noting that "this fluvial erosion must have necessarily encompassed large areas, for previous studies indicate the presence of clay (blue mud) under peat at depths comparable to this site" (Carmichael 1980). Averill et al., in describing the reestablishment of south flowing drainage in the Hackensack River system following isostatic rebound, state that in that period erosion dominated throughout the valley (Averill et al. 1980).

They place the reestablishment of the through-flowing south drainage at a maximum date of 11,000 years BP but note that it possibly occurred several millennia later (Averill et al. 1980).

Previous Research In and Near the Current Study Area

A geomorphological assessment of a broader study area adjacent to the APE was conducted in 2010 and was carried out to reconstruct the geomorphic history and, insofar as possible, environmental history of the study area. That assessment entailed examination of 60 boring logs recording the stratigraphy of borings previously conducted on the Standard Chlorine (SCCC), Diamond, and Seaboard sites, all located just north of the APE. Those boring logs revealed a generalized site-wide profile consisting of four stratigraphic units: 1) 6 to 10 feet of man-made placed fill; 2) 3 to 7 feet of estuarine marsh deposits (meadow mat or peat); 3) 3 to 8 feet of sand-dominated alluvium and; 4) varved glacial lake bed sediments. The profiles were subsequently compared to those reported in local well logs and archaeological, palynological, and geoarchaeological studies conducted in the Meadowlands over the last seven decades. The comparison allowed the study area stratigraphy to be placed within a wider context and allowed radiocarbon and palynological data from the other study sites to be extrapolated to the current study area.

The assessment found that the laterally expansive sandy alluvium underlying the SCCC and Diamond sites and nearby environs is not characteristic of the Meadowlands in general. The presence of the sandy alluvium layer in the borings indicates that the study area was a depositional setting during a period in the Early to Middle Holocene. As noted previously, other studies have found that the Meadowlands was generally subject to erosion and was a non-depositional setting in this period. The sandy alluvial layer found in the current study area indicates that this area was a depositional setting. The small amount of additional surface elevation resulting from this deposition, along with the enhanced drainage resulting from the presence of the sandy alluvium, may have produced an attractive habitation setting. The desirability of the setting as a habitation site would have increased in the Late Holocene as much of the surrounding area began to be inundated by sea level rise. If this is the case, the area would have constituted a terrestrial peninsula – perhaps vegetated in sedge, grass, and birch – projecting east from the southern end of the higher Harrison-Kearny-North Arlington ridge and surrounded on the north, south, and east by the developing marsh. If this is the case, this area – near the confluence of two major local drainages and providing access to estuarine resources – would seem to have been an attractive habitation setting. Therefore, the geomorphological assessment concluded that the potential for the presence of in-situ prehistoric cultural material existed throughout the 3 to 8 feet of sandy alluvium in the study area.

Following the data-based 2010 geomorphological study, archaeological monitoring was conducted during the excavation and construction of a slurry wall at the former SCCC and Diamond sites. The monitoring consisted of archaeological sampling of the sandy alluvial stratum and resulted in recovery of lithic debitage at several locations, with most artifacts recovered in proximity to the Hackensack River channel.

Despite the proximity of the SCCC and Diamond study area to the Hackensack River, Stiteler (2010) proposed that the packet of sand-dominated sediments beneath the meadow mat was predominantly a product of deposition by the Passaic River, with lesser inputs of alluvium from the Hackensack River. The Passaic River drainage basin comprises 935 square miles and much of the headwaters area is characterized by rocky outcrops of shale, sandstone, and igneous rock or regions of thin glacial soils that together result in poor drainage and locally impervious areas (Weisberg and Marchisin 1980), resulting in high runoff. The river and its tributaries have gradients as high as 1:3 to 1:100 in the northwest half of the watershed (Weisberg and Marchisin 1980) and even in the much flatter reaches of the lower watershed, just upstream from the study area, the main stem falls 25 feet over 15 river miles from Riverside to Harrison. The Hackensack River by contrast, has a low relief drainage basin comprising 202 square miles and falls less than 10 feet over 15 river miles from just below the Oradell Reservoir to the meander bend at the study area. The Passaic River thus carries much larger volumes of water, has a great propensity for flooding (Weisberg and Marchisin 1980), and has a greater competency to transport sand. The drainage basin contains a ready supply of sand and gravel in Lake Bayonne deltas which the trunk stream and its tributaries incise. Over much of its course, the channel of the Passaic River is relatively confined laterally. In the reaches just upstream from the study area it is confined by the Lake Bayonne deltas to the west and the sandstone and conglomerate ridge occupied by Lyndhurst, North Arlington, and Kearny on the east. Immediately west of the study area, the river swings 90 degrees to the east and passes between Newark and Harrison through Lake Bayonne delta and post-glacial Lower Passaic terrace deposits which also serve to confine the channel. At that point the channel enters the unconfined Hackensack lowlands and during high flow events prior to the inception of late Holocene sea level rises would have been able to spread across the former bed of Lake Hackensack, depositing its sediment load.

A Passaic River rather than the Hackensack River source for the sand-dominated sediments is supported by the distribution of the sands. Logs of wells and borings from NJGS OFM13 and NJGS OFM20 indicate that the sands are confined to the area between the Passaic and Hackensack River channels and do not extend to the east side of the Hackensack River. Logs 162, 163, 164, and 165 of NJGS OFM13, from borings on the Hackensack River meander bend point bar opposite the current study area, depict profiles consisting of almost entirely of clay from the base of estuarine muds at 8 to 13 feet bgs to gravel or shale bedrock at 50-60 feet bgs.

An east-west sampling transect across the point bar from Penhorn Creek to the Hackensack River opposite the study area revealed profiles of up to 10’ of peat and silt overlying clay (Historic Sites Research 1982, reported in Hunter Research, Inc. et al 2006, pp 1-5, 1-6). Absence of sand in what would typically be a depositional setting on the inside of the meander bend at the study area appears to support the premise that there is a relative dearth of sand in the sediment load of the Hackensack River or that the river is incapable of moving sand out of its channel. Sediment transported across the combined Passaic River/Hackensack River floodplain by overbanking flows of the Passaic River would be intercepted by the Hackensack River channel and transported downstream and thus would not appear in the sediment profiles on the east side of the Hackensack River opposite the study area.

Results of the Current Study

Numerous borings have been conducted in the overall NJ TRANSITGRID TRACTION POWER SYSTEM project area, though relatively few are located within the boundaries of the APE itself. The majority of the borings were conducted under the supervision of BEM Systems, Inc.; the remainder were conducted under the supervision of THEP (THE Partnership). The logs themselves and the figures showing their precise locations are proprietary material and are not reproduced here.

Logs of 77 borings conducted within the overall project area were initially examined for this study. Of these, 35 logs were found to contain information relevant to the study. Logs of the remaining 42 borings were dismissed, as the borings were deemed too shallow for the data to be of use. Many of these shallow wells were installed for the purposes of contaminant sampling and shallow groundwater monitoring. These borings and wells did not penetrate to the depth at which the sandy stratum might be encountered.

Logs supplying data used for this study include: B-KYWW1 through B-KYWW5, along with B-KYWW7 through B-KYWW9; B-KYEW1 through B-KYEW7, B-KYEW9, B-KYEW10B, and B-KYEW14B; MWKY1D, MWKY3D through MW-KY6D, MW-KY9D and MW-KY10D; KYSPB03 through KYSPB05; and PE 230KY through PE 233KY and PE 235KY through PE 237KY.

Those borings and wells deemed too shallow to be pertinent to the study were BEM borings KYCTDE01 through KYCTDE06; KYC03 through KYC18; B-KYEW8A, B-KYEW11 through B-KYEW13, and B-KYEW15; MWKY2D and MW-KY8D and monitoring wells MW-KY1S through MW-KY13S.

To the extent possible, the following discussion describes the logs of borings beginning at the western end of the overall NJ TRANSITGRID TRACTION POWER SYSTEM project area and progressing east.

Among the most instructive and pertinent logs are those of seven borings and wells that form a transect approximately along the western edge of the overall project area (Western Barrier Wall transect). This transect lies 1000 feet northwest of and parallel to the western boundary of the APE. The transect runs northeast to southwest from the edge of the Hackensack River channel to the distal edge of the overall proposed project area and comprises borings B-KYWW1 through B-KYWW5 along with a deep well, MW-KY-6D. These logs closely resemble profiles recorded in borings throughout the study area landform (those previously examined for the SCCC/Diamond study) and consistently record the presence of 3 to 4.5 feet of sandy alluvium across the 1000 foot length of the transect. The upper boundary of the sandy alluvium along the transect lies at a general elevation of 16 to 17 feet below the modern surface; the lower boundary, overlying varved lake clays, lies at 20 to 21 feet below surface. Over the length of the transect the sandy alluvium is directly overlain by 4 to 5 feet of peat and organic-rich silty estuarine deposits and 11 to 12 feet of fill.

Borings B-KYWW7 and B-KYWW8 were located 100 and 200 feet, respectively, east of the Western Barrier Wall transect, 800-900 feet west of the APE, and 800 feet from the Hackensack River channel. The logs of these borings reflected the general pattern described above. In each, approximately four feet of sandy alluvium was overlain by four feet of peat and eight feet of fill. The log of THEP boring PE 230KY, located near B-KYWW7, recorded 8 feet of fill and 3 feet of peat, overlying 5 feet of sandy alluvium from 11 to 16 feet below surface.

Boring B-KYWW9 was located 100 feet east of the western wall transect and approximately halfway between the Hackensack channel and the distal edge of the overall project area. The profile was as previously described – four feet of sandy alluvium at 15 to 19 feet below surface, overlain by 5 feet of peat and 10 feet of fill.

A deep well, MW-KY5D, was located approximately 800 feet east of boring B-KYWW7 and falls within the southwest corner of the current APE. The setting is approximately 650 feet from the Hackensack River channel. The profile was closely similar to those previously described, with a few minor variations not related to the presence or integrity of the sandy alluvial stratum. Topographic contours depicted on engineering maps and the opening elevation of the well boring suggest that the fill surface is somewhat mounded in this area and extends to approximately 19 feet below surface. The peat layer as recorded in the log is thinner than that in most other borings in the study area (<1 foot). This may reflect truncation of the meadow mat before the deposition of fill or compression of the organic material by the thicker fill cap. A layer of sandy alluvium was present from 20 to 24 feet below surface, overlying varved lake clays. THEP boring PE 231KY was located a short distance west of MW-KY5D and appears to fall within the boundaries of the APE. The log does not identify a peat layer, although the presence of wood and organics is noted in the lower few feet of a 15 foot thick layer of fill. The fill is depicted as directly overlying 3 feet of sandy alluvium from 15 to 18 feet below surface. According to opening elevations recorded on the boring logs, the surface of fill at MW-KY5D rises 6 feet above that at THEP boring PE 230KY, suggesting that the sandy alluvium lies at roughly the same absolute elevation at the two boring locations.

THEP boring PE 232KY was located in the eastern end of the APE. The log appears to depict the presence of fill to 15 feet below surface, directly overlying sand which extends to 20 feet below surface. The presence of peat immediately above the 5 foot-thick sand stratum is not recorded in the log; however three 2-foot advances of the spoon, from 6 to 12 feet below surface, were accomplished using only the weight of the hammer and recovered no sample. The advance from 12 to 14 feet was also accomplished by weight of hammer and recovered material that appears to have slumped from the fill above. Given the ease with which the spoon was advanced, peat may have been present but not retrieved by the spoon.

Well borings MW-KY4D and MW-KY9D were located 300-400 feet east of the southeastern and northeastern corners, respectively, of the current APE. The log of MW-KY9D, located on the right bank of the Hackensack River, recorded a profile much like that seen throughout much of the broader study area: 12 feet of fill overlaid 5 feet of peat and approximately 6 feet of sandy alluvium. Varved lake clays were recorded at around 23 feet below surface.

The log of MW-KY4D, outside the southeast corner of the APE, records the presence of fill to around 19 feet below surface; glass and brick were recorded between 17 and 19 feet below surface. Beneath the fill was a truncated layer of sand (5-6 inches) overlying lake clays. No peat was recorded in the log. According to a draft site plan included in a Phase IA archaeological survey report prepared by RGA (RGA 2016, Appendix B), this boring is in proximity to a buried medium pressure gas line. Removal of the peat and truncation of the sand layer may be related to trenching for this line.

Borings KYSPB03, KYSPB04, and KYSPB05 formed an east-west transect running east of MW-KY4D, spanning around 800 feet. The profiles depicted in the logs are typical of the study area landform, consisting of a fill/peat/sand/lake clay sequence. Thickness of the fill was generally 14 to 15 feet; thickness of the peat was generally 4 to 5 feet. The sandy stratum was consistently 4 feet thick, as seen throughout much of the study area.

The log of well boring MW-KY3D, extends this transect another 300 feet to the east and records an "intact" profile as seen elsewhere on the landform, consisting of 13 feet of fill over 2.5 feet of peat and 4 feet of sandy alluvium, all overlying varved lake clays. The log of well boring MW-KY1D, 500-600 feet south of MW-KY3D, records a similar intact fill/peat/sand/lake clay profile.

Borings KYEW-1 through KYEW-15 formed a transect running roughly north-south at along the eastern boundary of the overall NJ TRANSITGRID TRACTION POWER SYSTEM project area (East Barrier Wall transect). The transect lies approximately 1000 feet east of the current APE. Of these well borings, the points of termination in KYEW-8A, 11, 12, 13, and 15 were considered too shallow to add to this study. Logs of the remaining borings in the transect (KYEW-1, 2, 3, 4, 5, 6, 7, 9, 10B, and 14B) appear to depict a large area of subsurface that was subjected either to engineering disturbance or to scouring by channelized overbank flows prior to the introduction of fill. The stratum of sandy alluvium recorded throughout much of the study area landform is absent from these logs. The general pattern of the logs consists of fill ranging in thickness from 16 to 23 feet, overlying mixed peat, sand, silt, and clay directly overlying varved lake clays. The mixed zone generally extends to depths of 22 to 26 feet below surface but in the case of KYEW-2 extends to 33 feet below surface. Presence of a small amount of fine to medium gravel in some of the mixed zones suggests flood scouring rather than mechanical disturbance in this area. Well boring MW-KY10D, near the mid-point of this transect, also records deep fill (to 25 feet below surface), overlying mixed matrix to 28 feet and varved lake clays at 28 feet below surface. Well boring MW-KY3D was located approximately 100 feet west of the south end of this barrier wall transect and, as previously noted, records an intact fill/peat/sand/lake clay sequence.

THEP borings PE 235KY, PE 236KY, and PE 237KY were located between the East Barrier Wall transect and the eastern end of the APE. Topographic contours of engineering diagrams indicate that the fill surface is mounded in much of this area. None of the three logs record the presence of peat or the 3 to 6 foot thick sand stratum seen in other parts of the landform. The log of PE 235KY, 475 feet west of the barrier wall transect, records 18 feet of fill overlying mixed sand, silt, and gravel to 30 feet below surface. Lake clays were encountered at 30 feet below surface. In PE 237KY, 500 feet west of PE 235KY, fill extended to 20 feet below surface and directly overlaid lake clays. The log of PE 236KY, 425 feet west of PE 237KY and 450 feet east of the APE, records that fill extended to 28 feet below surface and overlaid mixed sand, silt, and gravel to 40 feet below surface.

Discussion and Interpretation

Previous research of the northern half of the study area landform (the Diamond and SCCC sites) has shown the subsurface stratigraphy to consist of (in descending order): Historic to recent fill; Late Holocene organic material (peat or "meadow mat"); sandy alluvium; and glaciolacustrine silty clay, much of which exhibits intact seasonal varves (Stiteler 2010). The sandy alluvium has been interpreted to be largely a product of deposition by the Passaic River – with smaller inputs by the Hackensack River in the areas immediately proximal to its channel – and to be of Early through late Middle Holocene age (Stiteler 2010). The stratum of sandy alluvium ranges in thickness from 3 to 8 feet; the upper boundary of the sandy alluvium lies at a general elevation of 10 to 16 feet below surface. Lithic debitage was recovered from within the sandy alluvium at several locations in the combined SCCC and Diamond sites, with most artifacts recovered in proximity to the Hackensack River channel.

Logs of 35 borings from throughout the proposed NJ TRANSITGRID TRACTION POWER SYSTEM project area were reviewed for this study. Relatively few boring logs from the APE itself were available for review; most of the logs which were examined bracket the APE to the east and west. Review of the boring logs indicated that the stratigraphic sequence described above extends into the western and central portion of the proposed NJ TRANSITGRID TRACTION POWER SYSTEM project area, including at least part of the APE. The boring logs indicate that the stratum of sandy alluvium with the potential to contain prehistoric cultural material is present in the western end of the overall project area, including at least part of the APE. Logs of borings along and just east of the Western Barrier Wall transect at the west end of the project area all record the fill/peat/sand/lake clay stratigraphy seen in the SCCC and Diamond sites just to the northwest.

Logs of borings that fall within the southwest and southeast parts of the APE (MW-KY5D, PE 231KY, PE 232KY) all record the presence of the intact sand stratum; in all of these profiles the peat layer appears to be present but truncated. No logs depicting the stratigraphy of the northern half of the APE were available for review and no conclusions can be drawn about the presence or absence of the sandy alluvial stratum in that area.

The results of borings east of the APE suggest that this area, extending to the eastern end of the overall project area, was disturbed or scoured prior to the introduction of fill. The stratum of well-sorted sandy alluvium and the stratum of peat is absent in this area. Throughout this zone, fill directly overlies mixed sand, silt, and clay, with some inclusions of peat and fine gravel. In at least one instance (PE 235KY) fill directly overlies varved lake clays. Near the southeast corner of the APE, the log of MW-KY4D records an absence of peat and a highly truncated sand stratum.

A possible explanation for the anomalous stratigraphy of the eastern project area is scouring and reworking by flow in a chute cutoff before fill was deposited over the point bar surface. Chute cutoffs occur during high flows on rivers when overbanking floodwater forms a temporary channel flowing across a point bar surface, essentially a “short-cut” for floodwater moving downstream. If this is the source of the stratigraphic disturbance, the mixed sand, silt, clay, peat, and gravel recorded in the logs may be channel fill deposited in the waning stage of the event or events and may be a mixture of material carried by the Hackensack River at flood stage and reworked material from the upper stratigraphy of the point bar. No logs of wells or borings in the northeast quadrant of the APE were available for examination. However, the log of well boring MW-KY9D, near the Hackensack River channel at a point 300 feet east of the northeast corner, appears to record intact stratigraphy. This suggests the possibility that – if in fact the disturbed nature of the eastern stratigraphy is the result of scouring by a chute cutoff – the point of origin of the chute may be along the channel edge in the eastern half of the APE, with the erosive water moving east-southeast across the point bar toward a point just downstream from the apex of the meander bend. Intact profiles in MW-KY3D, in the southeast corner of the overall project area, and in MW-KY1D, 500-600 feet to the south, suggest that whatever the source of the disturbance it was confined roughly to the eastern end of the project area and does not extend south of it.

Conclusions

Stratigraphy of the landform on which the NJ TRANSITGRID TRACTION POWER SYSTEM project area is located has been shown previously to consist of a sequence of fill, peat (meadow mat), sandy alluvium, and glaciolacustrine silty clays. The sandy stratum, with a general thickness of 3 to 8 feet, has been demonstrated to contain prehistoric cultural material a short distance north of the NJ TRANSITGRID TRACTION POWER SYSTEM project area in the SCCC site. Profiles of borings and wells examined for this study indicate that the sandy alluvium underlies roughly the western half of the NJ TRANSITGRID TRACTION POWER SYSTEM project area, including at least the southern half of the APE which was the focus of this study. Where it was identified in the APE, the sandy stratum is 3 to 5 feet thick; the upper boundary lies at depths ranging from 15 to 20 feet below surface, with the depth largely dependent on the thickness of the overlying fill. No data were available which might be used to assess the presence or absence of the sandy stratum in the northern half of the APE. Numerous boring logs indicate that the potentially artifact-bearing sandy stratum is not present in the project area east of the APE.

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ATTACHMENT D: ANNOTATED BIBLIOGRAPHY

Author:	Sharon D. White, Ph.D., RPA
Title:	Phase IA Archaeological Survey, NJ TRANSITGRID TRACTION POWER SYSTEM, Town of Kearny, Cities of Jersey City, Hoboken, Bayonne, and Union, and Townships of North Bergen and Weehawken, Hudson County, New Jersey
Date:	June 2017
RGA Database Title:	NJ TRANSITGRID Revisions
RGA Project No:	2015-136; 2016-026; 2017-021
State:	New Jersey
County:	Hudson
Municipality:	Town of Kearny; City of Jersey City, City of Hoboken; City of Bayonne, City of Union City; Township of North Bergen; Township of Weehawken
U.S.G.S. Quad:	Jersey City, NJ; Weehawken, NJ
Drainage Basin:	Hackensack River, Newark Bay, Kill Van Kull, New York Bay, Atlantic Ocean; Hudson River, Upper New York Bay, Lower New York Bay, Atlantic Ocean
Regulation:	Section 106; New Jersey Register of Historic Places Act
Project Type:	Energy: Generation Station
Project Sponsor:	New Jersey TRANSIT; Federal Transit Administration
Client:	BEM Systems, Inc.
Level of Survey:	Phase IA archaeological survey
Cultural Resources:	Old Main Delaware, Lackawanna and Western Railroad Historic District (NJHPO Opinion: 9/24/1996); Pennsylvania Railroad New York to Philadelphia Historic District (NJHPO Opinion: 10/2/2002); Pennsylvania Railroad New York Bay Branch Historic District (NJHPO Opinion: 4/22/2005); Lehigh Valley Railroad Historic District (NJHPO Opinion: 3/15/2002); Jersey City Water Works Historic District (NJHPO Opinion: 1/20/2003); Delaware, Lackawanna and Western Railroad Boonton Line Historic District (NJHPO Opinion: 9/18/2008); Erie Railroad Main Line Historic District (NJHPO Opinion: 2/20/2003); Jersey City Water Works Pipeline (NJHPO Opinion: 5/7/1999); St. Peter's Cemetery (NJHPO Opinion: 6/18/1996); Old and New Bergen Tunnels (NJHPO Opinion: 5/8/1998); Erie Railroad Bergen Hill Tunnel [aka Long Dock Tunnel (NJHPO Opinion: 4/27/2000); Covert/Larch Historic District (NJHPO Opinion: 3/10/1999); Jersey City Reservoir 2 and 3 Complex (NR: 8/27/2012; SR: 4/10/2012; NJHPO Opinion: 10/15/1991); New York, Susquehanna and Western Railroad Engine Repair Site (28-Hd-48) (NJHPO Opinion: 1/30/2015); Standard Chlorine Chemical Company Site (28-Hd-44) (NJHPO Opinion: 5/22/2012); Morris Canal (NR: 10/1/1974; SR: 11/26/1973); Exchange Place Landfill (28-Hd-19); Fulton's Landing (28-Hd-53)