Draft Restoration Plan and Environmental Assessment for the Lincoln Park Wetland Restoration Project

Prepared by:
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Office of Habitat Conservation, and
U.S. Army Corps of Engineers, New York District
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EXECUTIVE SUMMARY

This Draft Restoration Plan/Environmental Assessment (RP/EA) has been prepared by the National Oceanic and Atmospheric Administration (NOAA) in consultation with the New Jersey Department of Environmental Protection (NJDEP) and the Hudson County Department of Parks and Recreation (HCDPR), and others. This Draft RP/EA describes the process by which the project partners identified and evaluated alternatives to restore intertidal wetlands and associated habitats in an area of Jersey City, Hudson County, New Jersey that is referred to as the Lincoln Park West Wetland Restoration Project (LPWWRP).

Working under the requirements of the National Environmental Policy Act (NEPA) and New Jersey state environmental laws, the project partners considered three restoration alternatives to produce the desired water quality and habitat benefits at the Project Area. After thorough consideration of alternatives to accomplish the goal of restoring intertidal wetlands, specifically *Spartina alterniflora*-dominated salt marsh, to as much of the site as possible, NOAA and its project partners have identified either Alternative 2.5 or 2.5.1 as a preferred alternative, with plans to implement 2.5.1 if there are sufficient funds.

The LPWWRP site is located in a highly urbanized area of the Hackensack Meadowlands within the Arthur Kill ecosystem. The site is a parcel of land approximately 40-acres in size located on the eastern shore of the Hackensack River in Jersey City, Hudson County, New Jersey. The LPWWRP site is part of the Lincoln Park Complex, a parcel approximately 270 acres in size that is owned by the HCDPR. The site lies between the Hackensack River to the west, US Highway Truck Route 1 and 9 to the south and east, and Duncan Avenue to the north, and is part of the Lincoln Park complex. The HDCPR has owned the Lincoln Park Complex since 1905 and has dedicated the property to permanent open space and recreational usage.

The Project Area was formerly used as the Lincoln Park West Sanitary Landfill. The landfill contains unclassified municipal waste, construction, and demolition materials, including household garbage, wood, bottles, ash, metal, cloth, gravel, brick, and plastic. The landfill will be closed according to an NJDEP Solid and Hazardous Waste Program Closure and Post-Closure Plan Approval received May 20, 2009, in conjunction with restoration activities.

In the past, the site was dominated by *Spartina* species; however landfill operations by Hudson County and filling associated with the US Army Corps of Engineer's (ACOE) construction and maintenance of the Hackensack River navigation channel raised the surface elevation on the site beyond all but the most extreme high tides. The site is currently dominated by common reed (*Phragmites australis*), with several small remnant salt marsh communities located along the Hackensack River. There is an approximately 10-acre, man-made lake (i.e., West Lake) that has some limited tidal exchange via a buried culvert, and there are several small stagnant ponds that are remnants of historic tidal creeks. A concrete bulkhead forms an artificial barrier between the Hackensack River and the northern half of the site. Tidal exchange is limited to a few places where the bulkhead has deteriorated. The purpose of this Project is to modify the existing degraded environment for the purpose of restoring the native salt marsh community to the Project Area.

The Lincoln Park West Wetland Restoration Project presents a valuable opportunity to combine funds, experience, and resources from a number of sources to accomplish a dynamic restoration project that will restore a significant area of coastal wetlands in the Arthur Kill ecosystem.

Since 2006, the NJDEP – Office of Natural Resource Restoration (ONRR), has served as the lead agency for the project. With assistance provided by the NOAA Restoration Center, NJDEP –ONRR has been responsible for restoration planning and project management. The NJDEP has funded the production of this Draft RP/EA and the accompanying set of Plans and Specifications. The department will provide funding from its State Natural Resource Damage Recovery Fund towards project construction.

The NJDEP and the ACOE have contributed and will continue to provide substantial resources towards this project including expertise, materials, and funds. Specifically, the NJDEP and ACOE have provided $1.2 million for a Feasibility Study and a Draft Ecosystem Restoration Report and Environmental Assessment.

The HCDPR has agreed to provide construction materials, handling facilities, and staging areas, and will continue to own and maintain the site under a conservation easement agreement to be executed with the State of New Jersey.

The HCDPR, the NJDEP, the ACOE, and the Port Authority of New York and New Jersey have partnered to provide clean sand material from an ACOE navigational dredging project for use at the LPWWRP.

NOAA, the United States Fish and Wildlife Service, the State of New Jersey, and the State of New York, who collectively serve as the federal and state Natural Resource Trustees for resources impacted by the Exxon Bayway and B.T. Nautilus oil spills, have resolved to contribute about $2.4 million dollars in civil and criminal settlement funds from those cases towards this project. The LPWWRP comports with the Trustees' mandate to utilize the Exxon Bayway and B.T. Nautilus settlement funds to implement projects that will restore tidal wetlands in the New York/New Jersey Harbor Estuary, and specifically the Arthur Kill ecosystem. Additionally, the NJDEP applied for, and is proposed by NOAA to receive, a recipient of American Recovery and Reinvestment Act (ARRA) funds as the non-federal sponsor of the Lincoln Park West Wetland Restoration Project. NOAA proposes to fund the LPWWRP with $10.6 million of the $167 million in federal ARRA funds Congress has authorized for NOAA to administer for the restoration of coastal resources.

In 2006, the project partners evaluated seven restoration alternatives using a ranking matrix. The ranking matrix allowed the Team to evaluate an alternative based on each alternative's institutional, public, and technical significance, acceptability, completeness, effectiveness, efficiency, relative risk, relative uncertainty, and opportunity cost. This Draft RP/EA retains the use of the ranking matrix but groups the original seven alternatives into three sets of alternatives; the preferred alternative, the non-preferred alternative, and a no-action alternative.

The preferred alternative restores approximately 34 acres of estuarine wetlands and open water habitats, including open water/mudflat, high marsh, low marsh, and scrub-shrub communities. The entire site would be over-excavated by approximately two-feet to remove remnant waste materials from prior land filling activities and would have approximately two feet of clean fill placed over it. The newly created marsh plains would be planted with a mix of *Spartina alterniflora* in the low marsh areas and *Spartina patens, Distichlis spicata, Juncus gerardii, Spartina cynosuroides*, and other native tidal marsh species.

Implementation of the proposed Project will alter the existing physical, ecological, cultural, aesthetic, socioeconomic, and recreational conditions of the Project Area but will not create any significant or long-term adverse impacts. There will be specific short-term temporary and minor adverse impacts associated with the proposed Project during construction.

Coordination between multiple federal, state, and municipal entities and the public has been an integral component of this Project. Input from many natural resource professionals has continually been solicited and relied upon. The public's opportunity to formally comment on the proposed project activities will commence with the publication of this Draft RP/EA. This RP/EA also addresses the permits, approvals and regulatory requirements, necessary for Project implementation.

1.0 INTRODUCTION

This Draft Restoration Plan/Environmental Assessment (Draft RP/EA) has been prepared by the National Oceanic and Atmospheric Administration on behalf of the designated natural resource trustees for the resources impacted by the Exxon Bayway and B.T. Nautilus oil spills. NOAA has prepared this document in consultation with the New Jersey Department of Environmental Protection (NJDEP), the Hudson County Department of Parks and Recreation (HCDPR), and other project partners. In this document, NOAA describes the process by which the project partners identified and evaluated three restoration alternatives for restoring inter-tidal wetlands in an area of Jersey City, Hudson County, New Jersey that is referred to as the Lincoln Park West Wetland Restoration Project (LPWWRP). The LPWWRP presents a valuable opportunity to restore intertidal wetlands, specifically *Spartina alterniflora*, in a highly urbanized area of the Hackensack Meadowlands and restore a portion of the natural resources that were injured by the Exxon Bayway and B.T. Nautilus oil spills.

NOAA, the United States Fish and Wildlife Service (USFWS), the State of New Jersey, and the State of New York, who collectively serve as the federal and state Natural Resource Trustees for resources impacted by the Exxon Bayway and B.T. Nautilus oil spills, have resolved to contribute about $2.4 million dollars in civil and criminal settlement funds from those cases towards this project. Additionally, the NJDEP applied for, and is proposed by NOAA to be funded as a recipient of, American Recovery and Reinvestment Act (ARRA) funds as the non-federal sponsor of the Lincoln Park West Wetland Restoration Project. NOAA proposes to fund the Lincoln Park West Wetland Restoration Project site with $10.6 million of the $167 million in federal ARRA funds Congress has authorized NOAA to administer for restoration of coastal resources.

In accordance with requirements of the National Environmental Policy Act (NEPA), the Clean Water Act (CWA), New Jersey environmental laws, and other applicable federal and state laws, NOAA and its partners carefully considered three restoration alternatives to produce the desired water quality and habitat improvements at the LPWWRP site. This document describes the restoration planning, analysis, and decision-making process by which the agency and its partners identified either Alternative 2.5 or 2.5.1 as a preferred alternative to restore the LPWWRP site and compensate the public for the natural resources damages resulting from the Exxon Bayway and B.T. Nautilus oil spills, with plans to implement 2.5.1 if there are sufficient funds.

NOAA has prepared this Draft RP/EA to present the preferred restoration alternative to the public for review and comment. This document describes the proposed project site and its history; discusses the purpose and need of the proposed action; provides information on the existing conditions at the site; analyzes the alternatives the agency and its partners considered for accomplishing the desired restoration at the site; and, presents information on the potential environmental consequences that could result from implementing the preferred alternative. Additionally, NOAA presents information on applicable federal and state environmental regulations and requirements, and other applicable law, and describes how the project partners will attempt to address and mitigate for any deficiencies and inconsistencies that could be considered adverse to the environment or the health, welfare, and safety of the public and its environs.

1.1 AUTHORITY

This Draft RP/EA was prepared jointly by the Trustees pursuant to their respective authorities and responsibilities as natural resource trustees under the Federal Water Pollution Control Act, 33 U.S.C. § 1251, *et seq.*) (also known as the Clean Water Act or CWA), and other applicable federal or state laws.

1.2 NEPA COMPLIANCE

Actions undertaken by the Trustees to restore natural resources or services are subject to the National Environmental Policy Act (NEPA), 42 U.S.C. § 4321 *et seq.*, and the regulations guiding its implementation at 40 C.F.R. Parts 1500 through 1517. NEPA and its implementing regulations outline the responsibilities of federal agencies when preparing environmental documentation. In general, federal agencies contemplating implementation of a major federal action must produce an environmental impact statement (EIS) if the action is expected to have significant impacts on the quality of the human environment. When it is uncertain whether the proposed action is likely to have significant impacts, federal agencies prepare an environmental assessment (EA) to evaluate the need for an EIS. If the EA demonstrates that the proposed action will not significantly impact the quality of the human environment, the agency issues a Finding of No Significant Impact (FONSI), which satisfies the requirements of NEPA, and no EIS is required. For a proposed restoration plan, if a FONSI determination is made, the Trustees may then issue a final restoration plan describing the preferred restoration action(s).

In accordance with NEPA and its implementing regulations, this Draft RP/EA: summarizes the current environmental setting; assesses the injury to or loss of natural resources or ecological services associated with the Site; describes the purpose and need for restoration actions; identifies alternative actions; evaluates the alternatives and their feasibility; assesses their applicability and the potential direct, indirect, or cumulative impacts on the quality of the physical, biological and cultural environment of the alternatives; and, summarizes the opportunity the Trustees provided for public participation in the decision-making process. This information will be considered by the agency to determine whether preparation of an EIS is warranted prior to identification of the final restoration action.

1.3 PUBLIC PARTICIPATION

Public coordination tools may include post cards, newsletters, newspaper postings, and public meetings. Depending upon the type and level of the public comments provided as part of the public notice, forums may be held to inform the public of Project activities and to elicit additional comments and discussion.

Public Notice will be made on Oct 12, 2009 in the Jersey Journal, Hudson County's leading daily newspaper and in the Star Ledger, North Jersey's leading daily. The Public comment period will begin on October 12, 2009, and will continue for 15 days through October 27, 2009. Comments should be directed to Carl Alderson either by email to Carl.Alderson@noaa.gov, or mailed to:

NOAA Restoration Center - Sandy Hook Office
JJ Howard National Marine Fisheries Science Center
74 Magruder Road
Highlands, NJ 07732

A printed version of the draft RP/EA will be made available for public review at:
Jersey City Main Library
472 Jersey Ave.
Jersey City, NJ 07302
(201) 547-4518

The draft RP/EA can be viewed electronically at http://www.darrp.noaa.gov/.

2.0 Purpose and Need for the Action

The purpose of the proposed action is to fund the LPWWRP. NOAA, the United States Fish and Wildlife Service, the State of New Jersey, and the State of New York, who collectively serve as the federal and state Natural Resource Trustees for resources impacted by the Exxon Bayway and B.T. Nautilus oil spills, have resolved to contribute about $2.4 million dollars in civil and criminal settlement funds from those cases towards this project.

Additionally, the NJDEP applied for, and is proposed by NOAA to be funded as a recipient of, ARRA funds as the non-federal sponsor of the Lincoln Park West Wetland Restoration Project. NOAA proposes to fund the LPWWRP with $10.6 million of the $167 million in federal ARRA funds Congress has authorized the agency to administer for restoration of coastal resources.

The proposed action would restore wetland hydrology, increase the duration of flooding across the marsh plain, and maximize an increase in the acreage of tidally influenced open water bodies such as creeks and ponds, which will result in increased habitat for native salt marsh species, increased habitat for birds and other wildlife, and increased fish access to nursery habitat. Additionally, the completed project would provide a valuable area for public access to, and recreational use of, a dynamic restored wetland environment in the heart of a highly urbanized area of the Hackensack Meadowlands. The need for the proposed action is to compensate the public for injuries to natural resources caused by the Exxon Bayway and B.T. Nautilus oil spills.

2.1 INCIDENT SUMMARIES

Exxon Bayway Spill

On January 1-2, 1990 an uncontrolled release of #2 fuel oil spilled from the Exxon Bayway facility's underwater pipeline located in Linden, New Jersey into the Arthur Kill, a saltwater channel between New Jersey and Staten Island, NY. Approximately 567,000 gallons of oil were released and impacted fish and wildlife habitats, including wetlands, in the immediate area of the spill. The spill resulted in the oiling of more than 100 acres of tidal salt marsh on Staten Island and in New Jersey; some wetlands located closest to the release salt marsh cordgrass (Spartina alterniflora) experienced a large-scale die-off. Representatives of the City and State of New York, the State of New Jersey, the City of Elizabeth, New Jersey, the U.S. Fish and Wildlife Service (USF&WS), and NOAA, who collectively serve as the designated natural resource trustees, responded to the incident in order to assess and quantify the impacts to natural resources. Under authority of the Clean Water Act (CWA), NOAA, the United States Fish and Wildlife Service (US F&WS), the State of New Jersey and the State of New York trustees conducted a damage assessment as Trustees, and filed a claim for natural resources damages against Exxon, the owner and operator of the Bayway Linden facility. Exxon settled with the trustees and paid over $11.5 million in natural resource damages to be used to restore the injured natural resources resulting from the Exxon Bayway spill. The Trustees are jointly administering the settlement funds to accomplish the restoration of the natural resources impacted by the spill.

B.T. Nautilus Spill

On June 7, 1990 the B.T. Nautilus, a large British tanker ship owned and operated by the Nautilus Motor Tanker Co., Ltd, ran aground in the Kill Van Kull and leaked approximately 260,000 gallons of #6 fuel oil into the waters of New York and New Jersey. The natural resource Trustees for this spill are the City and State of New York, the State of New Jersey, the U.S. Fish and Wildlife Service (USF&WS), and NOAA. Representatives of the Trustees responded to the incident and conducted a damage assessment to determine the extent of injury to natural resources. The spill resulted in the contamination of significant areas of shoreline in both states. Piping plovers, which have been listed as threatened by the US F&WS and as endangered by the State of New Jersey has listed as endangered, and their habitat were oiled. Pursuant to their authority under the CWA, the Trustees filed a claim for natural resource damages against Nautilus Motor Tanker Co. Ltd. Settlement was reached in April of 1994, and Nautilus Motor Tanker Co., Ltd. provided $4 million to the Trustees to settle the natural resource damage claim. The Trustees are jointly administering the settlement funds to accomplish the restoration of the natural resources injured by the spill.

2.2 Overview of Post-spill Planning

NOAA, the United States Fish and Wildlife Service (US F&WS), the State of New Jersey, and the State of New York, collectively serve as the designated federal and state natural resource trustees for the natural resources impacted by the Exxon Bayway and B.T. Nautilus Oil Spills.

The Exxon Bayway and B.T. Nautilus oil spills adversely impacted natural resources in the New York/New Jersey Harbor Estuary, and specifically the Arthur Kill. In response to the Exxon Bayway and B. T. Nautilus oil spills, the local, state, and federal natural resource trustees formed the New York/New Jersey Harbor Oil Spill Restoration Committee. The Committee, which consists of NOAA, the US Fish and Wildlife Service, the States of New York and New Jersey, and the city of New York, was established to allocate and administer the settlement funds recovered under the Clean Water Act and manage the planning, implementation, oversight, and monitoring of the natural resource restoration of the injured natural resources funds collected pursuant to the legal settlements reached under the Clean Water Act, for restoration of injured natural resources.

Since 2006, the NJDEP and NOAA, in communication with the Committee, have led efforts to plan and design the proposed Lincoln Park West Wetland Restoration Project. The LPWWRP is a part of a larger proposed plan to restore and improve approximately 90 acres of the property in the Lincoln Park Complex via activities including: a landfill closure; wetland habitat restoration and recreational improvements (golf course and trails); and the beneficial reuse of harbor navigation materials (clean sand). The site will be excavated, with material removed and capped, in order to create tidal creeks, intertidal marshes, and connected upland transitional areas. It is estimated that it will cost $ 13.6 million dollars to complete the LPWWRP.

NOAA, the United States Fish and Wildlife Service (US F&WS), the State of New Jersey, and the State of New York, collectively serve as the designated federal and state natural resource trustees for the natural resources impacted by the Exxon Bayway and B.T. Nautilus Oil Spills. The Trustees have determined that the LPWWRP will restore significant coastal wetland habitat in the vicinity of, and of the same type as, the shoreline that was adversely impacted by the two spills. The Trustees have resolved to contribute about $2.4 million of Exxon Bayway and B.T. Nautilus settlement funds to the LPWWRP.

2.3 Site Description

The Lincoln Park Wetland Restoration Project is located within a parcel of land totaling approximately 40 acres in size. This parcel is located on the eastern shore of the Hackensack River in Jersey City, Hudson County, New Jersey and lies between the Hackensack River to the west, State Route 1 and 9 to the south and east, and the Lincoln Park West Sanitary Landfill to the north (see Appendix E, Figure 1). The Project Area is part of the Lincoln Park complex, an approximately 270-acre parcel owned by the Hudson County Department of Parks and Recreation (HCDPR) since 1905 and dedicated by Hudson County for permanent open space and recreational usage. The HCDPR has been the owner of the Lincoln Park Wetland Restoration Project Area since 1905.

The Lincoln Park West Sanitary Landfill covers approximately 30 acres and is located immediately north of the Lincoln Park West Wetland Restoration Project Area. This landfill is being closed and re- developed as a golf course complex (by others). The landfill is located along Duncan Avenue and contains unclassified municipal waste, construction, and demolition materials, including household garbage, wood, bottles, ash, metal, cloth, gravel, brick, and plastic. Dumping activities ceased at the landfill prior to 1982. The landfill will be closed according to an NJDEP Solid and Hazardous Waste Program Closure and Post-Closure Plan Approval received May 20, 2009, in conjunction with restoration activities. Some of the unclassified municipal waste is located within the Lincoln Park Wetland Restoration Project Area and will need to be excavated prior to the proposed restoration activities.

The Lincoln Park West Wetland Restoration Project Area is shown on a composite of the U.S. Geologic Survey (USGS) topographic maps of Jersey City and Weehawken, NJ 7.5-minute quadrangle, provided as (see Appendix E, Figure 2). The proposed Project Area totals approximately 40 acres in size, and centers approximately on a northing of 690,620 feet and an easting of 604,858 feet using the New Jersey State Plane Coordinates (North American Datum 1983, Zone 18).

The Project Area is currently dominated by common reed (*Phragmites australis*), with dirt access roads and trails interspersed throughout the site. Salt marsh cordgrass (*Spartina alterniflora*) fringes the southern portion of the site along the Hackensack River and a few small tidal creeks. A concrete bulkhead forms an artificial barrier between the Hackensack River and the northern portion of the western boundary of the site. Even the highest tides are prevented from normal flooding of the northern section of the marsh, with the exception of a few areas where the wall has deteriorated and some limited tidal flushing occurs. The eastern portion of the site contains an approximately 10-acre, man-made lake (i.e., West Lake) that was excavated in the late 1930s, and several stagnant pools. The man-made lake is connected to the Hackensack River via a buried 36-inch (3-foot) diameter culvert. Although this culvert is occluded with mud and sediment, some limited tidal exchange occurs between the lake and the Hackensack River. The small pools are each less than one acre in size and are possible remnants of tidal creeks that were historically present in the Project Area and were buried as a result of inconsistent filling activities during the early part of the 20^{th} century. Site features are shown in Appendix E, Figure 3.

Current recreational activities within the Project Area are varied and include birding, boating, fishing and crabbing from the Hackensack River shoreline. There is no public boat launch located in close proximity to the Project Area. A trail runs through the site, connecting other areas of the Lincoln Park Complex to the shoreline. There is a proposal by the New Jersey Meadowlands Commission for an eight-mile long waterfront park known as the Hackensack River Walk that would terminate at the northwestern corner of the site.

2.4 SITE HISTORY

Historically, the western portion of the Project Area functioned as a salt marsh dominated by native grass species while the eastern portion functioned as a freshwater wetland system dominated by Atlantic white cedar. Timber harvesting resulted in the elimination of the forest system and grass species dominated the site.

A concrete bulkhead was built in 1914 along the Hackensack River as part of a park building project. The park building project was never completed due to a lack of funding. Today, the bulkhead provides access to the Hackensack River, although it prevents normal tidal flows from reaching a large part of the Project Area. In addition, portions of the salt marsh area near the Hackensack River were filled with dredge material as a result of Hackensack River navigation channel construction and maintenance. As a result, currently only a small fringe of salt marsh dominated by native grasses still exists on-site. This small fringe, located in the southwestern portion of the site south of the bulkhead, is dominated by *Spartina alterniflora* and includes a small tidal channel extending approximately 500 feet into the Project Area. Currently, the land use within this portion of the site is open space, consisting primarily of upland grass-dominated areas, with small patches of trees and small pockets of open water located throughout. Dirt access roads and trails are interspersed throughout the site, providing access to the bulkhead and the Hackensack River. The dominant species is *Phragmites australis*.

The adverse environmental impacts associated with the historical construction and subsequent modifications to the Hackensack River navigation channel severely limited or eliminated access to intertidal marshes by juvenile anadromous fish species that previously used these areas as nurseries and refuge areas. Feeding, nesting, and roosting areas for waterfowl, wading birds, and shorebirds were also degraded. Remnant salt marshes that exist today within the greater Hackensack River ecosystem rarely provide the quality of habitat for avian and fish species that historically existed in the area. Restoring salt marshes to their original structure and degree of habitat complexity is essential to the ecological health of the Hackensack River ecosystem.

3.0 THE AFFECTED ENVIRONMENT

This section provides information on the physical, biological, and cultural environments within the proposed LPWWRP area. The information in this Section, together with other information in this document, provides the basis for the evaluation of the potential environmental impacts of the alternative restoration actions listed in Section 4. The scope of the environmental impacts addressed in this draft RP/EA include those on wildlife, fish and invertebrates, essential fish habitat, threatened and endangered species, farmland and urban development, recreation resources, water and sediment quality, air quality, cultural resources, hazardous and toxic waste, and environmental justice.

3.1 Physical Environment

3.1.1. Geomorphology

Topography within the Project Area is nearly level (see Appendix E, Figure 4). Elevations range from a minimum of sea level at the water's edge to a maximum of approximately 10 feet above mean sea level where fills have been historically deposited. Elevations within the Project area range from sea level at the water's edge to less than 20 feet (ft) (6 meters) above mean sea level (Appendix E, Figure 3). The expanse of estuarine flatlands identified as the Hackensack Meadowlands surround portions of the Hackensack River in the vicinity of the Project and reference areas (Hudson County Planning Board [HCPB] 2002).

The site is located within the Newark Basin of the glaciated Piedmont Lowlands Province of northern New Jersey where regional bedrock consists of the Triassic age Brunswick Formation (HCPB 2002). This formation is predominantly grayish-red to reddish-brown in color, evenly to irregularly bedded, thin to thick-bedded shale, siltstone, very fine to coarse-grain sandstone, and red-matrix conglomerate. The site is also underlain with the Lockatong Formation, which consists of coarse to fine grained arkosic sandstone, also underlies the site. Surficial geology consists of salt marsh and estuarine deposits laid down in salt marshes, estuaries, and tidal channels during Holocene sea-level rise. These deposits consist of silt, sand, peat, clay, and minor pebble gravel; are dark-brown to black; and are as much as 300 feet thick.

3.1.2. Soils

Soils within the Project area consist of material from the Quaternary period, part of the stratified drift lithologic unit, and are generally made up of silt and sand particles. Typically area soils have a significant urban land component due to the extensive amount of landfill and development activities in the county. Specifically, soils in the Project area consist entirely of the Sulfaquent-Udorthent-Psamment soil association. This association consists of very poorly drained, very deep, mineral and organic soils, generally located on tidal flats and similar areas overlain by fill materials. None of the soils in the Sulfaquent-Udorthent-Psamment Association are listed as soils of significant statewide importance (USDA-NRCS 1990). The soil mapping units within the Project Area are Sulfaquent-Udorthent-Psamments (NJ036) and open water (NJW), as shown in Appendix E, Figure 5.

A geotechnical investigation of subsurface soils was conducted by the USACE in the fall of 2002. Soil borings were taken at 25 locations across the Project area. Subsurface soils consist of generally poorly graded sands, silty/clayey/clay sands, and clays, as described using the Unified Soil Classification System (USACE Engineer Manual [EM] 1110-1-1906 and EM 111-1-1804). Organics, such as plant roots and decaying organic material, are found in the upper layers of these soils. However, a subsurface layer of peat (a highly organic soil) was found at depths ranging from 6–8 ft below the surface in the wetlands area near the Hackensack River. This subsurface peat layer likely represents the marsh surface prior to fill activities associated with the dredging of the Hackensack River. The water table is fairly shallow, ranging from 2–6 ft below the ground surface. Landfill debris represents a significant component of the soils on site.

3.1.3. Air Quality

The USEPA measures community-wide air quality based on daily measured concentrations of six criteria air pollutants: carbon monoxide, sulfur dioxide, respirable particulate matter, lead, nitrogen oxides, and ozone. Based on these measurements of air quality, the USEPA designates attainment areas and non-attainment areas nationwide. Non-attainment areas are designated in areas where air pollution levels persistently exceed the National Ambient Air Quality Standards (NAAQS).

Hudson County is located in the New York–Northern New Jersey–Long Island Air Quality Control Region. Similar to most urban industrial areas, emissions from automobiles, manufacturing processes, utility plants, and refineries have impacted air quality in the Project Area. Based on the NAAQS six primary pollutants, Hudson County, including the Project Area, is designated as a non-attainment area for ozone, a maintenance area for carbon monoxide, and an attainment area for sulfur dioxide, respirable particulate matter (PM10), lead, and nitrogen oxides (USEPA 2002b). The conformity threshold value for nitrogen oxides and ozone precursors is 25 tons per year.

3.1.4. Noise

Noise is generally defined as unwanted sound. The day-night noise level (Ld_n) is widely used to describe noise levels in any given community (USEPA 1978). The unit of measurement for Ld_n is the "A"-weighted decibel (dBA), which closely approximates the frequency responses of human hearing.

The primary source of noise in the Project Area is vehicular traffic on local roadways, and bridges, boat traffic on the Hackensack River, park maintenance activities (e.g., lawn mowing), and local construction projects that may be underway. Although noise level measurements have not been obtained in the Project Area, they can be approximated based on existing land uses. The typical Ld_n in residential areas ranges from 39 dBA for wooded residential areas to 59 dBA for old urban residential areas (USEPA 1978). It can be assumed that the existing sound levels in the Project Area are roughly within this range.

3.1.5. Water Resources

3.1.5.1. Groundwater Resources

The Project Area is located within the Piedmont and Blue Ridge provinces and is underlain by the Newark Basin of Aquifers in the Mesozoic Basin. The Newark Basin is the largest basin within the aquifers contained in the Mesozoic Basin, and yields the highest groundwater withdrawal. Precipitation and infiltration are the primary sources of recharge for the aquifer. The Newark Basin contains the Stockton Formation, Lockatong Formation, and Brunswick Group stratigraphic units (Trapp and Horn 1997).

The groundwater quality in the Mesozoic Basin is generally suitable for drinking and other reasonable uses. However, iron, manganese, and sulfate occur locally in objectionable concentrations (Trapp and Horn 1997). The predominant ions present in most New Jersey groundwater are calcium, magnesium, and bicarbonate (USGS 1988). Groundwater in the Newark Basin is generally of good quality. Median dissolved-solids concentrations are below the national drinking water standards and range from 32–219 milligram/liter (mg/L). Median chloride concentrations are 16.0 mg/L and hard groundwater ranges from 121–180 mg/L. Iron concentrations are below the national drinking water standard of 300 microgram/liter µg/L, and median concentrations of nitrate plus nitrite are below the national drinking water standard of 10 mg/L (USGS 1988).

3.1.5.2. Surface Water

The Project Area is located within the Hackensack River (below the Amtrak bridge) watershed (Hydrologic Unit Code 02030103180100 as shown in Appendix E, Figure 9), which is a sub-basin of the Hackensack River (below Hirshfeld Brook) watershed. The NJDEP Division of Watershed Management has divided watersheds in New Jersey into several Watershed Management Areas. The Project Area is located within the Hackensack, Hudson, and Pascack Watershed Management Areas (WMA 5).

The Project site is encompassed within an approximately 260-acre watershed that includes all of Lincoln Park. The Project Area is bordered on the western side by the tidally-influenced Hackensack River. NJDEP classifies the surface water of the Hackensack River, and tributaries from Overpeck Creek south to the State Route 1 and 9 crossing, as Saline Estuarine-2 (SE-2). NJDEP designated uses of SE-2 water include: maintenance, migration, and propagation of the natural and established biota; migration of diadromous fish; maintenance of wildlife; secondary contact recreation; and, any other reasonable uses. The Hackensack River is 45 miles long and has a drainage area of 202 square miles (mi^2). Approximately 139 mi^2 of the watershed is located within New Jersey and the remaining 63 mi^2 is located in New York. Major tributaries of the Hackensack River include Pascack Creek, Berry's Creek, Overpeck Creek, and Wolf Creek; major impoundments include Oradell Reservoir, Lake Tappan, and Woodcliff Reservoir (NJDEP 1996b). The Hackensack River basin is 4 to 7 miles wide, with 23 mi^2 of tidal marshes that extend 10 miles upstream from the mouth of the river at Newark Bay to Oradell Dam, the limit of tidal influence. The Hackensack River basin became rapidly urbanized in the later part of the 20th century with the downstream reaches being polluted to varying degrees by municipal and industrial point discharges (USGS 1986). Extensive mosquito ditching occurred throughout the watershed in the early part of the 20th century (USACE 1999a). Consequently, a large portion of the tidal wetlands dried up, and eventually became developed for commercial and residential use.

The Lincoln Park Complex contains three major ponds that are all connected via culverts. The streets adjacent to the park drain into the Jersey City storm sewer system, which is separate from the park's drainage system (Jennings 2001). The three ponds gather surface water runoff and direct it towards the southwestern section of the Project Area. One of these three major ponds is an approximately 10-acre, man-made lake (West Lake) located in the eastern portion of the Lincoln Park Wetland Restoration Project Area. This lake is currently connected directly to the Hackensack River via a 36-inch diameter culvert. This culvert has a one-way flap gate on the Hackensack River side of the pipe, however the gate is propped open and does not function. Other small ponds (less than 1 acre in size) occur within the Project Area and are possible remnants of tidal creeks that were historically present but were buried as a result of inconsistent filling activities during the early part of the 20th century.

Wetland hydrology within the Project Area was observed to be associated with seasonal high groundwater tables, surface saturation, and influence from the Hackensack River. The hydroperiod of a wetland defines the seasonal pattern of water levels. Following the Cowardin system (Cowardin et. al., 1979), the hydroperiod of wetlands and open water systems within the Project Area include: subtidal (tidal open water areas), regularly flooded (tidal emergent wetlands), irregularly flooded (tidal emergent wetlands), permanently flooded (freshwater open water areas), and seasonally flooded (freshwater emergent wetlands).

3.1.5.3. Tidal Influences

NOAA, National Ocean Service (NOS) predicts that the tidal range (i.e., Mean Low Water [MLW] to Mean High Water [MHW]) at the confluence of the Hackensack River and Newark Bay (one river mile downstream of the site) is 5.2 feet for mean tide and 6.29 feet for spring tide, and at the Amtrak Railroad Bridge (2.7 miles upstream of the site) is 5.29 feet for mean tide and 6.40 feet for spring tide (NOS 2001). Temporary water level recorders were placed throughout the Hackensack River in recent years by various entities conducting studies or designing flood control or ecosystem restoration projects. The New Jersey Meadowlands Commission (NJMC) had maintained the longest tidal records in recent years, although there are numerous tidal records that continuously recorded water levels for two months or more. Along with the tidal range, many other tidal data are useful in evaluating existing conditions and in designing a tidal wetland restoration project. Below are the tidal data and their definitions.

Mean High Water Spring (MHWS) – the average elevation of the high tides that occur on the New and Full Moon;
Mean Higher High Water (MHHW) – the average elevation of the higher of the high tides within a tidal cycle;
Mean High Water (MHW) – the average elevation of all high tides;
Mean Tide Level (MTL) – the average elevation of MHW and MLW;
Mean Low Water (MLW) – the average elevation of all low tides;
Mean Lower Low Water (MLLW) – the average elevation of the lower of the low tides within a tidal cycle; and
Mean Low Water Spring (MLWS) – the average elevation of the low tides that occur on the New and Full Moon.

Table 4 summarizes many of the tidal datums from various tidal records in the area. It is important to note that most of these gauges were not recording synchronously. Thus, storm surges, rainfall and runoff discharge patterns vary at all gauge locations and for all record periods. Additional information on the tidal data collection equipment and program, and the tidal data calculated for use for this Project were first presented in the ERR/EA (USACE 2006).

For this Project, six water level recorders were deployed throughout and adjacent to the Project Area from June 4, 2002 through August 16, 2002. The location of gauges in the Project Area are shown in Appendix E, Figure 10. Table 5 summarizes the water level records for these gauges. Site-specific tidal data were collected, and a tidal analysis was conducted, in order to accurately and completely model the existing hydrodynamic conditions in the Project Area. Based on these data, plant communities were surveyed and biobenchmarks were developed to identify the elevations at which desirable and undesirable plant communities were found in the Project Area. Additional information on the gauge locations, the hydrodynamic model, and biobenchmarks are presented in the ERR/EA (USACE 2006).

According to the literature (USFWS 1997), salinity ranges from 0 to 16 parts per thousand (ppt) in the Hackensack River. The portion of the river from the mouth, upriver to Cromakill Creek, is considered a moderate salinity (mesohaline: 5 to 18 ppt) zone, while the portion of the river above Cromakill Creek to the Town of Hackensack is considered a low salinity (oligohaline: 0.5 to 5 ppt) zone (USFWS 1997). Salinities recorded for the Project Area range from 12 to 23 ppt in the tidal creek, and 5 to 18 ppt in the man-made lake (i.e., West Lake) (USACE 2002d). The Project Area is located within the mesohaline zone and portions of the Project Area receive daily tidal inundation.

Historical fill activities that occurred in the early part of the 20th century raised much of the marsh surface in the Project Area above the range of normal tidal influence (supratidal). As a result, many of the remnant tidal creeks and ponds were cut off from regular tidal flushing, reducing the salinities throughout much of the marsh to low (oligohaline) or zero (freshwater) level (USACE 1999a).

Table 4. Comparison of Tidal Datums in the Hackensack River from Short Term Water Level Recorders

	Tide Datums from Previous Studies				***Tide Datums Generated for Lincoln Park Project***			
	From New Jersey Meadowlands Commission, done by Woods Hole Group, Inc., 2000-2001			**From Louis Berger Marsh Resources Report, March 2001[4]**	**Raw Data from NJMC[5]**	**NOAA Tide Station #8518750[6]**	**Raw Data from USACE**	**Data used in Lincoln Park Restoration Design**
	Riverbend[1]	**Berry Creek[2]**	**Mill Creek[3]**	**Doctors Creek****	**Riverbend**	**Battery**	**Lincoln Park****	**Adjusted to account for all MLW and MLLW readings**
	June1999 - Dec 2000	June1999 - June 2000	May-Sep 1998	May-Nov 1998	June 8-July 19, 2001	June 8-July 19, 2001	June 8-July 19, 2001	
River miles from Lincoln Park gauge	1.5 Miles Upstream	5.8 miles upstream	8.8 miles upstream	9.8 miles upstream	1.5 miles upstream	11.5 miles downstream	0 miles upstream	
MHHW	3.80	4.01	4.43	4.33	3.69	3.38	3.41	3.44
MHW	3.50	3.71	4.15	4.04	3.68	3.08	3.39	3.38
MTL	0.75	0.85	1.44	1.46	1.04	0.93	0.93	0.75
MLW	-2.00	-2.02	-1.27	-1.12	-1.60	-1.23	-1.54	-1.89
MLLW	-2.21	-2.25	-1.45	N/A	-1.64	-1.47	-1.62	-2.00
Range****	5.50	5.73	5.42	5.16	5.28	4.31	4.93	5.27
Great Diurnal Range*****	6.07	6.26	5.88	N/A	5.33	4.85	4.95	5.44

Notes:
See USACE (2006) for more detail on tidal datums. All elevations in ft National Geodetic Vertical Datum 1929 (NGVD29).
N/A = Not Applicable
*Difference between NGVD29 and NAVD (ft) = -1.11
**Gauge missed some MLW and MLLW readings
***Approximate locations, measured along center of Hackensack River using USGS Topographic Maps
****Range is MLW to MHW
*****Great Diurnal Range is MLLW to MHHW
Sources:
[1] WHG 2001; [2] WHG 2000a; [3] WHG 2000b; [4] The Louis Berger Group 2001; [5] Hobbel 2001; [6] NOS 2001.

Table 5. Summary of Installed Water Level Recorders

Gauge Period	A	B	C	D	E	F
Description	**middle lake**	**west lake**	**creek**	**north of path**	**south of path**	**Hackensack River**
Start of Record	6/7/2001	6/26/2001	6/4/2001	7/25/2001	7/19/2001	6/8/2001
End of Record	7/19/2001	7/19/2001	7/25/2001	8/16/2001	8/16/2001	7/19/2001
East NAD 83 ft	606080	605807	604309	604387	604290	603983
North NAD 83 ft	690070	690461	690440	691119	691134	690359
Water Level Statistics - in ft NGVD29						
Minimum	2.1	1.1	3.1	4.0	3.2	-2.7
Mean	2.2	1.5	3.3	4.2	4.0	1.0
Maximum	2.5	2.0	5.2	4.4	4.7	4.4
Total rainfall (inches)	4.38	1.93	4.80	1.44	1.85	4.38

3.2. BIOLOGICAL RESOURCES

3.2.1. Vegetated Habitats

Vegetation surveys, including site evaluations, aerial photography interpretation, cover type mapping, and quadrat sampling, were conducted by the USACE at the Project Area in 2001 (USACE 2002a) and was included in the 2004 ERR/EA. Surveys were conducted again in 2007 by NJDEP, along with wetland and open water community delineation within the Project Area. Bio-benchmarking surveys were conducted (2007) to determine the maximum, minimum, and mean elevation ranges for targeted vegetated communities. The following section presents a summary of the most current survey information on wetland and upland plant communities identified in the Project Area, and the results of bio-benchmarking surveys.

3.2.1.1. Uplands

Uplands within the Project Area consist of forest/scrub-shrub and herbaceous community types, totaling 12.8 acres, or 32.1 percent of the Project Area. These community types occur as fairly large patches throughout the Project Area. Evidence of disturbance within the upland community types is apparent, and includes disturbed soils, household trash, and construction debris. The ground in the southwest corner of the Project Area is heavily littered with old bottles, cans, sheet metal, and other miscellaneous debris. Table 1 presents the existing cover types and areas of upland and wetland habitat types in the Project Area. Existing habitat types are shown in Appendix E, Figure 6.

Upland forest/scrub-shrub habitat includes scattered mature trees such as white mulberry (*Morus alba*), tree-of-heaven (*Ailanthus altissima*), quaking aspen (*Populus tremula*), and black willow (*Salix nigra*). The sapling/shrub layer in this community is sparse and includes quaking aspen and tree-of-heaven saplings and shrubs such as common elderberry (*Sambucus canadensis*) and winged elm (*Ulmus alata*). The herbaceous layer in this community is sparse and includes species such as white snakeroot (*Ageratina altissima*), climbing nightshade (*Solanum dulcamara*), and rough goldenrod (*Solidago rugosa*). *Phragmites* covers 5.31 acres, or 13.3 percent of the upland portion of the Project

Area.

3.2.1.2. Wetlands

Historic filling, construction of a hardened shoreline, and other anthropogenic disturbances during the early 20th century have resulted in a reduction of wetland acreage and function within the Project area. Historically, wetlands within the Project area were salt marshes dominated by *S. alterniflora*. Presently, wetlands in the Project area consist primarily of highly degraded, tidally and non-tidally influenced, emergent marshes dominated by *Phragmites*, interspersed with minor components of salt marsh and scrub-shrub habitat.

The NJDEP Wetlands Inventory map indicates that five wetland/open water habitats have been mapped within the Project Area (see Appendix E, Figure 7). NJDEP mapped wetland/open water areas include artificial lake, herbaceous wetland, deciduous wooded wetland, saline marsh (low marsh), *Phragmites* wetland, and tidal water. Wetlands in the Project Area also are divided into estuarine and palustrine wetlands, based on NJDEP mapped wetlands and field surveys (see Appendix E, Figure 8). Estuarine wetlands occur in areas that are hydrologically connected to the Hackensack River and are primarily confined to the western portion of the Project Area. Palustrine wetlands include the wetlands associated with the large man-made lake and small ponds that are scattered throughout the site. Although the man-made lake does experience some tidal influence due to a culvert that connects the lake hydrologically to the Hackensack River, the lake is considered more similar to the palustrine ponds than to the estuarine system.

A wetland delineation survey was conducted in 2001 by USACE 2002b and was included as part of the December 2006 Draft ERR/EA. The wetland delineation conducted in 2007 updates and replaces the USACE survey in this October 2009 Draft RP/EA. Wetland and open water communities within the Project Area were delineated in 2007 in accordance with the procedures outlined in the U.S. Army Corps of Engineers' *Wetlands Delineation Manual* (Environmental Laboratory, 1987) and the 1989 Interagency *Federal Manual for Identifying and Delineating Jurisdictional Wetlands*. Wetlands, as defined in these manuals, are those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted to life in saturated soil conditions. Wetlands thus possess three characteristics: 1) hydric soils, 2) wetland hydrology, and 3) hydrophytic vegetation. A total of 26.04 acres of wetlands and open water were identified within the Project Area.

A request for a Letter of Interpretation (LOI) to verify the jurisdictional boundaries and confirm the resource value of the wetlands and waters within the Project Area was submitted to the NJDEP. Following a site inspection conducted in October 2007, the NJDEP approved the wetland delineation, assigned resource values that established transition areas, and issued LOI /Line Verification DLUR File No. 0906-07-0009.1, a copy of which is provided in Appendix A.

Table 1. Existing Habitats within the Project Area.

Existing Habitat Type	Area (Ac.)
Palustrine Wetlands	
Open Water (POW)	10.36
Emergent - *Phragmites* (PEM)	5.63
Scrub-Shrub (PSS)	0.43
Estuarine Wetlands	
Open Water (TOW)	0.81
Emergent - *Spartina* (EEM)	0.45
Emergent - *Phragmites* (EEM)	5.74
Scrub-Shrub (ESS)	2.62
Total	26.04
Uplands	
Herbaceous (UH)	4.10
Herbaceous - *Phragmites* (UH)	5.31
Forest/Scrub-Shrub	3.39
Total	12.80
Undisturbed	1.05
Total	**39.89**

3.2.1.3. Habitat Zonation

Estuarine wetlands occupy approximately 9.62 total acres (24.1 percent) of the Project Area, and include 0.81 acre (2.0 percent) of open water, 0.45 acre (1.1 percent) of *Spartina*-dominated emergent marsh, 5.74 acres (14.4 percent) of *Phragmites*-dominated emergent marsh, and 2.62 acres (6.6 percent) of scrub-shrub wetland. Estuarine wetlands are divided into intertidal (regularly flooded twice daily by tides) and supratidal (irregularly flooded) areas (Cowardin et al. 1979, Tiner 1985). The intertidal areas are confined to a portion of shoreline located directly adjacent to the Hackensack River in the southwestern portion of the Project Area that are inundated by the diurnal tidal cycle. The intertidal areas are almost entirely dominated by *S. alterniflora*.

The supratidal areas receive infrequent tidal inundation and are almost entirely dominated by *Phragmites*, which exhibited a mean height of 216 cm, vegetative cover of 75–100%, and mean stem density of 136 stems per square meter (USACE 2002a). *Phragmites* dominates many salt marsh wetlands in northern New Jersey that have been disturbed or degraded (Tiner 1985). Other species observed within supratidal areas include shrubs such as marsh elder (*Iva frutescens*) and groundsel tree (*Baccharis halimifolia*), and herbaceous species such as salt-marsh fleabane (*Pluchea purpurascens*) and swamp rose mallow (*Hibiscus palustris*). All vegetated estuarine wetlands within the Project Area are considered by the US Environmental Protection Agency (USEPA) to be priority wetlands.

Open water and intertidal mudflat habitat is located along the Hackensack River shoreline on the western edge of the Project boundary. Approximately one third of the mudflat habitat grades into the remnant intertidal *S. alterniflora* marsh, whereas the remainder of the mudflat is bordered by the concrete bulkhead hardened shoreline. The majority of the mudflat habitat is relatively devoid of cobble, rock, and other debris, and is composed of fine, cohesive sediments, which is of relatively high value as fish and wildlife habitat. No submerged aquatic vegetation (SAV) beds occur within the estuarine open water habitat.

Palustrine wetlands occupy approximately 16.42 acres (41.2 percent) of the Project Area, including designated open water habitat. Similar to the supratidal areas, the majority of the palustrine emergent wetlands are dominated by expansive stands of *Phragmites* (5.63 acres, 14.1 percent), interspersed with small forest/scrub-shrub patches (0.43 acre, 1.1 percent) comprised of swamp rose mallow, groundsel tree, and marsh elder. The remainder of the palustrine systems consist of open water habitat (10.36 acres, 26 percent) and includes the +/- 10-acre man-made lake.

Palustrine open water habitat on site has the potential to support SAV, especially in deeper areas of the lake. Species that may occur within palustrine open water include waterweed (*Elodea* spp.), pondweed (*Potamogeton* spp.), and milfoil (*Myriophyllum* spp.). A number of these species serve as food and/or cover for various species of waterfowl, fish, and invertebrates. The smaller ponds scattered throughout the site may dry out during the summer and would not be able to support SAV. However, these ponds are capable of supporting algal mats and free-floating plants such as duckweed (*Lemna* spp. and *Spirodela* spp.). Palustrine mudflat habitat is limited to a very narrow fringe of sediment around the lake that is exposed periodically.

Table 2 presents a listing of the plant species observed in the Project Area during the wetland delineation field efforts and the respective wetland indicator status.

Table 2. Vegetation Observed Within the Project Area

Common Name	**Scientific Name**	**Wetland Indicator Status**
white snakeroot	*Ageratina altissima*	FACU-
tree-of-heaven	*Ailanthus altissima*	NL
common ragweed	*Ambrosia artemisifolia*	FACU
mugwort	*Ambrosia vulgaris*	NL
green milkweed	*Asclepias viridiflora*	FACU
common milkweed	*Asclepias syriaca*	NL
groundsel tree	*Baccharis halimifolia*	FACW
Queen's Ann lace	*Daucus carota*	FACU
white thoroughwort	*Eupathorium album*	FAC
swamp rosemallow	*Hibiscus moscheutos*	OBL
spotted touch me not	*Impatiens carpensis*	FACW
marsh elder	*Iva frutescens*	FACW+
white mulberry	*Morus alba*	UPL
red mulberry	*Morus rubra*	FACU

princess tree	*Paulownia tomentosa*	UPL
common reed	*Phragmites australis*	FACW
common pokeweed	*Phytolacca americana*	FACU+
Japanese knotweed	*Polygonum cuspidatum*	FACU-
salt-marsh fleabane	*Pluchea purpurascens*	OBL
cottonwood	*Populus deltoides*	FAC
quaking aspen	*Populus tremula*	FACU
black locust	*Robinia pseaudoacacia*	FACU-
blackberry	*Rubus allegheniensis*	FACU-
weeping willow	*Salix babylonica*	FACW-
black willow	*Salix nigra*	FACW+
common elderberry	*Sambucus canadensis*	FACW-
climbing nightshade	*Solanum dulcamara*	FAC-
early goldenrod	*Solidago juncea*	NL
rough goldenrod	(*Solidago rugosa*)	FAC
smooth cordgrass	*Spartina alterniflora*	OBL
winged elm	*Ulmus alata*	FACU

Key to indicator categories
OBL: Obligate Wetland, occur almost always (estimated probability >99%) under natural conditions in wetlands.
FACW: Facultative Wetland, usually occur in wetlands (estimated probability 67%-99%), but occasionally found in non-wetlands.
FAC: Facultative, equally likely to occur in wetlands or non-wetlands (estimated probability 34%-66%).
FACU: Facultative Upland, usually occur in non-wetlands (estimated probability 67%-99%), but occasionally found in wetlands (estimated probability 1%-33%).
NL: Not listed.
A positive (+) sign following an indicator indicates a frequency toward the higher end of a category.
A negative (-) sign following an indicator indicates a frequency toward the lower end of a category.
Sources: 1995 Supplement to the List of Plant Species that Occur in Wetlands: Northeast (Region 1), US Fish and Wildlife Service, August, 1995.
National List of Plant Species that Occur in Wetlands: Northeast (Region I), US Fish and Wildlife Service, May 1988.

3.2.2. Shellfish

Previous studies conducted by Cerrato (1986), USFWS (1998), and USACE (1998) indicate a presence and high abundance of clams, particularly soft-shelled clam (*Mya arenaria*), throughout Newark Bay. However, Iocco et al. (2000) conducted sediment profile imagery and grab sampling throughout Newark Bay and found bivalves to be absent in their survey. Discrepancies among the results of the surveys were most likely related to differences in sampling methods (Iocco et al. 2000).

A survey conducted by the USACE (2002e), and a literature review conducted by USFWS (1996) suggest that the common shellfish species found in the vicinity of the Project Area include blue crab

(*Callinectes sapidus*), fiddler crab (*Uca* spp.), grass shrimp (*Palaemonetes pugio*), ribbed mussel (*Geukensia demissa*), and white-fingered mud crab (*Rhithropanoepus harrisii*). Blue crab is the only edible shellfish species captured during the USACE (2002e) survey. Table 6 presents the shellfish species that have been observed or are likely to occur in the vicinity of the Project Area.

3.2.3. Finfish

Finfish species captured in the Hackensack River are consistent with those expected in a tidal river and marsh complex in coastal New Jersey (USACE 2000a, b, USACE 2002d, e). The USFWS (1996) literature review and the USACE (2002d) fish survey in the Hackensack River and Newark Bay found freshwater, marine, anadromous and catadromous finfish species. Fish species likely to occur in the vicinity of the Project Area include alewife (*Alosa pseudoharengus*), American eel (*Anguilla rostrata*), Atlantic menhaden (*Brevoortia tyrannus*), Atlantic needlefish (*Strongylura marina*), Atlantic tomcod (*Microgadus tomcod*) bay anchovy (*Anchoa mitchilli*), bluefish (*Pomatomus saltatrix*), catfish (brown bullhead [*Ameiurus nebulosus*] and white catfish [*A. catus*]), common carp (*Cyprinus carpio*), crevelle jack (*Caranax hippos*), gizzard shad (*Dorosoma cepedianum*), killifish (banded killifish [*Fundulus diaphanus*], mummichog [*F. heteroclitus*], and striped killifish [*F. majalis*]), northern kingfish (*Menticirrhus saxatilis*), pumpkinseed (*Lepomis gibbosus*), striped bass (*Morone saxatilis*), white perch (*M. americana*), summer flounder (*Paralichthys denntatus*), weakfish (*Cynoscion regalis*), and winter flounder (*Pseudopleuronectes americana*) (USFWS 1996, USACE 2002d). Table 6 presents the finfish species that have been observed or are likely to occur in the vicinity of the Project Area.

In an attempt to establish a progressive anadromous fish management plan, the NJDEP, Division of Fish, Game, and Wildlife, Bureau of Marine Fisheries, has conducted several studies addressing upstream migratory impediments to, and restoration possibilities offor, anadromous species such as clupeid (i.e., alewife, blueback herring [*Alosa aestivalis*], American shad [*A. sapidissima*], and hickory shad [*A. mediocris*]), Atlantic tomcod, and striped bass (Zich 1977, NJDEP 1986, Durkas 1992). Zich (1977) determined that poor American shad spawning runs in New Jersey are the result of the combined effects of pollution, habitat displacement, man-made blockage, and overfishing. Alewife and blueback herring are the only species on the anadromous fish management plan that were collected in the Hackensack River (Zich 1977).

Table 6. Shellfish and Finfish Species Likely to Occur in the Vicinity of the Project Area

Common Name	Scientific Name	Project Area	Reference Area
Shellfish			
Blue crab	*Callinectes sapidus*	**X**	**X**
Fiddler crab	*Uca* spp.	**X**	**X**
Grass shrimp	*Palaemonetes pugio*	**X**	**X**
Ribbed mussel	*Geukensia demissa*	**X**	**X**
White-fingered mud crab	*Rhithropanoepus harrisii*	**x**	**x**
Finfish			
Alewife	*Alosa pseudoharengus*	**X**	**X**
American eel	*Anguilla rostrata*		**X**
Atlantic menhaden	*Brevoortia tyrannus*	**x**	**x**
Atlantic needlefish	*Strongylura marina*	**X**	
Atlantic silverside	*Menidia menidia*	**X**	**X**
Atlantic tomcod	*Microgadus tomcod*	**x**	**x**
Banded killifish	*Fundulus diaphanus*	**X**	
Bay anchovy	*Anchoa mitchilli*	**x**	**x**
Bluefish	*Pomatomus saltatrix*	**X**	**X**
Brown bullhead	*Ameiurus nebulosus*		**x**
Common carp	*Cyprinus carpio*	**x**	**x**
Crevelle jack	*Caranax hippos*		**X**
Gizzard shad	*Dorosoma cepedianum*	**X**	**X**
Inland silverside	*Menidia beryllina*	**x**	**x**
Mummichog	*Fundulus heteroclitus*	**X**	**X**
Northern kingfish	*Menticirrhus saxatilis*	**X**	
Pumpkinseed	*Lepomis gibbosus*		**x**
Striped bass	*Morone saxatilis*	**X**	**X**
Striped killifish	*Fundulus majalis*	**x**	**x**
Summer flounder	*Paralichthys denntatus*	**X**	**X**
Weakfish	*Cynoscion regalis*	**x**	**x**
White catfish	*Ameiurus catus*		**x**
White perch	*Morone americana*	**X**	**X**
Winter flounder	*Pseudopleuronectes americana*	**x**	**x**

Source: USFWS 1997, USACE 2002d. Compiled by Northern Ecological Associates, Inc.
Key: X = Species observed during field surveys.
x = Species likely to occur in the area.

3.2.4. Benthic Resources

Although there are no known studies of benthic resources in or adjacent to the Project Area, several surveys have been done approximately one mile downstream of the Project Area in Newark Bay. Historically, Newark Bay benthic assemblages have been characterized by low diversity (Cerrato 1986). The Project Area is located near the New York/New Jersey industrial and urban core with increasingly of New York/New Jersey which has caused a detrimental effect on fish and wildlife populations in the area (USACE 1987). Development and a variety of industrial pollutants are present in the Hackensack River, probably due to heavy development and the presence of 13 landfills in the Hackensack River drainage basin that have contributed to degraded water quality and reduced habitat (New York/New Jersey Harbor Spill Restoration Committee 1996).

A survey conducted by the USACE (1987) classified the overall benthic organism abundance of Newark Bay as moderate. Benthic communities from the USACE survey are dominated by polychaete worms, which are habitat generalists with high tolerance to environmentally stressful conditions such as low dissolved oxygen levels. Results of the USACE survey showed polychaete worms (i.e., *Streblospio benedicti* and *Sabellaria vulgaris*), as well as soft-shell clam, to be the dominant species during both the spring and summer periods. Survey results also showed some polychaete worm species (i.e., *Scolecolepides viridis*, *Nereis succinea*, and *Polydora ligni*) collected during the spring being replaced by polychaete worms (i.e., *Spio setosa*), barnacle (i.e., *Balanus improvisus*), and tunicate (i.e., *Molgula manhattensis*) during the summer (USACE 1987). The USACE (1987) concluded that the moderate species abundance and generally low species diversity in the benthos are results of a stressed environment where the development of the benthic community is restricted.

The USFWS (1996) conducted a literature search of benthic resources in the Hackensack River. This literature search revealed evidence from one survey that found 53 different benthic species dominated by polychaetes (36%), mollusks (15%), and amphipods (11%). Also, epibenthic invertebrate species included grass shrimp, mysid shrimp (*Neomysis americana*), sand shrimp (*Crangono septemspinosa*), white-fingered mud crab, and several species of amphipods.

Iocco et al. (2000) conducted sediment profile imagery (SPI) and grab sampling throughout Newark Bay and found polychaete worms to be the dominant species during the spring and fall (see Table 7). Polychaete worms *Streblospio benedicti*, Cirratulidae (lowest possible identification level [LPIL]), and *Leitoscoloplos* (LPIL) had the highest average abundance during the spring while dwarf surf clam (*Mulinia lateralis*), *Mediomastus* (LPIL), and *Streblospio benedicti* had the highest average abundance during the fall. Surveys also revealed that oligochaete worms were present during the spring and fall, whereas bivalves, such as dwarf surf clam, were only present during the fall (Iocco et al. 2000).

Table 7. Benthic Species Likely to Occur in the Vicinity of the Project Area

Common Name	Taxa
Segmented worms	Annelida
Bristle worm	Polychaeta
Fringed worm	Cirratulidae [1]
Blood worm	*Glycera americana*
Capitellid thread worm	*Heteromastus filiformis*
Orbinid worm	*Leitoscoloplos* [1]
Orbinid worm	*Leitoscoloplos fragilis*
Orbinid worm	*Leitoscoloplos robustus*
Red-gilled mud worm	*Marenzellaria viridis*
Capitellid thread worm	*Mediomastus* [1]
Common clam worm	*Nereis succinea*
Trumpet worm	*Pectinaria gouldii*
Paddle worm	Phyllodocidae [1]
Mud worm	*Polydora cornuta*
Mud worm	*Polydora ligni*
Sand-builder worm	*Sabellaria vulgaris*
Mud worm	*Scolecolepides viridis*
Mud worm	*Spio Setosa*
Mud worm	*Streblospio benedicti*
Fringed worm	*Tharyx acutus*
Aquatic earthworm	Oligochaeta [1]
Mollusks	Mollusca
Bivalve	Bivalvia [1]
Surf clam	*Mulinia lateralis*
Soft shell clam	*Mya arenaria*
Jointed-leg animals	Anthropoda
Crustacean	Crustacea
Barnacle	Cirripedia (Subclass)
Bay barnacle	*Balanus improvisus*
Amphipod	Amphipoda (Order) [1]
Decapod	Decapoda (Order)
Sand shrimp	*Crangono septemspinosa*
Grass shrimp	*Hippolytes* spp.
White-fingered mud crab	*Rhithropanopeus harrisii*
Mysid shrimp	Mysidacea (Order)
Mysid shrimp	*Neomysis americana*
Tunicates	Chordata
Ascidians	Ascidiacea
Sea grapes	*Molgula manhattensis*

Source: USACE 1987, USFWS 1997, and Iocco et al. 2000. Compiled by Northern Ecological Associates, Inc.

[1] LPIL – Lowest Possible Identification Level.

3.2.5. Reptiles and Amphibians

The USACE conducted wildlife surveys, including reptile and amphibian surveys, in the Project Area and a nearby reference marsh during the spring and fall of 2001 (USACE 2002f). According to the NJDEP, Division of Fish and Wildlife, Endangered and Non-game Species Program, 48 reptile and amphibian species are likely to occur in Hudson County, New Jersey (NJDEP 2001). Based on the USACE's surveys there is little suitable habitat for reptiles and amphibians present in the Project Area. The majority of amphibians (i.e., frogs, toads, and salamanders) require freshwater ponds, streams, and/or vernal pools for breeding habitat (Conant and Collins 1991, NJDEP 2001). Although the Project Area supports a number of wetlands, ponds, and the lake, these areas are occasionally subjected to saltwater influence, which precludes the majority of frogs and salamanders from breeding.

Despite the saltwater influence, three species of reptile were observed within the Project Area during field surveys, including common snapping turtle (*Cheldrya serpentina*), red-eared slider (*Trachemys scripta elegans*), and eastern garter snake (*Thamnophis sirtalis sirtalis*). Additionally, northern diamondback terrapins (*Malaclemys terrapin terrapin*) could potentially use remnant *S. alterniflora*-dominated wetlands within the Project Area. Table 8 presents the reptile and amphibian species that have been observed or are likely to occur in the Project Area.

Table 8. Reptile and Amphibian Species Observed or Likely to Occur in the Project Area

Common Name	Scientific Name	Project Area	Reference Area
Common garter snake	*Thamnophis sirtalis*	x	
Common snapping turtle	*Chelydra serpentina*	X	X
Eastern garter snake*	*Thamnophis sirtalis sirtalis*	X	
Eastern box turtle	*Terrapene carolina*	x	
Fowler's toad	*Bufo woodhousii fowleri*	x	
Northern diamondback terrapin	*Malaclemys terrapin terrapin*		X
Red-eared slider	*Trachemys scripta elegans*	X	

Source: USACE 2002f. Compiled by Northern Ecological Associates, Inc.
Key: X = Species observed during field surveys.
x = Species likely to occur in the area.

3.2.6. Birds

Avian surveys, using point counts, observation stations, and playback tapes, were conducted in the Project Area and a nearby reference marsh by the USACE in June and October 2001 (USACE 2002g). A diverse bird community was observed in the variety of habitats found in the Project Area and the reference area. Specifically, as indicated in Table 9, 71 bird species were observed during the spring and fall avian surveys (USACE 2002g).

The man-made lake and the Hackensack River in the Project Area provide feeding, resting, and brood-rearing habitat for a number of waterfowl, gulls, and wading birds. Specifically, Canada goose (*Branta canadensis*), American black duck (*Anas rubripes*), mallard (*Anas platyrhynchos*), gadwall

(*Anas strepera*), and blue-winged teal (*Anas discors*) are waterfowl species observed within the Project Area (USACE 2002g). Additionally, the forest/scrub-shrub portions of the Project Area provide habitat for a wide range of resident and migratory passerines. Examples of the most commonly observed passerines utilizing this habitat type include American goldfinch (*Carduelis tristis*), American robin (*Turdus migratorius*), cedar waxwing (*Bombycilla cedrorum*), downy woodpecker (*Picoides pubescens*), gray catbird (*Dumetella carolinensis*), and rufus-sided towhee (*Pipilo erythrophthalmus*). *Phragmites*-dominated portions of the Project Area provide habitat for species such as common grackle (*Quiscalus quiscula*), common yellowthroat (*Geothlypis trichas*), and red-winged blackbird (*Agelaius phoeniceus*).

The limited amount of existing salt marsh habitat within the Project Area does not meet the minimum habitat area requirements for marsh specialists such as sharp-tailed sparrows (*Ammoodramus caudacutus*) and marsh wrens (*Cistothorus palustris*). However, these species were observed at the reference area. Several state-listed avian species were identified during field sampling activities, and are discussed in Section 3.4.2 Threatened, Endangered, and Special Concern Species.

Table 9. Bird Species Observed in the Project Area

Common Name	**Scientific Name**	**Project Area**	**Reference Area**
American black duck	*Anas rupripes*	X	**X**
American coot*	*Fulica americana*		**X**
American crow	*Corvus brachyrhynchos*	**X**	**X**
American goldfinch	*Carduelis tristis*	**X**	
American kestrel*	*Falco sparverius*	**X**	
American redstart	*Setophaga ruticilla*	**X**	
American robin	*Turdus migratorius*	**X**	
American woodcock*	*Scolopax minor*	**X**	
Barn swallow	*Hirundo rustica*	**X**	**X**
Belted kingfisher	*Ceryle alcyon*	**X**	
Black-capped chickadee	*Parus atricapillus*	**X**	**X**
Black-crowned night-heron*	*Nycticorax nycticorax*	**X**	**X**
Blue jay	*Cyanocitta cristata*	**X**	
Blue-winged teal*	*Anas discors*	**X**	
Brant	*Branta bernicla*		**X**
Brown creeper	*Certhia americana*	**X**	
Brown-headed cowbird	*Molothrus ater*	**X**	
Brown thrasher*	*Toxostoma rufum*	**X**	
Canada goose	*Branta canadensis*	**X**	**X**
Cedar waxwing	*Bombycilla cedrorum*	**X**	
Clapper rail	*Rallus longirostris*		**X**
Common grackle	*Quiscalus quiscula*	**X**	**X**
Common yellowthroat	*Geothlypis trichas*	**X**	**X**
Dark-eyed junco	*Junco hyemalis*	**X**	
Double-crested cormorant	*Phalacrocorax auritus*	**X**	**X**
Downy woodpecker	*Picoides pubescens*	**X**	

Common Name	Scientific Name	Project Area	Reference Area
Eastern kingbird*	*Tyrannus tyrannus*	X	
European starling	*Sturnus vulgaris*	X	
Gadwall	*Anas strepera*	X	X
Gray catbird	*Dumetella carolinensis*	X	
Great blue heron*	*Ardea herodias*	X	X
Great crested flycatcher	*Myiarchus crinitus*	X	
Great egret	*Casmerodius albus*	X	X
Greater black-backed gull	*Larus marinus*	X	X
Greater yellowlegs	*Tringa melanoleuca*		X
Green heron	*Butorides striatus*	X	
Green-winged teal*	*Anas crecca*	X	
Herring gull	*Larus argentatus*	X	X
Killdeer	*Charadius vociferus*	X	
Least bittern*	*Ixobrychus exilis*	X	
Least flycatcher*	*Empidonax minimus*	X	
Least tern*	*Sterna antillarum*	X	
Lesser black-backed gull	*Larus fuscus*	X	
Mallard	*Anas platyrhynchos*	X	X
Marsh wren	*Cistothorus palustris*	X	X
Mourning dove	*Zenaida macroura*	X	
Mute swan	*Cygnus olor*		X
Northern harrier*	*Circus cyaneus*		X
Northern mockingbird	*Mimus gunlachii*	X	
Northern pintail	*Anas acuta*		X
Palm warbler	*Dendroica palmarum*	X	
Peregrine falcon*	*Falco peregrinus*		X
Purple finch	*Carpodacus purpureus*	X	
Red-tailed hawk	*Buteo jamaicensis*	X	
Red-winged blackbird	*Agelaius phoeniceus*	X	X
Ring-billed gull	*Larus delawarensis*	X	X
Ring-necked pheasant	*Phasianus colchicus*	X	
Rufus-sided towhee	*Pipilo erythrophthalmus*	X	
Sandpiper species	*Scolopacidae* species		X
Sharp-shinned hawk*	*Accipiter striatus*		X
Sharp-tailed sparrow	*Ammoodramus caudacutus*		X
Short-eared owl*	*Asio flammeus*	X	
Snow goose	*Chen caerulescens*	X	
Snowy egret	*Egretta thula*		X
Song sparrow	*Melospiza melodia*	X	X
Swamp sparrow*	*Melospiza georgiana*	X	
Tree swallow	*Tachycineta bicolor*	X	
Tricolored heron*	*Egretta tricolor*	X	
Warbling vireo	*Vireo gilvus*	X	

Common Name	Scientific Name	Project Area	Reference Area
White-throated sparrow	*Zonotrichia albicollis*	**X**	
Willow flycatcher	*Empidonax traillii*	**X**	
Yellow-crowned night-heron*	*Nyctanassa violacea*	**X**	
Yellow-rumped warbler	*Dendroica coronata*	**X**	
Yellow-shafted flicker	*Colaptes auratus*	**X**	**X**
Yellow warbler	*Dendroica petechia*	**X**	

Source: USACE 2002g. Compiled by Northern Ecological Associates, Inc.
Key: * State-listed threatened, endangered, or special concern species.
X = Species observed during field surveys.

3.2.7. Mammals

Numerous small terrestrial mammals (e.g., mice, rabbit, squirrel) are known to inhabit New Jersey (NJDEP 2002a). Site-specific surveys for small mammal usage of the Project Area were conducted in June and October 2001. Results of these surveys confirmed the presence of seven mammal species within the Project Area including white-footed mouse (*Peromyscus leucopus*), house mouse (*Mus musculus*), southern red-backed vole (*Clethrionomys gapperi*), Norway rat (*Rattus norvegicus*), eastern cottontail rabbit (*Sylvilagus floridanus*), muskrat (*Ondatra zibethicus*), and raccoon (*Procyon lotor*) (Table 10) (USACE 2002f). These mammals are generalist species that have adapted to urban environments.

Mammals were observed in almost every community type within the Project Area. Mice and voles were predominately observed in *Phragmites*-dominated wetlands and upland forested areas. Evidence of raccoon and muskrat activity was observed along several of the small ponds scattered throughout the Project Area. Eastern cottontails were commonly observed within woodlands, along roads and paths, and grazing in the maintained playing fields within and adjacent to the Project Area. Muskrats were the only mammals observed at the reference area during survey activities. Muskrat houses and muskrat individuals were observed in, and swimming between, the salt marsh and *Phragmites*-dominated wetlands (USACE 2002f).

Table 10. Mammal Species Observed in the Project Area

Common Name	Scientific Name	Project Area	Reference Area
Eastern cottontail rabbit	*Sylvilagus floridanus*	**X**	
House mouse	*Mus musculus*	**X**	
Muskrat	*Ondatra zibethicus*	**X**	**X**
Norway rat	*Rattus norvegicus*	**X**	
Raccoon	*Procyon lotor*	**X**	
Southern red-backed vole	*Clethrionomys gapperi*	**X**	
White-footed mouse	*Peromyscus leucopus*	**X**	

Source: USACE 2002f. Compiled by Northern Ecological Associates, Inc.
Key: X = Species observed during field surveys.

3.3. CULTURAL AND HUMAN ENVIRONMENT

As a portion of the larger Abraham Lincoln Memorial County Park, Lincoln Park West was never fully developed. Historic maps consistently show the area as uninhabited, undesirable marsh and lowland (USACE 2003). Large portions of the property are covered with recent garbage. The only structure currently on the property is the concrete bulkhead along the Hackensack River shore. The Project Area remains undeveloped, with areas of upland herbaceous, forest/scrub-shrub, salt marsh, and salt and fresh water-influenced *Phragmites* wetlands. Subsurface investigations did not identify significant cultural resources within the Area of Potential Effect. The following sections describe the existing prehistoric and historic resources in the vicinity of the Project Area.

3.3.1. Prehistoric

The Project Area is in proximity to two prehistoric sites. The nearest site (i.e., 26 Hd 7) is approximately 700 feet to the east on higher ground. Prior to landfilling, the Project Area would have been wet marshland, which is unlikely to have been inhabited by prehistoric groups (USACE 2003).

3.3.2. Historic

Historic maps show that there was no sign of development in the Project Area until 1904. Although development was proposed, it was never constructed. By 1911 there were several structures and a man-made lake in the Project A-rea. The structures are all on pilings and the two most notable are indicated on the map as the Jersey City Gun Club and the Passaic River Yacht Club. Many facilities were proposed but never constructed. The most notable changes to the property were the concrete bulkhead, built early in the twentieth century, and State Route 1 and 9, which separated the western and eastern portions of the Park by the early 1940s (USACE 2003).

3.3.3. Population

Based on the 2000 Census, the population of Jersey City was estimated at 240,055. Over the past 10 years Jersey City has experienced a relatively small population increase of 5.0% (Hudson County Planning Board [HCPB] 2002). In contrast, the population of Hudson County increased 10.0% and the State of New Jersey increased 8.9% over the same period. In 2000, Hudson County's total population was estimated at 608,975. Approximately 7.2% of New Jersey's population (8.4 million) resides in Hudson County, the most densely populated county in the state.

3.3.4. Economy, Income and Employment

Prior to the economic downturn of 2008-2009, the economy in Hudson County was experiencing growth and development in almost every aspect of the economy. The unemployment rate was down, job generation and retention was up, development was on the rise, the crime rate was down, and the quality of life continued to improve. In particular, many state and Federal programs and increased tourism opportunities have contributed to the improved economy (HCPB 2002). Current statistics are unavailable at the time of this writing.

In 1990, the average per capita income in Hudson County was estimated at $14,480, which was lower than the statewide average of $18,714, and ranked 19th out of the 21 New Jersey counties. Hudson County has historically had a relatively low per capita income because of the high levels of unemployment and public assistance it has experienced (HCPB 2002). However, by 1999, the average per capita income had risen to $27,662 for Hudson County residents, and $35,612 for the state. The 1999 per capita income level places Hudson County at 17th of New Jersey's 21 counties, which is 78% of the state average and 97% of the national average of $28,546 (Hudson County Economic Development Corporation 2002).

The unemployment rate in Hudson County has experienced fluctuations throughout the past decade ranging from 5.7–11.2%. However, in 2000, unemployment was estimated at its lowest rate in recent history (5.7%) (New Jersey Department of Labor 2002). Employment in the manufacturing, retail trade, insurance, and real estate industries comprised the bulk of the work force, with smaller percentages employed in agriculture, forestry, fishing, and mining industries. Prior to the economic downturn, Hudson County was projected to have large gains in employment through 2010, due to an expanding local economy, strategic redevelopment, including redevelopment of waterfront areas, and supportive government policies (HCPB 2002).

3.3.5. Housing

Hudson County has a rich history of providing for the diverse needs of its residents. From the latter part of the 1800's to the late 1970's, significant population surges resulting from various ethnic immigrant populations occurred throughout Hudson County. The flood of immigrants placed a strain on the ability of local communities to provide the needed housing to handle the new residents. This influx of people forced the county to address the needs of low-income residents and emphasized the difficulties of ensuring reasonable quality, safe shelters for thousands of people. Today, Hudson County still has high concentrations of low-income families and more than 7,000 deteriorated housing units in need of rehabilitation (HCPB 2002).

In 2000, there were approximately 240,618 housing units in Hudson County, including the 93,648 units located in Jersey City. Most of the homes in Hudson County were constructed prior to 1940. In 1990, 84.4% of Hudson County's housing units were multi-family, containing two or more families (HCPB 2002).

3.3.6. Education

The average enrollment of school age students in Jersey City has been steadily increasing over the past 20 years and is expected to continue rising. In 1990, approximately 28.3% of Jersey City residents age 25 or older had achieved a high school education or higher and 13.3% had achieved a bachelor's degree or higher.

3.4. THREATENED, ENDANGERED, AND SPECIAL CONCERN SPECIES

The project partners contacted the NJDEP Natural Heritage Program (NHP) and NOAA's National Marine Fisheries Service (NMFS) to request information on any known occurrences of federal or state endangered, threatened, proposed, or candidate species of flora or fauna or any critical habitats known to support those species within the vicinity of the Project Area. The USFWS New Jersey Field Office website was reviewed to determine whether any federally listed species may occur in the Project Area. Agency correspondence is provided in Appendix B.

3.4.1. Federally Listed Species

The table *Federally Listed and Candidate Species Occurrences in New Jersey by County and Municipality* located on the U.S. Fish and Wildlife Service's (USFWS) New Jersey Field Office website (http://www.fws.gov/northeast/njfieldoffice/) indicates that there are no Federally-listed species known to occur in Hudson County, New Jersey. Therefore, no additional correspondence with the USFWS is required.

The NMFS reports in its February 5, 2009 and June 16, 2009 correspondence that no threatened or endangered species under the jurisdiction of NMFS are expected to occur within the Project Area. In accordance with the Fish and Wildlife Coordination Act, NMFS lists the Hackensack River as an important migratory pathway for the anadromous species alewife and blueback herring. These species are listed by NOAA as species of concern.

3.4.2. State Listed Species

The NJDEP NHP reports in its January 29, 2009 correspondence that the Natural Heritage Database and Landscape Project Database indicate Cattle Egret, Glossy Ibis, Little blue Heron, Snowy Egret and Peregrine Falcon are known to occur within the Project Area (see Table 11). Cattle Egret, Glossy Ibis, Little blue Heron, and Snowy Egret are considered species of special concern. Special concern applies to species that warrant special attention because of some evidence of decline, inherent vulnerability to environmental deterioration, or habitat modification that would result in their becoming a Threatened species. At the national level, the peregrine falcon has been removed from the Federal Endangered Species List. This is based on USFWS data that indicates the American peregrine has recovered in sufficient numbers throughout most of the country. The peregrine is still listed as an endangered species in the state of New Jersey, due to the concerns of human disturbance and the threat of contaminants in the environment.

Although, the state-listed endangered Least tern (*Sterna antillarum*), the state-listed threatened Yellow-crowned Night Heron (*Nyctanassa violacea*), and Black-crowned Night Heron (breeding population only) (*Nycticoraz nycticorax*) were not identified by NJDEP as inhabiting the Project Area, these species were observed within the Project Area during USACE ecological sampling activities conducted in 2002. Black-crowned Night Herons forage in marshes and along the edges of ponds and creeks. Within coastal tidal marshes, black-crowned night herons will forage in shallow tide pools, tidal channels, mudflats and in the vegetated marsh. Preferred roosting habitat consists of mixed hardwood forests and scrub-shrub habitats. Hardwood species preferred by the Black-crowned Night Heron include Red maple (*Acer rubrum*), Sweetgum (*Liquidambar styraciflua*), Black gum (*Nyssa sylvatica*), and Blueberry (*Vaccinium* spp.). Herons will also roost in marshes that contain shrubs such as marsh elder (*Iva frutescens*). Yellow-crowned Night Herons roost in habitats similar to those of the Black-crowned Night Heron, including dredge spoil islands and bay islands containing forested wetlands or scrub-shrub thickets. They often nest in colonies in trees or shrubs overhanging the water. Yellow-crowned night herons forage along the shores of tidal creeks and tide pools within salt and brackish marshes dominated by *S. alterniflora*. They also wade in shallow water and mudflats in search of prey.

The ERR/EA (USACE 2006) indicates the state-listed endangered Short-eared Owl (*Asio flammeus*) is likely to occur in the Project Area. In addition, seven New Jersey Division of Fish and Wildlife species of special concern were identified as likely to be found in the Project Area, including the Fowlers Toad (*Bufo woodhousii fowlen*), American Kestrel (*Falco sparverius*), Great blue Heron (*Ardea herodias*), Least Bittern (*Ixobrychus exilis*), Least Flycatcher (*Empidonax minimus*), Sharp-shinned Hawk (*Accipiter striatus*), and Tricolored Heron (*Egretta tricolor*). In addition, the USFWS' New Jersey Field Office has designated species of concern for the breeding populations of six species that are likely to occur in the Project Area. These species include the American Woodcock (*Scolopax minor*), Blue-winged Teal, Brown Thrasher (*Toxostoma rufum*), Eastern Kingbird (*Tyrannus tyrannus*), Green-winged Teal (*Anas crecca*), and Swamp Sparrow (*Melospiza georgiana*).

In addition, Jersey City, Hudson County, New Jersey is not listed on Attachment C – Known Locations of Swamp Pink in New Jersey or Attachment D – Known Location of Bog Turtles in New Jersey pursuant to the tables located in N.J.A.C. 7:7A.

Table 11. State-listed Species Occurrence in the Project Area.

Common Name	Scientific Name	State Status
Cattle Egret	*Bubulcis ibis*	SC
Glossy Ibis	*Plegadis falcinellus*	SC/S
Little Blue Heron	*Egretta caerulea*	SC
Peregrine Falcon	*Falco peregrinus*	E
Snowy Egret	*Egretta thula*	SC/S

Source: New Jersey Natural Heritage Program, 2009
E= are those whose prospects for survival in New Jersey are in immediate danger because of a loss of or change in habitat, over-exploitation, predation, competition, disease, disturbance, or contamination.
SC= Special Concern - applies to animal species that warrant special attention because of some evidence of decline, inherent vulnerability to environmental deterioration, or habitat modification that would result in their becoming a Threatened species. This category would also be applied to species that meet the foregoing criteria and for which there is little understanding of their current population status in the state.
S= Stable species-a species whose population is not undergoing any long-term increase/decrease within its natural cycle.
Status for species separated by a slash (/) indicate a dual status. The first status refers to the state breeding population, and the second status refers to the migratory or winter population.

4.0 PROJECT ALTERNATIVES

This section describes the process by which NOAA, its co-trustees, and other project partners including the NJDEP, the U.S. Army Corps of Engineers, and the HCDPR, developed restoration alternatives for the LPWWRP area and evaluated the environmental impacts and benefits of those alternatives. Based on these analyses, the trustees are proposing to implement Alternative 2.5 as the preferred alternative to accomplish restoration at the LPWWRP site.

Three alternatives were developed including a no action alternative, wetland restoration with optional pond enhancement alternative, and wetland restoration without pond enhancement alternative. Except for the no action alternative, each restoration alternative includes options for the removal of the fill previously placed at the site, re-contouring the landscape so the optimum duration of tidal flooding could be achieved for the desired habitat, and planting native vegetation on the newly graded landscape. This Project was designed to maximize, to the greatest extent possible, the area of S. alterniflora-dominated salt marsh, within the limitations of the space available for restoration activities. To meet this objective, alternative restoration plans were developed to remove and control the spread of Phragmites, including enhancement of the adjacent pond. The pond is a source of extensive Phragmites growth and low resource value. Tidal elevations amenable to Phragmites establishment and growth were avoided as much as possible to minimize the potential for Phragmites invasion in the future.

The bio-benchmarks and the tidal elevations observed and analyzed at the site identified a target grading range between 0.75 to 2.5 feet NGVD29 (Appendix E, Figure 12). *S. alterniflora* was observed to be growing between 0.1 to 3.1 feet NGVD29. The lowest point at which *Phragmites* was observed was 2.7 feet NGVD29. The aforementioned target grading range was chosen because it offered room for the low marsh to expand, and it conservatively let the marsh adjust to the different friction conditions that the marsh could experience as the plants grow, without sacrificing acreage of low marsh. The creek layouts were adjusted so the slopes of the low marsh would provide for adequate drainage. Mudflats would exist on the banks of all the proposed and enhanced creeks at low tide. A hydrodynamic model was created and calibrated to validate the proposed alternatives, so that all proposed locations of low marsh were within the duration of flooding that currently exists for *S. alterniflora* on-site. This numerical model is explained, and its results can be found in Appendix B (USACE 2006).

The existing 1,000 foot concrete bulkhead/retaining wall located along the Hackensack River remained in all alternatives, at the request of the NJDEP, the local sponsor for the project. The retaining wall, while dilapidated, has historic and recreational value to the community. A 35 foot wide buffer is maintained aside the retaining wall at all times. No excavation will occur here in order to protect and maintain the structural integrity and stability of the wall. The sections of the site that are not protected by the retaining wall have tidal creeks and embayments that cut into the site from the Hackensack River. These features would be enhanced to convey the proper hydrodynamic exchange into the proposed intertidal wetland. Based on the hydrodynamic modeling, it was predicted that the banks of the Hackensack River adjacent to the site, and in the enhanced creeks themselves, would be mostly stable. Based on soil investigations, the substrate of an historic creek bed has the correct soil characteristics and texture to support a tidal creek once again.

The 36-inch diameter culvert that currently connects the lake to the Hackensack River is another feature that remained in place for all alternatives. Although daylighting the culvert was initially considered as an alternative, the buried culvert traverses the site under the center section of the landfill, where elevations exceed 15 feet NGVD29. There was no indication that a historical tidal creek existed along the footprint of the buried culvert. It currently offers limited hydrologic exchange between the two bodies of water, as the culvert on the lake-side has filled up with approximately 2.5 feet of silt. It was not economically feasible or ecologically preferable to unearth the culvert. Instead, the culvert will remain active throughout the process of excavating and de-watering the fill materials and throughout the phase of de-watering of clean sand back-fill that will be delivered to the site in a sand slurry mix. The pipe will be crushed in place and retired from use after these activities.

The excavation plan for the restoration alternatives called for the minimum amount of earth movement, while achieving the following objectives:

1. Restoring/creating/enhancing the most acres of low marsh (*S. alterniflora*);
2. Maintaining public access to the site;
3. Incorporating various restoration features, including:
    a. Maximizing tidal creek fringe and essential fish habitat;
    b. Offering diverse habitats within close proximity (i.e., open water, low and high marsh, and upland);
4. Creating contiguous pristine ecosystems;
5. Enhancing existing ecological functions; and
6. Removing *Phragmites* rhizomes and preventing reestablishment.

The excavated material will be placed on top of the existing upland landfill. *Phragmites* rhizomes will be sifted out and removed from excavated sediment to the greatest extent possible to avoid reestablishment of *Phragmites* in the upland portions of the Project Area. All excavation and disposal locations will be capped with at least 1 foot of clean fill material to ensure that any possible remnants of the existing landfill will be away from active hydraulic, sediment, and benthic zones. The landfill will be closed according to an NJDEP Solid and Hazardous Waste Program Closure and Post-Closure Plan Approval received May 20, 2009. The specific design elements for all three alternatives are described in the following sections.

4.1 ALTERNATIVE 1

The goal of the first alternative restoration plan at Lincoln Park was to create a tidal wetland within the footprint of the existing Phragmites dominated fill area without extending to the adjacent 9.1 acres of open water pond. All of the options within Alternative 1 explore this avenue. Alternative 1.1 and Alternative 1.2 keep the amount of material to be excavated and removed to a minimum, while utilizing all of the access paths that exist throughout the site. The areas that were lower than elevation 10 feet NGVD29 were identified using the existing topographic mapping. From those areas, the locations closest to the existing tidal connection south of the retaining wall comprised the low marsh area, with the exception of the dirt roads and paths that currently traverse the site. Culverts were needed for this alternative to hydraulically connect the proposed salt marsh restoration areas under the existing roads and paths.

4.1.1 Alternative 1.1.

An upland island was planned in the central/west section of the Project Area. Large deciduous trees currently exist on this upland area, which has existing elevations greater than 15 feet NGVD29, and lower elevations surrounding it. Similar forested habitats exist in the southern and northern sections of the site, but their proximity to the site’s boundary made them better suited as upland peninsulas that protrude into the proposed wetland to offer varied habitat (See Appendix E, Figure 13).

The creeks were laid out to hydraulically connect the low marsh within the zone with elevations 10 feet NGVD29 or lower. Existing depressions in the topography were tied into the creek for the purpose of minimizing excavation costs. These depressions currently collect and hold stagnant water, creating prime breeding grounds for mosquitoes. They do not offer high ecological value in their current condition. Some creeks were placed strategically to create a hydraulic buffer between the low/high marsh and upland habitat, to minimize *Phragmites* invasion from the upland to the low and high marshes. The lake and the retaining wall would remain unchanged from its existing condition.

Channels were designed to tidally connect all the low and high marsh areas. The main tidal channel that connects the site to the Hackensack River would be 70 feet wide at the inlet and 2 feet deep at MLW (–2 feet NGVD29). The channel side slopes at this inlet would be stabilized using filter fabric with *S. alterniflora* plugs planted through it. All of the proposed tidal creeks would have 1:3 side slopes. This main creek would narrow to a 10 foot wide creek in less than 300 feet. The primary tidal creek, which extends east from the inlet opening, maintains a depth of –2 feet NGVD29. All other creeks have a depth of –1 foot NGVD29, with 1:3 side slopes.

For Alternative 1.1, 11.5 acres of low marsh and 6.3 acres of high marsh would be created. At low tide, 1.9 acres of tidal channels and 2.9 acres of mudflat would be present. A total of 22.6 acres would be restored. The excavated material would be placed in the northern section of the site, in a mound approximately 8 feet high, over 14.9 acres of the existing landfill. The entire site (i.e., 22.6-acre restored wetland area and 14.9-acre disposal area) would have 1 foot of clean fill placed over it. The newly created marsh would be planted with a mix of *S. alterniflora*, *S. patens* and other native tidal marsh species. The transition from marsh to existing grade would be planted with salt-tolerant herbaceous plants and salt-tolerant shrubs (e.g., *Iva frutescens*). Alternative 1.1 would generate 200,000 cubic yards (cy) of excavated material and would require placement of 60,000 cy of clean fill.

There were several issues of concern associated with Alternative 1.1. By leaving in the existing paths, the amount of marsh available for marsh creation diminishes significantly. Also, the presence of the paths creates a potential opportunity for disturbance by the public, such as illegal dumping or filling. In addition, the dirt roads and paths lie at between 5 and 8 feet NGVD29, a prime elevation for *Phragmites* to re-invade if the site is not properly managed. The marsh would wrap around the path, but the slopes from the marsh up to the roads/paths would be vulnerable to *Phragmites* invasion.

4.1.2 Alternative 1.2

Alternative 1.2 would have the same exterior boundary as Alternative 1.1 However this plan includes removal of the southern dirt road/path that separates the areas targeted for restoration in Alternative 1.1 (see Appendix E, Figure 14). Alternative 1.2 also had the same goals of keeping the amount of excavated material to a minimum by starting with areas lower than 10 feet NGVD29. Culverts under the dirt road/path would not be needed and the lake would remain unchanged in this alternative. The upland island and upland forested peninsulas described in Alternative 1.1 would also be included in Alternative 1.2.

Alternative 1.2 would convert additional areas from the dirt road/path and upland/*Phragmites* habitat to low marsh. This would increase the low marsh acreage by over 4 acres compared to Alternative 1.1 Without the dirt road/path the creek layout would not have the restrictions of culverts. Thus, creek layout was modified to incorporate more of the stagnant depressional pools in the northwest section of the site, although the overall length of the creeks remained the same.

This plan offers a more contiguous marsh plain and eliminates the need for culverts to hydraulically connect all proposed low marsh areas to the hydrology source. By removing the southern road/path that traversed the low marsh, *Phragmites* invasion would be curtailed and it would allow for the center of the marsh to be less disturbed by the public. A road/path exists at the northern boundary of the site. This northern road/path could be elevated using the excavated material, to offer a broader vista of the entire site. The northern road/path could be designed and maintained to prohibit *Phragmites* growth (i.e., mowing and treatments). Thus, the road/path could serve as the northern *Phragmites* barrier for the entire proposed low and high marsh.

The morphology and stabilization methods proposed for tidal channels in Alternative 1.1 are the same for Alternative 1.2.

For Alternative 1.2, 15.8 acres of low marsh and 7.0 acres of high marsh would be created. At low tide, 1.9 acres of tidal channels and 2.9 acres of mudflat would be present. A total of 27.6 acres would maximally be restored. The excavated material would be placed in the northern section of the site in a mound approximately 8 feet high, over 18.3 acres of the existing landfill. The entire site would have 1 foot of clean fill placed over it. The newly created marsh would be vegetated in the same manner described for Alternative 1.1. Alternative 1.2 would generate 236,000 cy of excavated material and would require placement of 74,000 cy of clean fill.

Although this alternative meets the design goals better than Alternative 1.2, it still does not maximize the area of intertidal salt marsh to its full potential.

4.2 ALTERNATIVE 2

The second alternative expands upon Alternative 1. The new feature in Alternative 2 is an open water connection, with or without optional lake enhancements, between the lake and the site's primary source of hydrology, the Hackensack River. By increasing the tidal range and prism of the lake, more flushing will occur in the lake. Currently, the tidal fluctuation of the lake is 0.5 foot, compared to the Hackensack River, which has a tidal range of over 5 feet. Also, by increasing the salinity of the lake, the perimeter of the lake will support an ecosystem more suitable for *S. alterniflora* species and less suitable for *Phragmites*, the current perimeter species.

4.2.1 ALTERNATIVE 2.1

Alternative 2.1 features a change in the pond/wetland ecosystem that would be expected to occur without the need to regrade the perimeter of the lake. Construction activities around the lake would focus only on clearing/grubbing of the *Phragmites* and planting of *S. alterniflora*. With an increase in tidal range of 1.5 to 2 feet, intertidal marsh would be expected to occupy a band approximately 15-feet wide band around the perimeter of the lake (see Appendix E, Figure 15).

Alternative 2.1 would extend the tidal creek system east to connect to the lake and convert the surrounding upland/*Phragmites* habitat to low marsh. The morphology and stabilization methods of the tidal channels proposed in Alternative 1 would remain unchanged.

For Alternative 2.1, 17.9 acres of low marsh and 7.1 acres of high marsh would be created. At low tide, 2.0 acres of tidal channels and 3.1 acres of mudflat would be present. A total of 30.0 acres would be restored. The excavated material would be placed in the northern section of the site in a mound approximately 8 feet high, over 19.0 acres of the existing landfill. The entire site would have 1 foot of clean fill placed over it. The newly created marsh would be vegetated in the same manner described previously. Alternative 2.1 would generate 244,000 cy of excavated material, and would require placement of 79,000 cy of clean fill.

A primary concern with Alternative 2.1 is the high volume (and associated high cost) of material to be excavated, to implement the alternative.

4.2.2 Alternative 2.2

Alternative 2.2 attempts to optimize the ecological benefits gained for each dollar invested. The added benefit of increasing the hydrodynamic flushing of the lake would greatly enhance the lake and the park ecosystems. The addition of the lake into the tidal hydrodynamic scheme of the Project could also be done at a minimal cost per ecological benefit. Alternative 2.2 begins with all the features of Alternative 2.1, but reduces the area of low marsh by 4 acres in the northwest and northeast sections of the site. The 4.0 acres that were eliminated from consideration were the farthest from the existing tidal connection and were areas of higher existing elevation, thus resulting in higher proposed cut volumes, upland disposal volumes, and clean fill volumes. The proposed tidal creek was modified and would provide increased flooding to the proposed low marsh areas (see Appendix E, Figure 16).

The morphology and stabilization methods of the tidal channels proposed in Alternative 1.1, 1.2 and 2.1 would remain unchanged.

For Alternative 2.2, 16.9 acres of low marsh and 5.9 acres of high marsh would be created. At low tide, 1.3 acres of tidal channels and 1.8 acres of mudflat would be present. A total of 25.9 acres would be restored. The excavated material would be placed in the northern section of the site in an approximately 8 foot high mound, over 16.0 acres of the existing landfill. The entire site would have 1 foot of clean fill placed over it. The newly created marsh would be vegetated in the same manner described previously. Alternative 2.2 would generate 206,000 cy of excavated material and would require placement of 67,000 cy of clean fill.

One concern with Alternative 2.2 is that leaving intact an upland peninsula in the northern central section of the proposed restoration area may provide an opportunity for re-invasion by *Phragmites.* The elevations in this area are appropriate for *Phragmites* establishment and growth.

4.2.3 Alternative 2.3

The design goal of achieving a contiguous marsh was enhanced in Alternative 2.3 (see Appendix E, Figure 17). The upland peninsula in the northern central section of the proposed restoration area was not included in the previous layouts because the existing elevations exceed 10 feet NGVD29. Thus, to convert this area to a low marsh community would involve more excavation than converting some of the other areas. Despite the added expense of including this area in the low marsh design, the high marsh fringe is the most vulnerable to *Phragmites* invasion, and exclusion of this area from restoration greatly increases the boundary of the high marsh to existing grade. Transforming this area into low marsh would create a more contiguous tidal ecosystem.

The morphology and stabilization methods of the tidal channels proposed in the previous alternatives would remain unchanged.

For Alternative 2.3, 17.5 acres of low marsh and 5.5 acres of high marsh would be created. At low tide, 1.3 acres of tidal channels and 1.8 acres of mudflat would be present. A total of 26.2 acres would be restored. The excavated material would be placed in the northern section of the site, in a mound approximately 8 feet high, over 16.4 acres of the existing landfill. The entire site would have 1 foot of clean fill placed over it. The newly created marsh would be vegetated in the same manner described previously. Alternative 2.3 would generate 212,000 cy of excavated material and would require placement of 69,000 cy of clean fill.

Alternative 2.3 would accomplish the purpose and need of the Project, however, one of its cost savings measures (a 1.0 ft depth of clean cap) was found to be less protective by the Trustees and by State regulatory authorities. Additionally, Alternative 2.3 would provide 26.2 total acres of wetland restoration, whereas Alternative 2.5 would provide 39.9 total acres of restored wetlands and make better use of the available budget to maximized the restoration potential of the site.

4.2.4 Alternative 2.4

Alternative 2.4 is a modification of Alternative 2.1, with the upland peninsula in the northern central section of the proposed restoration area converted to low marsh (see Appendix E, Figure 18). Thus, Alternative 2.4 includes many of the previous features proposed. To summarize, the areas lower than 10 feet NGVD29 and the southern dirt/path would be removed and regraded to low marsh elevations. Just as all of the options in Alternative 2, the lake would be connected to the Hackensack River. Also, Alternative 2.4 would not truncate the areas furthest from the Hackensack River.

The morphology and stabilization methods of the tidal channels proposed in the previous alternatives would remain unchanged.

For Alternative 2.4, 18.5 acres of low marsh and 6.8 acres of high marsh would be created. At low tide, 2.0 acres of tidal channels and 3.1 acres of mudflat would be present. A total of 30.3 acres would be restored. The excavated material would be placed in the northern section of the site, in a mound approximately 8 feet high, over 19.4 acres of the existing landfill. The entire site would have 1 foot of clean fill placed on it. The newly created marsh would be vegetated in the same manner described previously. Alternative 2.4 would generate 250,000 cy of excavated material and would require placement of 80,000 cy of clean fill.

Alternative 2.4 would also accomplish the purpose and need of the Project, however, one of its cost savings measures (a 1.0 ft depth of clean cap) was found to be less protective by the Trustees and by State regulatory authorities. Additionally, Alternative 2.3 would provide 30.3 total acres of wetland restoration compared to 39.9 total acres provided by Alternative 2.5, based on the available budget if used to maximize the restoration potential of the site.

4.2.5 Alternative 2.5

Alternative 2.5 maximizes the creation of low marsh, minimizes excavation, and also proposes the creation and enhancement of additional upland and wetland community types within the Project Area. Alternative 2.5 would connect the lake with the tidal channel system (see Appendix E, Figure 19) and would provide a continuous low marsh/tidal creek complex stretching over 1,200 feet from the Hackensack River to the lake. This modification would reduce the potential for re-invasion by *Phragmites* from the upland areas. Wetland and upland scrub-shrub communities would be planted to provide vertical heterogeneity. The establishment of native woody stem vegetation would promote plant and wildlife species diversity. The morphology of the tidal channels proposed in the previous alternatives would remain unchanged. The use of rip-rap in the vicinity of a weir structures and bridge will be evaluated as a means of provided channel stabilization.

A footpath would be constructed on uplands along the northern portion of the Project Area, along the western edge of the lake on uplands crossing the primary tidal channel on a footbridge, and along the southern edge of the marsh complex. The addition of a walkway/nature path through the Project Area would continue to be coordinated with Hudson County and would completment plans for other trails and environmental/visitor centers in the area, as well as the Hackensack River Walk.

Alternative 2.5 would result in approximately 34.4 acres of wetland and open water habitats, including 19.9 acres of low marsh, 1.4 acres of high marsh, 12.4 acres of tidal channels and mudflat, and 0.7 acre of scrub-shrub wetlands. The lake would not be physically altered by construction, but an additional hydrologic connection to the Hackensack River would be created. Herbaceous and scrub-shrub uplands would cover 3.2 acres, while walkways and the footbridge would account for 0.6 acres. A total of 39.9 acres would be included in the restoration Project. Wherever waste is over-excavated within the Project Area, clean fill material will be required to establish the required elevations. The newly created marsh plain would be vegetated in the same manner described previously.

The excavation of the Project Area will involve the removal of approximately 269,000 cy of material from the wetland restoration area and placing the material atop the existing landfill. Areas within the wetland restoration area containing waste will be over-excavated by two feet and then filled with clean material requiring the placement of approximately 250,000 cy of clean fill for the entire project (approximately 100,000 cy for the wetland restoration area and approximately 150,000 cy for the landfill closure project).

The clean fill that would be placed over the site would be beneficially re-used sand dredged from the upcoming USACE/Port Authority of NY and NJ dredging of the Anchorage Channel. Although the landfill closure and golf course development projects would use sand from the same source and would complement the LPWWRP, these actions are not part of the federal actions being considered in this Draft RP/EA. A total of about 250,000 cubic yards of sand would be needed for all 3 projects. A temporary Sand Containment and Dewatering Facility (CDF) would be placed in an upland area east of the lake to receive and dewater clean sand fill. Sand would be shipped to the site by barge, hydraulically pumped to the CDF, and dewatered prior to placement over the salt marsh areas.

4.2.5.1 Alternative 2.5 with a Pond Option (2.5.1)

Alternative 2.5.1 is configured to deliver exactly the same configuration of services and acreages as Alternative 2.5 but with the addition of enhancing the services provided by the connected pond (see Appendix E, Figure 20). This alternative, known as the Pond Option, would not only connect the lake with the tidal channel system, it would provide a re-graded and deepened pond with a continuous wetland edge planting constructed on a re-contoured shoreline bench. This modification would create the greatest reduction in the potential for re-invasion by *Phragmites* from all upland areas and the pond edge.

Alternative 2.5.1 would result in approximately the same acres benefits as described in Alternative 2.5 with the addition of a 9.1 acre enhancement of the pond condition. The lake would be physically altered by construction, and would enhance the habitat value of the pond and the 1,200 foot long length of the hydrologic connection to the Hackensack River that was created leading to it. A total of 39.9 acres would be included in the restoration Project. The lake would be over excavated by two feet depth and backfilled with clean sand materials. The pond edge would have a bench of sand backfill set at an elevation within 0.0’ to 1.0’ to provide a suitable planting zone for intertidal emergent grasses. The newly created marsh bench within the pond would be vegetated in the same manner as the wetland described in Alternative 2.5.

The excavation of the Project Area will involve the removal of approximately 326,000 cy of material from the wetland restoration area and placing the material atop the existing landfill (269,000 from the wetland and 56,500 approximately from the pond). Areas within the wetland restoration and the pond area containing waste will be over-excavated by two feet and then filled with clean material requiring the placement of approximately 280,000 cy of clean fill for the entire project (approximately 130,000 cy for the wetland restoration area and approximately 150,000 cy for the landfill closure project).

The clean fill that would be placed over the site would be beneficially reused sand dredged from the upcoming USACE/Port Authority of NY and NJ dredging of the Anchorage Channel as per Alternative 2.5. The temporary Sand Containment and Dewatering Facility (CDF), described in Alternative 2.5 would handle the processing of the additional 30,000 cubic yards of clean material needed for backfilling of the pond.

Table 12 below presents a summary of the Proposed Habitat Types within the Project Area that will result through implementation of Alternative 2.5 and/or the 2.5.1 Option. NOAA and its project partners have identified either Alternative 2.5 or 2.5.1 as a preferred alternative, with plans to implement 2.5.1 if there are sufficient funds.

Table 12. Proposed Habitat Types for the Project Area

Proposed Habitat Type	**Area (Ac.)**
Estuarine Wetlands	
Open Water/Mudflat (TOW/MF)	12.38
Emergent - High Marsh (EEM)	1.35
Emergent - Low Marsh (EEM)	19.92
Scrub-Shrub (ESS)	0.70
Total	34.35
Uplands	
Herbaceous (UH)	0.59
Scrub-Shrub (USS)	1.32
Forest (UF)	1.32
Total	3.23
Walkways and Bridge	0.56
Undisturbed	1.75
Total	**39.89**
Open Water	
Open Water/Pond with wetland bench (Alternative 2.5.1)	**9.1**

4.3 ALTERNATIVE 3

The third alternative is a no-action alternative. This would leave the Lincoln Park West Wetland Restoration Project site in the current state – at least temporarily. The site could exist temporarily in its current condition until Hudson County completes the landfill closure and capping that the state of NJ is requiring. Until that time, existing Phragmites grasslands would remain in place and either expand or contract depending on competition from other vegetation entities. Existing upland shrub/scrub and woodland areas would likely expand or contract dependent on yearly fluctuations of weather conditions, rainfall, and presence of pests and disease. The site in its current condition would continue to provide limited services to marine finfish and shellfish. In the short term, Alternative 3 would necessitate the need for a redesign of the landfill closure plan.

Table 13. Summary of Restoration Alternatives

	No Action	Alt.1.1	Alt.1.2	Alt. 2.1	Alt. 2.2	Alt. 2.3	Alt. 2.4	Alt. 2.5	Alt 2.5.1
Acres of Channel	0	1.89	1.89	1.99	1.32	1.32	1.99	3.9	3.9
Acres of Mudflat	0	2.88	2.88	3.06	1.84	1.84	3.06		
Acres of Intertidal	0	11.48	15.82	17.86	16.86	17.52	18.52	19.2	19.2
Acres Supratidal	0	6.31	6.97	7.12	5.85	5.49	6.76	2.2	2.2
Open water Pond	0	0	0	0	0	0	0	0	9.1
Total Acres Restored	**0**	**22.56**	**27.57**	**30.04**	**25.88**	**26.17**	**30.33**	**39.9**	**50.0**
CY excavated	0	200,000	236,000	244,000	206,000	212,000	250,000	269,000	326,000
CY clean fill	0	60,000	74,000	79,000	67,000	69,000	80,000	100,000	130,000

5.0 ENVIRONMENTAL CONSEQUENCES

5.1 PROPOSED ACTION

This section presents the environmental impacts of the proposed Project on physical, ecological, cultural, aesthetic, socioeconomic, and recreational conditions of the Project Area. Alternative 2.5 or Alternative 2.5.1 (Pond Option), is identified as the preferred alternative because it most effectively meets the stated goals of the project, namely: to compensate the public for injuries to natural resources caused by the Exxon Bayway and B.T. Nautilus oil spills by: restoring the historic tidal hydrologic connection between the restoration site and Hackensack River; increasing the percent cover of Spartina alterniflora; improving the aesthetic viewshed associated with the site; enhancing fisheries and wildlife breeding, nursery, forage and refuge habitat; and, providing a cost effective means to accomplish the restoration of marsh acreage and functionality. Alternatives 2.5 or 2.5.1 also meets the goals of the NOAA Restoration Center's ARRA Competitive Grant Program.

5.1.1 GEOMORPHOLOGY AND SOILS

Implementation of the preferred alternative would result in significant changes to existing topography. However, these changes are expected to be beneficial. The existing topography would be modified throughout the majority of the site according to the preferred restoration plan, and the project would involve: excavation of accumulated waste associated with the adjacent landfill, historic fill material, and *Phragmites*-dominated areas; creation of intertidal and supratidal areas, including the creation of tidal creeks to supply an additional tidal hydrology source; and, deposition of excavated spoil material on the landfill. The design for the preferred restoration plan includes restoring 19.2 acres of low marsh and 1.3 acres of high marsh. Tidal channels and mudflat would cover 3.9 acres, and scrub-shrub wetlands would cover 0.9 acres. The lake would not be physically altered by construction, but an additional hydrologic connection to the Hackensack River would be created. Herbaceous and scrub-shrub uplands would cover 2.8 acres, while walkways and the footbridge would account for 0.7 acres. A total of 39.2 acres of habitat would be restored.

Activities proposed for the intertidal zone include connecting the Hackensack River and the existing man-made lake via a primary tidal creek and creating additional secondary tidal creeks to increase the hydrology supply across the site. The majority of the restoration area is currently at an elevation of 10 feet NGVD29 or lower. Material from this area would be excavated and deposited atop the adjacent landfill as part of the landfill closure process and according to the following specifications:

- Primary tidal creeks would range from 70 ft wide at the mouth to 10 ft wide, at a depth of -2 ft NGVD29, grading up to 0.75 ft NGVD29 on a 1:3 slope. Secondary tidal creeks would be approximately 10 ft wide, at a depth of -1 foot NGVD29, grading up to 0.75 ft NGVD29 on a 1:3 slope.
- Mudflat areas are the portions of the channels that, at low tide, extend from mean low water (-1.89 ft NGVD29) to the edge of the intertidal community (0.75 ft NGVD29).
- Intertidal zone slopes would vary depending on the distance between tidal creeks/mudflat (0.75 ft NGVD29) and the upper limit of the intertidal community (2.5 ft NGVD29).
- The supratidal zone would extend from the intertidal zone to the upper limit of the restoration area, on a 1:3 slope.
- Excavated spoil material would be deposited in specified upland areas within the Project Area to a depth of approximately 8 ft above the existing elevation.

The entire restoration area would be excavated approximately 2 feet below the desired depth and clean fill material would be placed over the existing soil. In addition, the upland disposal area would receive a cap of clean sand fill. The clean sand fill would be beneficially reused sand dredged from the USACE/Port Authority of NY and NJ dredging of the Anchorage Channel. This clean fill material has been approved by USACE and NJDEP for use as cap material for this Project.

No significant or long-term impacts would occur to geology within the Project Area.

5.1.2 LAND USE AND ZONING

Implementation of the preferred alternative would result in a change of land cover types from *Phragmites*-dominated land, upland herbaceous, and forest/scrub-shrub to a predominantly a saline marsh ecosystem with minor components of upland herbaceous and scrub-shrub habitats. Land uses in the Project Area are primarily recreational and open space uses and the increased area of salt marsh would provide additional recreational opportunities and open land. Accordingly, no negative impacts to land use are anticipated as a result of the construction of the preferred alternative.

The entire Project Area is located in a Parks-Open Space zone as defined by the Jersey City zoning regulations. Construction of the preferred alternative would be consistent with the current city zoning regulations and policies. Accordingly, no significant impacts to zoning would result from construction of the preferred alternative.

5.1.3 WATER RESOURCES

The following sections present Project impacts associated with regional hydrogeology and groundwater resources, surface water, and tidal influences.

5.1.3.1 Regional Hydrogeology and Groundwater Resources

The excavation and regrading of the Project Area and off-site disposal of excavated materials for the proposed Project would change the existing grades. However, the preferred alternative is not expected to have significant negative impacts on the regional hydrology and groundwater resources.

5.1.3.2 Surface Water

The proposed Project is expected to result in temporary increases in turbidity during construction. Excavation of the waste material to create tidal creeks and excavation of the marsh plain also may cause a temporary degradation of water quality in the Hackensack River and areas within the Project Area during construction. However, best management practices would be used to minimize and/or prevent sediments from entering the Hackensack River, including installation of a temporary water exclusion berm at the main inlet and floating turbidity barrier just offshore, as well as other erosion and sedimentation controls, to protect the Hackensack River to the maximum extent possible during construction. Therefore, turbidity caused by construction activities should be minimal and re-suspended sediments are likely to quickly settle out of the water column or be dissipated by the tidal fluctuations of the Hackensack River. Accordingly, turbidity and sedimentation would have minimal impact to the overall surface water quality of the Project Area and the Hackensack River. A Clean Water Act Section 404(b)(1) Guidelines Evaluation was completed for the ERR/EA (USACE 2006). Soil Erosion and Sediment Control Plan authorization from the Hudson, Essex, and Passaic Counties Soil Conservation District will be acquired prior to any construction activities.

5.1.3.3 Tidal Influences

The proposed Project would significantly alter the tidal influence of the Project Area. The intent of the excavation is to extend the existing tidal creeks (both primary and secondary channels), lower the marsh plain elevation, and provide better overall tidal inundation and circulation within the Project Area. The alteration of on-site tidal influences is vital to providing the necessary hydrology for salt marsh habitat restoration and is not expected to cause significant offsite impacts. Additional information on tidal influences and the hydrodynamic model are included in the ERR/EA (USACE 2006).

5.1.4 VEGETATION

This section describes impacts to wetland and upland vegetation resources. Implementation of the preferred alternative would result in conversion of a relatively degraded wetland complex and associated uplands to valuable and vital salt marsh wetland habitat. Accordingly, there would be positive impacts on vegetation as a result of implementation of the preferred alternative.

5.1.4.1 Wetlands

Implementation of the preferred alternative would have a long-term beneficial impact on wetlands. Currently, only small patches of remnant salt marsh exist within the Project Area. Creation of additional high value salt marsh as the result of conversion of low value *Phragmites*-dominated habitat would restore a significant extent of salt marsh was historically present on the site. This conversion would also have a positive effect on the existing diversity of wildlife habitat on site.

Although the USEPA considers all estuarine wetlands in the Project Area as priority wetlands, salt marsh is designated as priority habitat in New Jersey (USEPA 1994), and is therefore a desirable unique feature in the landscape that is ecologically and environmentally more valuable than the existing *Phragmites*-dominated wetlands. Specifically, *Phragmites,* forest/scrub-shrub, and upland herbaceous habitats would be permanently converted to salt marsh, resulting in a net increase of 16.5 acres of salt marsh habitat in the Project Area.

Impacts to wetland vegetation include removal of vegetation during construction activities. Existing mature trees and shrubs will be left intact to the greatest extent possible during construction. However, in the interest of removing waste material from within the Project Area, it is unlikely that significant numbers of trees will be preserved. Additionally, once construction is completed, the wetland vegetation would be restored by planting with native salt marsh species. Woody species will be planted as well in the appropriate habitat types to increase vertical heterogeneity within the Project Area.

Temporary impacts to approximately 2,000 square feet of wetlands and 3,200 square feet of transition area adjacent to the Hackensack River and north of the Project Area are anticipated from construction of the temporary above-ground dredge conveyance pipeline associated with the CDF facility. This pipeline is needed to bring clean sand fill to the site from a barge in the Hackensack River, and would be in place for up to ten weeks. Temporary impacts would be restored, as appropriate, following completion of the CDF operation. The CDF Operation would be authorized and permitted by the NJDEP Waterfront Development Permit (see section 6 for list of applicable permits and authorizations).

5.1.4.2 Uplands

Implementation of the preferred alternative will result in the permanent conversion of approximately 10 acres of upland vegetation to wetland vegetation. Specifically, 5.3 acres of upland Phragmites-dominated habitat, 4.1 acres of upland herbaceous, and 3.4 forest scrub-shrub would be disturbed and converted. The preferred alternative includes the establishment of approximately 2.3 acres of upland scrub-shrub habitat interspersed amongst the tidal creeks and salt marsh. Since salt marsh is considered a priority habitat in New Jersey and is considered to be of higher value than the existing upland habitats, the Project Team decided that conversion to salt marsh is acceptable.

However, HCDPR has expressed interest in saving and transplanting as many of the shrubs and trees from the forest/scrub-shrub areas as feasible to preserve some of the character and nature of the Project Area, and provide newly created upland areas a head start on achieving stable and diverse habitat restoration goals (Jennings 2002). This approach may be feasible. However, excavation of waste material is a Project priority and may compromise the salvage of on-site woody species. Also, *Phragmites* is seen as an aggressive wetland transitional species that tends to form expansive monocultures and is undesirable. Therefore, excavation of expansive networks of *Phragmites* rhizomes is also a Project priority and may also compromise salvage of on-site woody species. Therefore, a loss of upland vegetation is anticipated due to construction of the preferred alternative. However, this impact would be offset by the net increase in priority wetland habitat.

5.1.5 FISH AND WILDLIFE

This section identifies the impacts to fish and wildlife due to the proposed Project, including shellfish, finfish, benthic resources, reptiles and amphibians, birds, and mammals. In addition, a *Final Fish and Wildlife Coordination Act Section 2(b) Report* has been prepared by the USFWS (2004).

5.1.5.1 Shellfish

The proposed Project would have a temporary impact on existing shellfish during construction. Excavation of the tidal creeks and marsh surface would dislodge and eradicate the existing shellfish (e.g., ribbed mussels), and would have a detrimental impact on specific individuals. However, shellfish species are expected to recolonize the Project Area immediately following construction with recruitment from nearby, unaffected portions of the Hackensack River adjacent to the Project Area (Hettler 1989, LaSalle et al. 1991).

An increase in turbidity and sedimentation are expected from construction activities and may affect the ability of nearby filter feeding shellfish to feed. However, best management practices, including erosion and sedimentation controls, would be used to minimize and/or prevent sediments from entering the Hackensack River, in order to protect the Hackensack River to the maximum extent possible during construction. The increased turbidity and sedimentation from construction activities are expected to quickly settle out of the water column. Any fine re-suspended sediment (silt and clay) that does not settle would be dispersed with the tidal fluctuation from the Hackensack River and would have minimal impact on existing and nearby nekton species.

The proposed Project would have an overall beneficial result on the existing shellfish species. The excavation of the primary and secondary tidal creeks and excavation of the marsh surface would restore tidal hydrology to the Project Area, promote tidal inundation, and improve the quality and quantity of suitable mudflat substrate. Additionally, the creation of salt marsh and additional deeper/wider tidal creeks would provide expanded habitat with substantial feeding opportunities and reduced predation risk, and encourage recruitment and establishment of shellfish and nekton species in the tidal creeks and marsh surface (Hettler 1989). In general, results from spring, summer, and fall nekton sampling events support the proposed Project. Shellfish sampling data indicated either higher or no difference in use of *S. alterniflora* habitat versus *Phragmites* habitat in the Project Area (USACE 2002d).

Some burrowing crab species (mud crab) and shrimp species (grass shrimp) may be removed during excavation activities. The overall impact to these mobile shellfish species would be minimal due to their ability to relocate to deeper waters of the Hackensack River to seek food and shelter during construction activities. Following construction activities, individuals can return to the Project Area and colonize the tidal channels and marsh plain.

5.1.5.2 Finfish and Essential Fish Habitat

Similar to the shellfish species, the proposed Project would have a temporary impact on finfish during construction. The increase in turbidity and sedimentation from dredging and excavation could potentially lead to gill abrasions and may suffocate individual fish in the Project Area, as well as hinder predation efficiency of sight feeding fish at or adjacent to the Project Area. However, best management practices, including erosion and sedimentation controls, would be used to minimize and/or prevent sediments from entering the Hackensack River, in order to protect the Hackensack River to the maximum extent possible during construction. Therefore, turbidity and sedimentation caused by the construction activities should be minimal and are likely to quickly settle out of the water column. In addition, fish are generally mobile, would be able to avoid direct impacts from construction activities, and seek the deeper water of the Hackensack River for shelter. Accordingly, risks from suffocation and gill abrasions are expected to be minimal.

The removal of benthic macroinvertebrates and dispersion of nekton species would temporarily impact food sources for finfish in the Project Area during construction. However, the existing fish species are expected to relocate and feed in the unaffected portion of the Hackensack River. In addition, benthic macroinvertebrates and nekton species are expected to recolonize the Project Area immediately following construction with recruitment from nearby, unaffected portions of the Hackensack River (Hettler 1989, LaSalle et al. 1991). Therefore, impacts to finfish due to loss of food availability are expected to be minimal.

Construction of the proposed Project would also result in beneficial impacts for some finfish species. *Phragmites* is documented to degrade marsh function, reduce tidal exchange, and restrict the free movement of aquatic life (Weinstein and Balletto 1999). Excavation and replanting of the marsh plain, and widening and extending the tidal creeks would replace the dense monospecific stands of *Phragmites* with *Spartina* species and other beneficial marsh species and promote tidal inundation of the marsh plain. Weinstein and Balletto (1999) found marshes dissected by numerous tidal creeks were used more by fish than marsh habitat with low drainage densities. In addition, fish were observed to be concentrated near the interface between the salt marsh and open water, with individuals leaving the marsh on ebb tide having fuller stomachs than individuals captured in adjacent tidal creeks.

Additionally, the results from spring, summer, and fall nekton sampling events generally support the proposed Project. Finfish sampling data indicated higher use of *S. alterniflora* habitat versus *Phragmites* habitat in the Project Area during spring and fall sampling. However, use of *S. alterniflora* habitat was lower than use of *Phragmites* during the summer sampling event (USACE 2002d). This may be attributed to the fact that the majority of the catch during the summer sampling event was killifish. Killifish exhibit no preference between *S. alterniflora* and *Phragmites* communities, but prefer areas with loose, muddy substrate into which they can burrow.

The Hackensack River provides a migratory pathway for anadromous fish such as alewife and blueback herring as they travel to spawning grounds in upstream portions of the river. Increased turbidity and degraded water quality resulting from construction activities may impede the migration of these species to their spawning areas. To minimize impacts to anadromous fish, the proposed Project would adhere to the construction window imposed by NMFS, namely that no work be performed within the Hackensack River between March 1st and June 30th.

EFH has been designated near the Project Area. Winter flounder, and EFH-designated species may use the Hackensack River adjacent to the Project Area for spawning. Other EFH-designated species and their prey may also be present. To protect winter flounder EFH, NMFS recommends that work within the Hackensack River be avoided from January 1st to May 31st. Provided Best Management Practices are used to isolate the Project Area from the Hackensack River and minimize the release of sediments to the river during construction, work within the Project Area does not require a timing restriction.

The increase in salt marsh acreage and the creation of tidal channels would physically allow more fish movement in and out of the salt marsh and lake. The increased volume of water and improved water quality in the restored salt marsh would increase the availability and quality of habitat for all trophic levels of aquatic organisms. In particular, these improvements would benefit forage fish for EFH-designated species, as many of these forage fish spend most or all of their life in salt marshes. Larger numbers of small, resident forage fish in the salt marsh would provide an increased food source for larger predatory EFH-designated species that would also be able to move more easily into and out of the salt marsh due to the presence of primary and secondary tidal channels and removal of tidal restrictions. Improved water and sediment quality will result in more expansive benthic habitat required for demersal fish species, including EFH-designated species.

Construction activities may result in short-term increases in erosion and delivery of sediment to nearby wetlands and waters. Most EFH-designated species likely to occur in the Hackensack River are typically found in the often turbid conditions of estuaries and can avoid temporary increases in suspended sediments. Impacts will be mitigated by measures including isolating the construction area from the Hackensack River, performing in-water work during low tide, working in dry conditions within a temporary water exclusion berm and floating turbidity barrier to minimize migration of turbidity offsite, and re-stabilizing soils with plant material and seeding following earthwork completion. Additionally, best management practices for soil erosion and sediment control will be implemented and maintained to minimize sediment entering waterways. For these reasons, no long-term adverse impacts to EFH or EFH-designated species or their prey are expected from the proposed Project.

5.1.5.3 Benthic Resources

Excavation of intertidal and subtidal areas will result in the direct loss of benthic species and habitat in the Project Area during and immediately following construction. Benthic communities in areas temporarily isolated from tidal flow would also be lost. Additionally, excavation has the potential to result in erosion and delivery of sediment to the Hackensack River and adjacent wetlands, with associated impacts to the benthic community. Epibenthic organisms such as shrimp and crabs are mobile and can avoid areas of increased suspended sediment. However, most adult benthic infauna have limited mobility and sediment deposition may result in burial or impaired feeding.

Potential impacts to the benthic and epibenthic communities of the adjacent Hackensack River and other wetlands would be minimized and avoided by employing and maintaining best management practices for soil erosion and sediment control. Impacts to benthic macroinvertebrates would be temporary, as recolonization would commence immediately following construction. Recruitment of benthic and epibenthic organisms would come from nearby, unaffected areas of the Hackensack River (Hettler 1989, LaSalle et al. 1991). LaSalle et al. (1991) found that the species composition and relative abundances of benthic macroinvertebrates in a newly developed salt marsh are similar to those reported from natural marshes, with a trend toward greater density and more well-established populations for some species, with age of the constructed marsh complex. For these reasons, no long-term adverse impacts to benthic resources are expected from the proposed Project.

5.1.5.4 Reptiles and Amphibians

Based on the results of on-site surveys in 2001, little suitable habitat for reptiles and amphibians currently exists within the Project Area (USACE 2002f). In addition, those species found or expected on-site are fairly mobile and could relocate during construction activities. Accordingly, although some individuals may be lost during construction, the loss is expected to be minor. Therefore, no significant impacts to reptiles and amphibians are anticipated.

The creation of salt marsh within the Project Area would potentially benefit a number of reptiles that inhabit Hudson County. The increased area of salt marsh may provide suitable nesting and foraging habitat for diamondback terrapins, which are known to inhabit the Hackensack River and its associated salt marshes (USACE 2002f). Additionally, common snapping turtles also utilize salt marsh habitat for foraging, and although not observed during the 2001 reptile and amphibian surveys, mud turtles (*Kinosternon subrubrum*) can tolerate brackish water and may potentially utilize the restored salt marsh habitat.

5.1.5.5 Birds

Birds in the Project Area may temporarily be affected by construction activities. During construction, heavy machinery activity, increased noise levels, vegetation clearing, and earth moving activities may cause displacement of individuals and nesting failure/disruptions near construction activities. However, avian species are highly mobile and are expected to avoid direct mortality. Accordingly, no significant impacts to birds are anticipated.

Beneficial impacts to birds would result from the conversion of the generally *Phragmites*-dominated habitat to a salt marsh ecosystem. The expanded salt marsh would provide increased habitat for, and likely attract, salt marsh bird specialists, such as clapper rails (*Rallus longirostris*), sharp-tailed sparrows and marsh wrens. Additionally, salt marshes provide valuable foraging and nesting habitat for a variety of herons, egrets, and waterfowl.

Conversely, the removal of trees (i.e., forest/scrub-shrub) within the Project footprint would decrease the amount of habitat available for birds. Most of the birds that utilize the forested habitat within the Project Area are generalists and would disperse to other areas of similar habitat nearby. However, tree removal will be minimized, and planting of native shrubs and increased edge habitat along the border of the new marsh complex, would provide habitat for a number of forest/upland bird species.

5.1.5.6 Mammals

Mammals may be temporarily affected by construction activities on-site. During construction, heavy machinery activity, increased noise levels, vegetation clearing, and earth moving activities may cause mortality of some less-mobile small mammal species (e.g., mice and voles) individuals, or indirectly cause displacement of individuals during construction activities. However, most mammals are highly mobile and are expected to avoid direct mortality. Also, the less mobile species typically have high reproductive capability and thus can be expected to repopulate rapidly. Accordingly, no significant impacts to mammals are anticipated.

Long-term beneficial impacts to mammals would result from the conversion of the existing *Phragmites*-dominated habitat to a salt marsh ecosystem. Construction of the preferred alternative would provide increased habitat for species that utilize salt marshes, such as muskrat and raccoon. Creation of additional salt marsh would provide a greater area of higher quality habitat for these species in the Project Area.

However, conversion of existing habitat, especially the forested areas, would decrease habitat available for forest dwelling species such as gray squirrel (*Sciurus carolinensis*) and some small mammal species. Some of these species would disperse from the Project Area and recolonize similar habitats adjacent to the site.

5.1.6 RARE, THREATENED, ENDANGERED, AND SPECIAL CONCERN SPECIES

This section discusses the proposed Project's impacts on Federal and state-listed threatened and endangered species and species of special concern. Correspondence received from these agencies is presented in Appendix B.

5.1.6.1 Federal Species

No federally-listed threatened and endangered species or species of special concern are known to occur within the proposed Project Area. Accordingly, no federally-listed threatened and endangered species are likely to be impacted by the construction of the preferred alternative. Dredging of the tidal creeks and excavation of the marsh plain has the potential to cause temporary increases in turbidity and degraded water quality during construction and may impede the migration of the special concern fish species alewife and blueback herring to their upstream spawning areas. As a result, NMFS prohibits construction within the Hackensack River from March 1st to June 30th. In addition, best management practices, such as the use of hay bales, silt curtains, and erosion and sedimentation controls, would be implemented and maintained in areas adjacent to the river during construction to minimize sediments entering the river. The proposed Project would have overall benefits for fish and wildlife through the restoration of tidal hydrology to a degraded site, as well as the potential future use of the site by Federally-listed threatened and endangered species and their prey species.

5.1.6.2 State Species

The special concern species cattle egret, glossy ibis, little blue heron, and snowy egret, and the state-listed endangered peregrine falcon, are known to occur within the Project Area (Appendix B). The state-listed endangered least tern, the threatened yellow-crowned night heron, and black-crowned night heron (only breeding populations listed) were observed within the Project Area during USACE ecological sampling activities conducted in 2002. The wading species (herons, egrets and ibis) forage in brackish marshes, tidal channels, and mudflats and roost in scrub-shrub thickets and forested wetlands. These wading bird species would be temporarily displaced from the Project Area during construction by heavy machinery activity, increased noise levels, vegetation clearing, and earth moving activities. However, avian species are highly mobile and are expected to avoid direct mortality, to quickly return to the site following restoration activities due to the projected high value foraging habitats in the marsh, tidal channels, and mudflats. Scrub-shrub habitat has been incorporated into the tidal marsh complex and is anticipated to provide possible roosting and nesting habitat for avian species. The peregrine falcon is a particularly mobile species with expansive hunting territories, and temporary displacement from a relatively small area is not expected to significantly affect this species. Following restoration activities, the marsh would serve as high value hunting habitat for the peregrine falcons.

The state listed-endangered short-eared owl and a number of species of special concern including Fowlers toad, American kestrel, great blue heron, least bittern, least flycatcher, sharp-shinned hawk, tricolored heron, American woodcock, blue-winged teal, brown thrasher, eastern kingbird, green-winged teal, and swamp sparrow are likely to occur in the vicinity of the Project. These species may temporarily be affected by construction activities, and would likely avoid the Project Area for the duration of construction. However, most of these species are highly mobile avian species and are expected to avoid direct mortality. Some mortality of the less mobile Fowler's toad may occur, but this species would return to the restoration site following cessation of construction.

Therefore, no significant impacts to state threatened, endangered, or special concern species are anticipated, and the proposed Project would have overall benefits for these species.

5.1.7 SOCIO-ECONOMICS

This section discusses the impacts of the proposed Project on population, income and employment, housing, and education within the Project Area.

5.1.7.1 Population

Implementation of the preferred alternative would neither induce, nor inhibit, growth in the surrounding communities since the surrounding area is almost completely developed and has minimal potential for expansion. Furthermore, construction of the preferred alternative would have no impact on the number, density, or racial composition of residents living in the Project vicinity.

5.1.7.2 Economy, Income and Employment

The preferred alternative would have a positive direct economic impact on existing businesses surrounding the Project Area due to dramatic changes and improvements to the value and appearance of the Park. There would also be a minor indirect beneficial economic impact on the local economy during construction of the preferred alternative due to the increase in purchases of supplies and food by construction workers during the construction phase. With the exception of the short-term increase in employment of construction workers involved with the Project construction, there would be no impact on employment in the community surrounding the Project Area.

5.1.7.3 Housing

The proposed Project would not have any significant impacts on housing in Jersey City, Hudson County, New Jersey.

5.1.7.4 Education

Implementation of the preferred alternative would have no negative impacts on the structure or value of education received by school age children in the surrounding communities. However, construction of the preferred alternative would provide children with a clean, safe environment for environmental education programs and passive recreation (e.g., after school activities).

5.1.8 CULTURAL RESOURCES

This section discusses the impacts of the preferred alternative on prehistoric and historic cultural resources within the Project Area.

5.1.8.1 Prehistoric

Prehistoric activity in this marsh environment would have been limited to hunting and/or fishing and would not have involved settlement. As a result, the existence of cultural resources would be limited to no more than a stray find that would not provide useful information beyond what the nearby site (26 Hd 7) has already provided. Therefore, implementation of the proposed Project would have no impacts on significant prehistoric resources.

5.1.8.2 Historic

With the exception of the concrete bulkhead along the Hackensack River, there are no historic structures in the Project Area. Due to the extremely poor condition of the bulkhead and its lack of association with the proposed original park plans, the bulkhead is not considered eligible for inclusion in the National Register of Historic Places. Although the eastern portion of Lincoln Park was considered by the New Jersey Historic Preservation Officer to be eligible for inclusion in the National Register of Historic Places, the Project Area (i.e., Lincoln Park West, west of State Route 1 and 9) does not contribute to the eligibility of the Park. Therefore, implementation of the proposed Project would have no impacts on significant historic resources.

5.1.9 FLOODPLAINS

The footprint of the entire preferred alternative project area would be constructed within the 100-year tidal flood limit of the Hackensack River. Although the entire footprint of the preferred alternative is located within the flood fringe of the Hackensack River, construction of the salt marsh would not increase the jurisdictional area of floodplains within Jersey City. Subsequently, there would be no significant impact on the floodplain of the Hackensack River from implementation of the preferred alternative.

Although not a primary objective of the Project, construction of the salt marsh would provide additional floodwater storage capacity and improve flood flow de-synchronization along the Hackensack River. Accordingly, constructing of the preferred alternative would be consistent with the Hudson County Master Plan policy of implementing environmental mandates into urban planning (HCPB 2002).

5.1.10 COASTAL ZONE MANAGEMENT

Based on review of the applicable New Jersey Rules on Coastal Zone Management (NJDEP 1997), the guidelines applicable to the Project have been identified. The proposed Lincoln Park Wetland Restoration Project is consistent with New Jersey's Coastal Zone Management Program. A New Jersey Coastal Zone Management Consistency Evaluation is provided in Appendix C and is under review by the NJDEP Office of Dredging and Sediment Technology as a requirement of compliance with the Waterfront Development Law (N.J.S.A. 12:5-3).

5.1.11 HAZARDOUS, TOXIC AND RADIOACTIVE WASTE

The proposed Project would have no significant impact on any of the existing Hazardous Toxic and Radioactive Waste (HTRW) sites, upstream or downstream of the Project Area. The waste encountered in the excavated/restored areas will be relocated to the upland disposal area atop the adjacent landfill. A 2-foot cap of clean fill material will then be placed. Wetland and upland vegetation, wildlife, and the public will be protected from contact with contaminated soils/sediments. Additionally, the landfill and all deposited material will be re-graded and capped as part of the NJDEP Solid and Hazardous Waste Program Closure and Post-Closure Plan Approval. The closure of the landfill is not part of the LPWWRP activities, but the clean fill materials proposed to be used would be used by both activities as described previously. Several sediment samples taken in the man-made lake exceeded ER-M levels for SVOCs and metals, and one sample exceeded the ER-L for a pesticide. However, sediments in the manmade lake would not be disturbed by implementation of Alternative 2.5, so there would be no increase in potential ecological risk from sediment contaminants. Sediments in the man-made lake would be dredged and permanently placed in the closed and capped landfill within the Hudson County landfill closure area and a clean backfill of 2.0' would be placed in the pond bottom. This would reduce exposure to wildlife to the greatest extent. Alternative 2.5.1 is the preferred optimal approach for this purpose. If funding becomes available for this option before the project award date, then it will become the preferred alternative to Alternative 2.5.

5.1.12 NAVIGATION

The proposed Project would not affect navigation of the Hackensack River. Temporary, minor increases in turbidity and sedimentation of the Hackensack River may occur as a result of on-site excavation. However, the amount of sediment deposited into the Hackensack River would have a negligible impact to navigation.

The CDF facility would require a barge to be situated in the Hackensack River, approximately 200 feet off of the Project Area, for a period of up to ten weeks. This barge would carry sand for use as clean fill material for the wetland restoration Project, as well as the landfill closure and golf course development projects. The barge would be located outside of the federal navigation channel and would be operated and marked in accordance with all applicable U.S. Coast Guard regulations. Therefore, implementation of the proposed Project would have no impacts on navigation.

5.1.13 AESTHETICS AND SCENIC RESOURCES

Short-term adverse impacts to the aesthetic and scenic resources in the Project Area would be minor. Aesthetic values would be reduced temporarily during construction, due to the presence of construction equipment and construction activities. However, these impacts would be temporary, and scenic and aesthetic values would be restored and enhanced as a result of the Project. Permanent, minor, adverse impacts include the loss of aesthetic values by removal of trees within the footprint of the preferred alternative. HCDPR has expressed interest in saving and transplanting as many of the shrubs and trees from the forest/scrub-shrub areas as is feasible during Project construction, to preserve some of the character and nature of the Project Area (Jennings 2002).

Long-term positive impacts on aesthetic and scenic resources would occur from implementation of the preferred plan. The preferred plan would create unobstructed view corridors of the Hackensack River, which are currently obstructed by dense stands of *Phragmites*. Specifically, the walkway and footbridge created proposed as part of the preferred alternative would provide visual vantage points for views of the surrounding marsh and the Hackensack River. In addition, planting native shrubs in and around the Project Area would increase the aesthetic and scenic value of the site. Therefore, implementation of the proposed Project would have no impacts on aesthetics and scenic resources.

5.1.13.1 RECREATION

Implementation of the preferred alternative would result in a positive long-term impact on recreation. Recreational opportunities that currently exist, such as hiking, jogging, birding, and fishing, would be enhanced by implementation of the preferred alternative. Specifically, the construction of the walkway along and within the salt marsh would provide access to the marsh and lake and create viewing areas for birders and other wildlife enthusiasts. Additionally, the walkway would be integrated into the existing trail system within the Project Area and eventually could become part of the planned Hackensack River Walk. Implementing the preferred alternative would be consistent with the long-term environmental awareness and recreation goals for Lincoln Park.

Temporary impacts associated with implementation of the preferred alternative may include limited public access to the existing trail system and the Hackensack River during the construction phase. No significant or long-term negative impacts to recreational resources in the Project Area are expected as a result of the Project.

5.1.14 TRANSPORTATION

Temporary impacts to the land-based transportation resources in the Project Area would be associated with the movement of construction equipment and workers' vehicles during the construction phase of the Project. Specifically, the gravel parking area adjacent to the existing playing fields may be used as contractor parking and equipment staging areas during construction. However, these impacts are expected to be minimal, short-term, and limited to the period of construction. The preferred alternative would not result in a significant long-term increase in traffic. During construction, coordination with local officials would occur as needed to minimize effects to the local traffic patterns and parking.

On-site transportation of excavated material from the salt marsh restoration area to the upland disposal site would be restricted to the existing gravel road system within and immediately adjacent to the Project Area. Improvements, such as minor widening or deposition of rock to stabilize the roadbed in low lying areas may be required to support heavy machinery (e.g., dump trucks and front-end loaders). However, the impacts resulting from these improvements would be minor.

The Hackensack River is the only navigable waterway located in the Project vicinity. The preferred alternative identifies minimal excavation activities at the mouth of the primary tidal creek. This activity would not significantly impact the navigability of the Hackensack River. Therefore, there would be no significant impact to water-based transportation.

5.1.15 AIR QUALITY

The Project is located in an ozone non-attainment area. Off-road construction equipment used on-site may produce minor amounts of NAAQS criteria pollutants in the immediate vicinity of the Project Area. However, construction activities would have no significant or long-term impacts on air quality. Based on the current design, emissions calculations indicate the Project is under the conformity threshold value of 25 tons per year for nitrogen oxides and ozone precursors. As required by the approved closure plan, measures will be taken during construction as required to minimize particulate circulation due to dust, etc. Therefore, there would be no significant impact to air quality.

5.1.16 NOISE

There would be a minor increase in noise levels in the immediate Project vicinity during construction due to the increase in worker vehicles and traffic, and the operation of construction equipment.

However, these impacts are expected to be minimal and short-term, and limited to the period of active construction. There would be no long-term impact on noise levels.

5.1.17 AIR TRAFFIC

The preferred alternative project area is about 3.75 miles from Newark Airport and about 7.4 miles from Teterboro Airport. The project would be within the 5-mile perimeter of Newark Airport as described in the Federal Aviation Administration's (FAA) Advisory Circular 150/5200-33B. These guidelines provide recommendations to land use planners and project developers regarding practices that may attract wildlife populations that are hazardous to air traffic within a 5-mile radius. Impacts of the project on air traffic could potentially include an increase in waterfowl using the area due to the increase in amount of tidal wetlands. Geese in particular rank high on the list of 25 species groups as to relative hazard to aircraft. Other guilds that are likely to use the project area have low hazard rankings. Canada Goose (Branta canadensis) and Brant (Branta bernicla) are the most likely species that are of concern, but both species are already using the area currently. These species would most likely use the open water component of the proposed project, rather than the spartina wetlands component. "Loafing" as the FAA terms roosting or idle standing, is a behavior common to both resident and migratory populations, however, the well known behavior of loafing by large flocks of resident geese on lawns in parks, airports, sports fields, and corporate lawns and golf courses would be discouraged by the planting of native Spartina grasses. Canada Geese are particularly drawn to lawns for two reasons: they can digest grass, and when they are feeding with their young, manicured lawns give them a wide, unobstructed view of any approaching predators. Because Spartina grass in its tall form lacks these features it is not likely to attract large numbers or flocks of idle birds or foraging birds.

According to the FAA and other sources, migratory Canada geese have been in decline for over a decade, whereas the population of resident geese has seen near exponential growth. Because they never leave their familiar year-round habitats, and due to this dramatic increase in population size, resident geese are responsible for most conflicts with urban and suburban owners of agricultural fields and lawns.

Native marshes and restored marshes such as the planned Lincoln Park restoration within the NY/NJ Harbor typically attract small numbers of breeding pairs from Spring through early Summer. Young can be seen with swimming with parents in tidal creeks during the summer and on through the summer molt when many of the birds are temporarily flightless. Geese are in part colonial and congregate in flight in large numbers, especially during Fall migration in October.

The largest areas of congregation at Lincoln Park are within the areas of lawns designated for active and passive recreational use. Highest areas of concentration are within open water lakes especially where lawn and lake meet (personal communication Carl Alderson). Because of the diminishing numbers of migratory geese on the Atlantic flyway and due to the limited numbers of Resident type geese attracted seasonally to a salt marsh, the creation of tidal marsh and tidal creeks are not believed to cause a significant impact to air travel due to preferred alternative project area. Consultation with the FAA and the operators of Newark Liberty International will be sought in accordance with the 5-mile radius guideline stated in the Advisory. Avian population monitoring will be conducted for three years post restoration.

5.2 NO-ACTION ALTERNATIVE

Alternative 1, No Action, was not preferred since it does not meet the project goal or purpose. The site in its current condition permits only limited finfish and wildlife forage, breeding, nursery and refuge habitat. The baseline analysis showed that the site currently supports only a limited diversity of species. The No Action alternative does not promote an increase in fisheries and wildlife habitat and is therefore not conducive to replacing the natural resources that were lost as a result of the Exxon Bayway and B.T. Nautilus oil spills. The Trustees believe that restoring the habitat to a mix of low marsh and emergent high marsh plant species communities, and removing historic fill material in order to enable natural hydrologic exchange, is necessary to benefit the fish and wildlife species and compensate the public. This alternative will not benefit fish and wildlife species; nor will it compensate the public or restore lost habitat function and has therefore not been further considered in this evaluation.

5.3 NON-SELECTED ALTERNATIVES

This section presents the environmental impacts of the non-selected Project Alternatives on physical, ecological, cultural, aesthetic, socioeconomic, and recreational conditions of the Project Area.

Alternative 1 would adequately meet the stated goals of the project, namely: to compensate the public for injuries to natural resources caused by the Exxon Bayway and B.T. Nautilus oil spills by: restoring the historic tidal hydrologic connection between the restoration site and Hackensack River; increasing the percent cover of *Spartina alterniflora;* improving the aesthetic viewshed associated with the site; enhancing fisheries and wildlife breeding, nursery, forage and refuge habitat; and, accomplishing the restoration of marsh acreage and functionality cost effectively. The selection also meets the goals set forth by the NOAA Restoration Center's ARRA Competitive Grant Program. However this Alternative was not selected because it would not maximize the potential of the site to provide the goals and benefits set forth for the project. Relative to the selected alternative, this alternative provided a combination of benefits that when taken together resulted in a lesser gain than that of the selected alternative.

There were several issues of concern associated with Alternative 1. Both Alternative 1.1 and 1.2 options provided reduced gains relative to any of the Alternative 2 configurations. These two alternatives: result in a lesser gain of acreage converted from landfill to restored wetland; reduce the acres of Phragmites dominated area to a lesser extent; and fail to provide connectivity to the pond. Notably, these two alternatives greatly reduce improvement to Essential Fish Habitat. By leaving in the existing paths, the amount of marsh available for marsh creation diminishes significantly. Also, the presence of the paths creates a potential opportunity for disturbance by the public, such as illegal dumping or filling. In addition, the dirt roads and paths lie at between 5 and 8 feet NGVD29, a prime elevation for *Phragmites* to re-invade if the site is not properly managed. The marsh would wrap around the path, but the slopes from the marsh up to the roads/paths would be vulnerable to *Phragmites* invasion.

Although Alternative 1.1 did meet the design goals better than Alternative 1.2, it did not maximize the area of intertidal salt marsh to its full potential.

5.3.1 GEOMORPHOLOGY AND SOILS

Implementation of the non-preferred alternative would result in significant changes to existing topography. However, these changes are expected to be beneficial. The existing topography would be modified throughout the majority of the site according to the preferred restoration plan, and would involve excavation of accumulated waste associated with the adjacent landfill, historic fill material, and *Phragmites*-dominated areas; creation of intertidal and supratidal areas, including the creation of tidal creeks to supply an additional tidal hydrology source; and, deposition of excavated spoil material on the landfill. The design for the preferred non-preferred restoration plan includes restoring no more than **27.57** acres of combined habitat improvements. The lake would not be physically altered by construction, and a hydrologic connection would not be made to the Hackensack River.

The intertidal zone includes connecting the Hackensack River via a primary tidal creek and creating additional secondary tidal creeks to increase the hydrology supply across the wetland site only. The majority of the restoration area is currently at an elevation of 10 feet NGVD29 or lower. Material from this area would be excavated and deposited atop the adjacent landfill as part of the landfill closure process and according to the following specifications:

The entire restoration area would be excavated approximately to only 1 feet below the desired depth and clean fill material would be placed over the existing soil. The clean sand fill would be substantially less cubic yards in Alternative 1.0 of beneficially reused sand dredged from the USACE/Port Authority of NY and NJ dredging of the Anchorage Channel. While this provided a cost savings, it did not adequately address the need to protect wildlife from the underlying substrate which may contain residual contaminants.

No significant or long-term impacts would occur to geology within the Project Area.

5.3.2 LAND USE AND ZONING

Implementation of the non-preferred alternative would result in a change of land cover types from *Phragmites*-dominated land, upland herbaceous, and forest/scrub-shrub to predominantly a saline marsh ecosystem with large components of remnant upland herbaceous and scrub-shrub habitats. Land uses in the Project Area are primarily recreational and open space uses and the increased area of salt marsh would provide additional recreational opportunities and open land. Accordingly, no negative impacts to land use are anticipated as a result of the construction of the non-preferred alternative.

The entire Project Area is located in a Parks-Open Space zone as defined by the Jersey City zoning regulations. Construction of the non-preferred alternative would be consistent with the current city zoning regulations and policies. Accordingly, no significant impacts to zoning would result from construction of the non-preferred alternative.

5.3.3 WATER RESOURCES

The following sections present the non-preferred Project impacts associated with regional hydrogeology and groundwater resources, surface water, and tidal influences.

5.3.3.1 Regional Hydrogeology and Groundwater Resources

The excavation and regrading of the Project Area and off-site disposal of excavated materials for the proposed Project would change the existing grades. However, the non-preferred alternative is not expected to have significant negative impacts on the regional hydrology and groundwater resources.

5.3.3.2 Surface Water

The non-preferred alternative is expected to result in temporary increases in turbidity during construction. Excavation of the waste material to create tidal creeks and excavation of the marsh plain also may cause a temporary degradation of water quality in the Hackensack River and areas within the Project Area during construction. However, best management practices would be used to minimize and/or prevent sediments from entering the Hackensack River, including installation of a temporary water exclusion berm at the main inlet and floating turbidity barrier just offshore, as well as other erosion and sedimentation controls, to protect the Hackensack River to the maximum extent possible during construction. Therefore, turbidity caused by construction activities should be minimal and re-suspended sediments are likely to quickly settle out of the water column or be dissipated by the tidal fluctuation of the Hackensack River. Accordingly, turbidity and sedimentation would have minimal impact to the overall surface water quality of the Project Area and the Hackensack River. A Clean Water Act Section 404(b)(1) Guidelines Evaluation was completed for the ERR/EA (USACE 2006). Soil Erosion and Sediment Control Plan authorization from the Hudson, Essex, and Passaic Counties Soil Conservation District will be acquired prior to any construction activities.

5.3.3.3 Tidal Influences

The non-preferred alternative would significantly alter the tidal influence of the Project Area. The intent of the excavation is to extend the existing tidal creeks (both primary and secondary channels), lower the marsh plain elevation, and provide better overall tidal inundation and circulation within the Project Area. The alteration of on-site tidal influences is vital to providing the necessary hydrology for salt marsh habitat restoration and is not expected to cause significant offsite impacts. Additional information on tidal influences and the hydrodynamic model are included in Appendix B (USACE 2006).

5.3.4 VEGETATION

This section describes impacts to wetland and upland vegetation resources. Implementation of the non-preferred alternative would result in conversion of a relatively degraded wetland complex and associated uplands to valuable and vital salt marsh wetland habitat. Accordingly, there would be positive impacts on vegetation as a result of implementation of the non-preferred alternative. Benefits, relative to any of the configurations identified in Alternative 2, are reduced in acreage. Total conversion of filled and degraded Phragmites dominant habitats results in total 27.57 acres. This compared to a minimum 39.9 acres of restored habitats in the preferred alternative.

5.3.4.1 Wetlands

Implementation of the non-preferred alternative would have a long-term beneficial impact on wetlands. Currently, only small patches of remnant salt marsh exist within the Project Area. Creation of additional high value salt marsh as the result of conversion of low value *Phragmites*-dominated habitat would restore a significant extent of salt marsh -historically present on the site. This conversion would also have a positive effect on the existing diversity of wildlife habitat on site.

Although the USEPA considers all estuarine wetlands in the Project Area as priority wetlands, salt marsh is designated as priority habitat in New Jersey (USEPA 1994), and considered to be ecologically and environmentally more valuable than the existing Phragmites-dominated wetlands. Specifically, Phragmites, forest/scrub-shrub, and upland herbaceous habitats would be permanently converted to salt marsh, resulting in a net increase of 15.82 acres of salt marsh habitat in the Project Area compared to 19.8 acres in the preferred alternative.

Impacts to wetland vegetation include removal of vegetation during construction activities. This alternative leaves intact the greatest extent of existing mature trees and shrubs. However, in the interest of removing waste material from within the Project Area, it is less critical to leave numbers of trees then to protect from contaminated waste material.

Temporary impacts to approximately 2,000 square feet of wetlands and 3,200 square feet of transition area adjacent to the Hackensack River and north of the Project Area are anticipated from construction of the temporary above-ground dredge conveyance pipeline associated with the CDF facility. This pipeline is needed to bring clean sand fill to the site from a barge in the Hackensack River, and would be in place for up to ten weeks. Temporary impacts would be restored as appropriate following completion of the CDF operation.

5.3.4.2 Uplands

Approximately 6 acres of upland vegetation would be permanently converted to wetland vegetation resulting from implementation of the non-preferred alternative. The non-preferred alternative includes the establishment of approximately 6.3 acres of upland scrub-shrub habitat interspersed amongst the tidal creeks and salt marsh. Since salt marsh is considered a priority habitat in New Jersey and is considered to be of higher value than the existing upland habitats, the Project Team decided that the greatest number of acres conversion of to salt marsh was preferred. This alternative did not fully meet that objective.

However, HCDPR has expressed interest in saving and transplanting as many of the shrubs and trees from the forest/scrub-shrub areas as feasible to preserve some of the character and nature of the Project Area, and provide newly created upland areas a head start on achieving stable and diverse habitat restoration goals (Jennings 2002). This approach may be feasible. However, excavation of waste material is a Project priority and may compromise the salvage of on-site woody species. Also, *Phragmites* is seen as an aggressive wetland transitional species that tends to form expansive monocultures and is undesirable. Therefore, excavation of expansive networks of *Phragmites* rhizomes is also a Project priority and may also compromise salvage of on-site woody species. Therefore, while Alternative 1 sought to preserve the greatest extent of upland, a loss of upland vegetation is anticipated due to construction of the non-preferred alternative. However, this impact would be offset by the net increase in priority wetland habitat. The alternative does not adequately address the need to reduce Pharagmites in the project area.

5.3.5 FISH AND WILDLIFE

This section identifies the impacts to fish and wildlife due to the proposed Project, including shellfish, finfish, benthic resources, reptiles and amphibians, birds, and mammals. In addition, a *Final Fish and Wildlife Coordination Act Section 2(b) Report* has been prepared by the USFWS (2004).

5.3.5.1 Shellfish

The non-preferred alternative would have a temporary impact on existing shellfish during construction. Excavation of the tidal creeks and marsh surface would dislodge and eradicate the existing shellfish (e.g., ribbed mussels), and would have a detrimental impact on specific individuals. However, shellfish species are expected to recolonize the Project Area immediately following construction with recruitment from nearby, unaffected portions of the Hackensack River adjacent to the Project Area (Hettler 1989, LaSalle et al. 1991).

An increase in turbidity and sedimentation are expected from construction activities and may affect the ability of nearby filter feeding shellfish to feed. The increased turbidity and sedimentation from construction activities are expected to quickly settle out of the water column. Any fine re-suspended sediment (silt and clay) that does not settle would be dispersed with the tidal fluctuation from the Hackensack River and would have minimal impact on existing and nearby nekton species.

The non-preferred alternative would have an overall beneficial result on the existing shellfish species. The excavation of the primary and secondary tidal creeks and excavation of the marsh surface would restore tidal hydrology to the Project Area, promote tidal inundation, and improve the quality and quantity of suitable mudflat substrate. Additionally, the creation of salt marsh and additional deeper/wider tidal creeks would provide expanded habitat with substantial feeding opportunities and reduced predation risk, and encourage recruitment and establishment of shellfish and nekton species in the tidal creeks and marsh surface (Hettler 1989). In general, results from spring, summer, and fall nekton sampling events support the proposed Project. Shellfish sampling data indicated either higher or no difference in use of *S. alterniflora* habitat versus *Phragmites* habitat in the Project Area (USACE 2002d).

Some burrowing crab species (mud crab) and shrimp species (grass shrimp) may be removed during excavation activities. The overall impact to these mobile shellfish species would be minimal due to their ability to relocate to deeper waters of the Hackensack River to seek food and shelter during construction activities. Following construction activities, individuals can return to the Project Area and colonize the tidal channels and marsh plain. The non-preferred alternative did not maximize the potential for invertebrate recolonization due to the large amount of acreage that would remain intact of the existing fill.

5.3.5.2 Finfish and Essential Fish Habitat

Similar to the shellfish species, the non-preferred alternative would have a temporary impact on finfish during construction. The increase in turbidity and sedimentation from dredging and excavation could potentially lead to gill abrasions and may suffocate individual fish in the Project Area, as well as hinder predation efficiency of sight feeding fish at or adjacent to the Project Area. However, best management practices, including erosion and sedimentation controls, would be used to minimize and/or prevent sediments from entering the Hackensack River, in order to protect the Hackensack River to the maximum extent possible during construction. Therefore, turbidity and sedimentation caused by the construction activities should be minimal and are likely to quickly settle out of the water column. In addition, fish are generally mobile, would be able to avoid direct impacts from construction activities, and seek the deeper water of the Hackensack River for shelter. Accordingly, risks from suffocation and gill abrasions are expected to be minimal.

The removal of benthic macroinvertebrates and dispersion of nekton species would temporarily impact food sources for finfish in the Project Area during construction. However, the existing fish species are expected to relocate and feed in the unaffected portion of the Hackensack River. In addition, benthic macroinvertebrates and nekton species would be expected to recolonize the non-preferred alternative immediately following construction with recruitment from nearby, unaffected portions of the Hackensack River (Hettler 1989, LaSalle et al. 1991). Therefore, impacts to finfish due to loss of food availability are expected to be minimal.

Construction of the non-preferred alternative would also result in beneficial impacts for some finfish species. *Phragmites* is documented to degrade marsh function, reduce tidal exchange, and restrict the free movement of aquatic life (Weinstein and Balletto 1999). Excavation and replanting of the marsh plain, and widening and extending the tidal creeks would replace the dense monospecific stands of *Phragmites* with *Spartina* species and other beneficial marsh species and promote tidal inundation of the marsh plain. Weinstein and Balletto (1999) found marshes dissected by numerous tidal creeks were used more by fish than marsh habitat with low drainage densities. In addition, fish were observed to be concentrated near the interface between the salt marsh and open water, with individuals leaving the marsh on ebb tide having fuller stomachs than individuals captured in adjacent tidal creeks.

Additionally, in general the results from spring, summer, and fall nekton sampling events generally support the proposed Project. Finfish sampling data indicated higher use of *S. alterniflora* habitat versus *Phragmites* habitat in the Project Area during spring and fall sampling. However, use of *S. alterniflora* habitat was lower than use of *Phragmites* during the summer sampling event (USACE 2002d). This may be attributed to the fact that the majority of the catch during the summer sampling event was killifish. Killifish exhibit no preference between *S. alterniflora* and *Phragmites* communities, but prefer areas with loose, muddy substrate into which they can burrow.

The Hackensack River provides a migratory pathway for anadromous fish such as alewife and blueback herring as they travel to spawning grounds in upstream portions of the river. Increased turbidity and degraded water quality resulting from construction activities may impede the migration of these species to their spawning areas. To minimize impacts to anadromous fish, the proposed Project would adhere to the construction window imposed by NMFS, namely that no work be performed within the Hackensack River between March 1st and June 30th.

EFH has been designated near the Project Area. Winter flounder, an EFH-designated specie may use the Hackensack River adjacent to the Project Area for spawning. Other EFH-designated species and their prey may also be present. To protect winter flounder EFH, NMFS recommends that work within the Hackensack River be avoided from January 1st to May 31st. Provided Best Management Practices are used to isolate the Project Area from the Hackensack River and minimize the release of sediments to the river during construction, work within the Project Area does not require a timing restriction.

The increase in salt marsh acreage and the creation of tidal channels would physically allow more fish movement in and out of the salt marsh and lake. The increased volume of water and improved water quality in the restored salt marsh would increase the availability and quality of habitat for all trophic levels of aquatic organisms. In particular, these improvements would benefit forage fish for EFH-designated species, as many of these forage fish spend most or all of their life in salt marshes. Larger numbers of small, resident forage fish in the salt marsh would provide an increased food source for larger predatory EFH-designated species that would also be able to move more easily into and out of the salt marsh due to the presence of primary and secondary tidal channels and removal of tidal restrictions. Improved water and sediment quality will result in more expansive benthic habitat required for demersal fish species, including EFH-designated species.

Construction activities may result in short-term increases in erosion and delivery of sediment to nearby wetlands and waters. Most EFH-designated species likely to occur in the Hackensack River are typically found in the often turbid conditions of estuaries and can avoid temporary increases in suspended sediments. Impacts will be mitigated by measures including isolating the construction area from the Hackensack River, performing in-water work during low tide, working in dry conditions within a temporary water exclusion berm and floating turbidity barrier to minimize migration of turbidity offsite, and re-stabilizing soils with plant material and seeding following earthwork completion. Additionally, best management practices for soil erosion and sediment control will be implemented and maintained to minimize sediment entering waterways. For these reasons, no long-term adverse impacts to EFH or EFH-designated species or their prey are expected from the proposed Project.

Similar to the findings of impacts to invertebrates, the non-preferred alternative did not maximize the potential for invertebrate recolonization due to the large amount of acreage that would remain intact of the existing fill and also the lack of connectivity to the pond and its resources.

5.3.5.3 Benthic Resources

The excavation of intertidal and subtidal areas called for in the non-preferred alternative will result in the direct loss of benthic species and habitat in the Project Area during and immediately following construction. Benthic communities in areas temporarily isolated from tidal flow would also be lost. Additionally, excavation has the potential to result in erosion and delivery of sediment to the Hackensack River and adjacent wetlands, with associated impacts to the benthic community. Epibenthic organisms such as shrimp and crabs are mobile and can avoid areas of increased suspended sediment. However, most adult benthic infauna have limited mobility and sediment deposition may result in burial or impaired feeding.

Potential impacts to the benthic and epibenthic communities of the adjacent Hackensack River and other wetlands would be minimized and avoided by employing and maintaining best management practices for soil erosion and sediment control. Impacts to benthic macroinvertebrates would be temporary, as recolonization would commence immediately following construction. Recruitment of benthic and epibenthic organisms would come from nearby, unaffected areas of the Hackensack River (Hettler 1989, LaSalle et al. 1991). LaSalle et al. (1991) found that the species composition and relative abundances of benthic macroinvertebrates in a newly developed salt marsh are similar to those reported from natural marshes, with a trend toward greater density and more well-established populations for some species, with age of the constructed marsh complex. For these reasons, no long-term adverse impacts to benthic resources are expected from the proposed Project.

However, the non-preferred alternative did not maximize the potential for benthic recolonization due to the large extent of acreage that would remain intact of the existing fill and lack of connectivity to the pond.

5.3.5.4 Reptiles and Amphibians

Based on the results of on-site surveys in 2001, little suitable habitat for reptiles and amphibians currently exists within the Project Area (USACE 2002f). In addition, those species found or expected on-site are fairly mobile and could relocate during construction activities. Accordingly, although some individuals may be lost during construction, the loss is expected to be minor. Therefore, no significant impacts to reptiles and amphibians are anticipated.

The creation of salt marsh within the non-preferred alternative project area would potentially benefit a number of reptiles that inhabit Hudson County. The increased area of salt marsh and associated upland may provide suitable nesting and foraging habitat for diamondback terrapins, which are known to inhabit the Hackensack River and its associated salt marshes (USACE 2002f). Additionally, common snapping turtles also utilize salt marsh habitat for foraging, and although not observed during the 2001 reptile and amphibian surveys, mud turtles (*Kinosternon subrubrum*) can tolerate brackish water and may potentially utilize the restored salt marsh habitat.

5.3.5.5 Birds

Birds in the non-preferred alternative project area may temporarily be affected by construction activities. During construction, heavy machinery activity, increased noise levels, vegetation clearing, and earth moving activities may cause displacement of individuals and nesting failure/disruptions near construction activities. However, avian species are highly mobile and are expected to avoid direct mortality. Accordingly, no significant impacts to birds are anticipated.

Beneficial impacts to birds would result from the conversion of the generally *Phragmites*-dominated habitat to a salt marsh ecosystem. The expanded salt marsh would provide increased habitat for, and likely attract, salt marsh bird specialists, such as clapper rails (*Rallus longirostris*), sharp-tailed sparrows and marsh wrens. Additionally, salt marshes provide valuable foraging and nesting habitat for a variety of herons, egrets, and waterfowl.

Conversely, the removal of trees (i.e., forest/scrub-shrub) within the Project footprint would decrease the amount of habitat available for birds. This alternative minimizes the loss to the greatest extent, however most of the birds that utilize the forested habitat within the Project Area are generalists and would disperse to other areas of similar habitat nearby. However, tree removal will be minimized, and planting of native shrubs, and increased edge habitat along the border of the new marsh complex would provide habitat for a number of forest/upland bird species.

5.3.5.6 Mammals

Mammals may be temporarily affected by construction activities on-site. During construction, heavy machinery activity, increased noise levels, vegetation clearing, and earth moving activities may cause mortality of some individuals of less mobile small mammal species (e.g., mice and voles), or indirectly cause displacement of individuals during construction activities. However, most mammals are highly mobile and are expected to avoid direct mortality. Also, the less mobile species typically have high reproductive capability and thus can be expected to repopulate rapidly. Accordingly, no significant impacts to mammals are anticipated.

Within the non-preferred alternative project area, long-term beneficial impacts to mammals would result from the conversion of the existing *Phragmites*-dominated habitat to a salt marsh ecosystem. Construction of the non-preferred alternative would provide increased habitat for species that utilize salt marshes, such as muskrat and raccoon. Creation of additional salt marsh areas adjacent to a large area of remnant upland habitat would provide a greater area of higher quality habitat for these species of all alternative configurations.

Conversion of existing habitat, especially the forested areas, would decrease habitat available for forest dwelling species such as gray squirrel (*Sciurus carolinensis*) and some small mammal species. Some of these species would disperse from the Project Area and recolonize similar habitats adjacent to the site. This alternative has the least amount of conversion, therefore the smallest loss to forest dwellers. However, this option does not protect wildlife from direct contact with contaminated fill materials and does not therefore meet adequately the objective of protecting wildlife from contact.

5.3.6 RARE, THREATENED, ENDANGERED, AND SPECIAL CONCERN SPECIES

This section discusses the non-preferred alternative project area impacts on Federal and state-listed threatened and endangered species and species of special concern. Correspondence received from these agencies is presented in Appendix B.

5.3.6.1 Federal Species

As stated in Section 3.6.1, no Federally-listed threatened and endangered species or species of special concern are known to occur within the proposed Project Area. Accordingly, no Federally-listed threatened and endangered species are likely to be impacted by the construction of the non-preferred alternative. Dredging of the tidal creeks and excavation of the marsh plain has the potential to cause temporary increases in turbidity and degraded water quality during construction and may impede the migration of the special concern fish species alewife and blueback herring to their upstream spawning areas. As a result, NMFS prohibits construction within the Hackensack River from March 1st to June 30th. In addition, best management practices, such as hay bales, silt curtains, and erosion and sedimentation controls, would be implemented and maintained in areas adjacent to the river during construction to minimize sediments entering the river. The proposed Project would have overall benefits for fish and wildlife through the restoration of tidal hydrology to a degraded site, as well as the potential future use of the site by Federally-listed threatened and endangered species and their prey species.

5.3.6.2 State Species

The special concern species cattle egret, glossy ibis, little blue heron, and snowy egret, and the endangered peregrine falcon are known to occur within the Project Area (Appendix B). The state-listed endangered least tern, threatened yellow-crowned night heron, and black-crowned night heron (only breeding populations listed) were observed within the Project Area during USACE ecological sampling activities conducted in 2002. The wading species (herons, egrets and ibis) forage in brackish marshes, tidal channels, and mudflats and roost in scrub-shrub thickets and forested wetlands. These wading bird species would be temporarily displaced from the Project Area during construction by heavy machinery activity, increased noise levels, vegetation clearing, and earth moving activities. However, avian species are highly mobile and are expected to avoid direct mortality, and would quickly return to the site following restoration activities due to the projected high value foraging habitats in the marsh, tidal channels, and mudflats. Scrub-shrub habitat has been incorporated into the tidal marsh complex and is anticipated to provide possible roosting and nesting habitat for avian species. The peregrine falcon is a particularly mobile species with expansive hunting territories, and temporary displacement from a relatively small area is not expected to significantly affect this species. Following restoration activities, the marsh would serve as high value hunting habitat for the peregrine falcons.

The state listed-endangered short-eared owl and a number of species of special concern including Fowlers toad, American kestrel, great blue heron, least bittern, least flycatcher, sharp-shinned hawk, tricolored heron, American woodcock, blue-winged teal, brown thrasher, eastern kingbird, green-winged teal, and swamp sparrow are likely to occur in the vicinity of the Project. These species may temporarily be affected by construction activities, and would likely avoid the Project Area for the duration of construction. However, most of these species are highly mobile avian species and are expected to avoid direct mortality. Some mortality of the less mobile Fowler’s toad may occur, but this species would return to the restoration site following cessation of construction.

Therefore, no significant impacts to state threatened, endangered, or special concern species are anticipated, and the non-preferred alternative project area would have overall benefits for these species.

5.3.7 SOCIO-ECONOMICS

This section discusses the impacts of the non-preferred alternative project area on population, income and employment, housing, and education within the Project Area.

5.3.7.1 Population

Implementation of the non-preferred alternative would neither induce, nor inhibit, growth in the surrounding communities since the surrounding area is almost completely developed and has minimal potential for expansion. Furthermore, construction of the non-preferred alternative would have no impact on the number, density, or racial composition of residents living in the Project vicinity.

5.3.7.2 Economy, Income, and Employment

The non-preferred alternative would have a positive direct economic impact on existing businesses surrounding the Project Area due to dramatic changes and improvements to the value and appearance of the Park. There would also be a minor indirect beneficial economic impact on the local economy during construction of the non-preferred alternative due to the increase in purchases of supplies and food by construction workers during the construction phase. With the exception of the short-term increase in employment of construction workers involved with the Project construction, there would be no impact on employment in the community surrounding the Project Area.

5.3.7.3 Housing

The proposed Project would not have any significant impacts on housing in Jersey City, Hudson County, New Jersey.

5.3.7.4 Education

Implementation of the non-preferred alternative would have no negative impacts on the structure or value of education received by school age children in the surrounding communities. However, construction of the non-preferred alternative would provide children with a clean, safe environment for environmental education programs and passive recreation (e.g., after school activities).

5.3.8 CULTURAL RESOURCES

This section discusses the impacts of the non-preferred alternative on prehistoric and historic cultural resources within the Project Area.

5.3.8.1 Prehistoric

Prehistoric activity in this marsh environment would have been limited to hunting and/or fishing and would not have involved settlement. As a result, the existence of cultural resources would be limited to no more than a stray find that would not provide useful information beyond what the nearby site (26 Hd 7) has already provided. Therefore, implementation of the non-preferred alternative project would have no impacts on significant prehistoric resources.

5.3.8.2 Historic

With the exception of the concrete bulkhead along the Hackensack River, there are no historic structures in the Project Area. Due to the extremely poor condition of the bulkhead and its lack of association with the proposed original park plans, the bulkhead is not considered eligible for inclusion in the National Register of Historic Places. Although the eastern portion of Lincoln Park was considered by the New Jersey Historic Preservation Officer to be eligible for inclusion in the National Register of Historic Places, the Project Area (i.e., Lincoln Park West, west of State Route 1 and 9) does not contribute to the eligibility of the Park. Therefore, implementation of the proposed non-preferred alternative project would have no impacts on significant historic resources.

5.3.9 FLOODPLAINS

The footprint of the entire non-preferred alternative would be constructed within the 100-year tidal flood limit of the Hackensack River. Although the entire footprint of the non-preferred alternative is located within the flood fringe of the Hackensack River, construction of the salt marsh would not increase the jurisdictional area of floodplains within Jersey City. Subsequently, there would be no significant impact on the floodplain of the Hackensack River from implementation of the non-preferred alternative.

Although not a primary objective of the Project, construction of the salt marsh would provide additional floodwater storage capacity and improve flood flow desynchronization along the Hackensack River. Accordingly, constructing of the non-preferred alternative would be consistent with the Hudson County Master Plan policy of implementing environmental mandates into urban planning (HCPB 2002).

5.3.10 COASTAL ZONE MANAGEMENT

Based on review of the applicable New Jersey Rules on Coastal Zone Management (NJDEP 1997), the guidelines applicable to the Project have been identified. The proposed Lincoln Park Wetland Restoration Project is consistent with New Jersey's Coastal Zone Management Program. A New Jersey Coastal Zone Management Consistency Evaluation is provided in Appendix C and is under review by the NJDEP Office of Dredging and Sediment Technology as a requirement of compliance with the Waterfront Development Law (N.J.S.A. 12:5-3).

5.3.11 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

The proposed non-preferred alternative project would have no significant impact on any of the existing Hazardous Toxic and Radioactive Waste (HTRW) sites, upstream or downstream of the Project Area. The waste encountered in the excavated/restored areas will be relocated to the upland disposal area atop the adjacent landfill. A 1-foot cap of clean fill material will then be placed. Wetland and upland vegetation, wildlife, and the public will be protected from contact with contaminated soils/sediments. Additionally, the landfill and all deposited material will be regraded and capped as part of the NJDEP Solid and Hazardous Waste Program Closure and Post-Closure Plan Approval . Several sediment samples taken in the manmade lake exceeded ER-M levels for SVOCs and metals, and one sample exceeded the ER-L for a pesticide. However, sediments in the manmade lake would not be disturbed by the proposed Project, so there would be no increase in potential ecological risk from sediment contaminants.

5.3.12 NAVIGATION

The non-preferred alternative project would not affect navigation of the Hackensack River. Temporary, minor increases in turbidity and sedimentation of the Hackensack River may occur as a result of on-site excavation. However, the amount of sediment deposited into the Hackensack River would have a negligible impact to navigation.

The CDF facility would require a barge to be situated in the Hackensack River, approximately 200 feet off of the Project Area for a period of up to ten weeks. This barge would carry sand for use as clean fill material for the wetland restoration Project, as well as the landfill closure and golf course development projects. The barge would be located outside of the federal navigation channel and would be operated and marked in accordance with all applicable U.S. Coast Guard regulations. Therefore, implementation of the non-preferred alternative project would have no impacts on navigation.

5.3.13 AESTHETICS AND SCENIC RESOURCES

Short-term adverse impacts to the aesthetic and scenic resources in the non-preferred alternative project area would be minor. Aesthetic values would be reduced temporarily during construction, due to the presence of construction equipment and construction activities. However, these impacts would be temporary, and scenic and aesthetic values would be restored and enhanced as a result of the Project. Permanent, minor, adverse impacts include the loss of aesthetic values by removal of trees within the footprint of the non-preferred alternative. HCDPR has expressed interest in saving and transplanting as many of the shrubs and trees from the forest/scrub-shrub areas as is feasible during Project construction, to preserve some of the character and nature of the Project Area (Jennings 2002).

Long-term positive results of the construction of the non-preferred alternative project aesthetic and scenic resources would occur from implementation of the preferred plan. The preferred plan would create unobstructed view corridors of the Hackensack River, which are currently obstructed by dense stands of *Phragmites*. Specifically, the walkway and footbridge created as part of the non-preferred alternative would provide visual vantage points for views of the surrounding marsh and the Hackensack River. In addition, planting native shrubs in and around the Project Area would increase the aesthetic and scenic value of the site. Therefore, implementation of the non-preferred alternative project would have no impacts on aesthetics and scenic resources.

5.3.14 RECREATION

Implementation of the non-preferred alternative would result in a positive long-term positive gain towards recreation. Recreational opportunities that currently exist, such as hiking, jogging, birding, and fishing, would be enhanced by implementation of the non-preferred alternative. Specifically, the construction of the walkway along and within the salt marsh would provide access to the marsh and lake and create viewing areas for birders and other wildlife enthusiasts. Additionally, the walkway would be integrated into the existing trail system within the Project Area and eventually become part of the planned Hackensack River Walk. Implementing the non-preferred alternative would be consistent with the long-term environmental awareness and recreation goals for Lincoln Park.

Temporary impacts associated with implementation of the non-preferred alternative may include limited public access to the existing trail system and the Hackensack River during the construction phase. No significant or long-term negative impacts to recreational resources in the non-preferred alternative project area are expected as a result of the Project.

5.3.15 TRANSPORTATION

Temporary impacts to the land-based transportation resources in the non-preferred alternative project would be associated with the movement of construction equipment and workers' vehicles during the construction phase of the Project. Specifically, the gravel parking area adjacent to the existing playing fields may be used as contractor parking and equipment staging areas during construction. However, these impacts are expected to be minimal, short-term, and limited to the period of construction. The non-preferred alternative would not result in a significant long-term increase in traffic. During construction, coordination with local officials would occur as needed to minimize effects to the local traffic patterns and parking.

On-site transportation of excavated material from the salt marsh restoration area to the upland disposal site would be restricted to the existing gravel road system within and immediately adjacent to the project area. Improvements, such as minor widening or deposition of rock to stabilize the roadbed in low lying areas may be required to support heavy machinery (e.g., dump trucks and front-end loaders). However, the impacts resulting from these improvements would be minor.

The Hackensack River is the only navigable water located in the Project vicinity. The non-preferred alternative identifies minimal excavation activities at the mouth of the primary tidal creek. This activity would not significantly impact the navigability of the Hackensack River. Therefore, there would be no significant impact to water-based transportation.

5.3.16 AIR QUALITY

The Project is located in an ozone non-attainment area. Off-road construction equipment used on-site may produce minor amounts of NAAQS criteria pollutants in the immediate vicinity of the non-preferred alternative project area. However, construction activities would have no significant or long-term impacts on air quality. Based on the current design, emissions calculations indicate the Project is under the conformity threshold value of 25 tons per year for nitrogen oxides and ozone precursors. Measures will be taken during construction as required to minimize particulate circulation due to dust, etc. Therefore, there would be no significant impact to air quality.

5.3.17 NOISE

There would be a minor increase in noise levels in the immediate Project vicinity during construction due to the increase in worker vehicles and traffic, and the operation of construction equipment. However, these impacts are expected to be minimal and short-term, and limited to the period of active construction. There would be no long-term impact on noise levels in the non-preferred alternative project area.

5.3.18 AIR TRAFFIC

The non-preferred alternative project area is also about 3.75 miles from Newark Airport and about 7.4 miles from Teterboro Airport. The project would be within the 5-mile perimeter of Newark Airport as described in the Federal Aviation Administration's (FAA) Advisory Circular 150/5200-33B. These guidelines provide recommendations to land use planners and project developers regarding practices that may attract wildlife populations that are hazardous to air traffic within a 5-mile radius. Impacts of the project on air traffic could potentially include an increase in waterfowl using the area due to the increase in amount of tidal wetlands. Geese in particular rank high on the list of 25 species groups as to relative hazard to aircraft. Other guilds that are likely to use the project area have low hazard rankings. Canada Goose (Branta canadensis) and Brant (Branta bernicla) are the most likely species that are of concern, but both species are already using the area currently. These species would most likely use the open water component of the proposed project, rather than the spartina wetlands component. "Loafing" as the FAA terms roosting or idle standing, is a behavior common to both resident and migratory populations, however, the well known behavior of loafing by large flocks of resident geese on lawns in parks, airports, sports fields, and corporate lawns and golf courses would be discouraged by the planting of native Spartina grasses. Canada Geese are particularly drawn to lawns for two reasons: they can digest grass, and when they are feeding with their young, manicured lawns give them a wide, unobstructed view of any approaching predators. Because Spartina grass in its tall form lacks these features it is not likely to attract large numbers or flocks of idle birds or foraging birds.

According to the FAA and other sources, migratory Canada geese have been in decline for over a decade, whereas the population of resident geese has seen near exponential growth. Because they never leave their familiar year-round habitats, and due to this dramatic increase in population size, resident geese are responsible for most conflicts with urban and suburban owners of agricultural fields and lawns.

Native marshes and restored marshes such as the planned Lincoln Park restoration within the NY/NJ Harbor typically attract small numbers of breeding pairs from Spring through early Summer. Young can be seen with swimming with parents in tidal creeks during the summer and on through the summer molt when many of the birds are temporarily flightless. Geese are in part colonial and congregate in flight in large numbers, especially during Fall migration in October.

The largest areas of congregation at Lincoln Park are within the areas of lawns designated for active and passive recreational use. Highest areas of concentration are within open water lakes especially where lawn and lake meet (personal communication Carl Alderson). Because of the diminishing numbers of migratory geese on the Atlantic flyway and due to the limited numbers of Resident type geese attracted seasonally to a salt marsh, the creation of tidal marsh and tidal creeks are not believed to cause a significant impact to air travel for the non-preferred alternative project area. Consultation with the FAA and the operators of Newark Liberty International will be sought in accordance with the 5-mile radius guideline stated in the Advisory. Avian population monitoring will be conducted for three years post restoration.

6.0 COMPLIANCE WITH KEY STATUTES, REGULATIONS, AND POLICIES

Table 14. Federal and State Agency Permits, Approvals, and Consultation Required for the Project

Permits and Approvals	**Status**	**Agency**[1]	**Action**[2]
Federal			
Clean Water Act of 1977, as amended	Under Review	USACE, NJDEP, USEPA	Under Section 404, issue a Nationwide 27 Permit.
Coastal Zone Management Act of 1972, as amended	Attached and Under Review	NOAA, NJDEP	Provide a Coastal Consistency Certification for the Project.
Clean Air Act	Completed	USACE, USEPA	Under Section 176, prepare a Clean Air Act General Conformity for the Project.
Endangered Species Act of 1973, as amended	Completed	USFWS, NMFS	Consult on Federally- listed threatened and endangered species.
Marine Mammal Protection Act of 1972, as amended	Completed	USFWS, NMFS	Review of, and comments on, the Project to determine impacts to marine mammals.
Fish and Wildlife Coordination Act, as amended	Completed	USFWS, NMFS, USACE	Consult on wildlife resources and conservation practices.
National Historic Preservation Act of 1966, as amended	Completed	NJHPO (NJDEP)	Per Section 106, review of, and comment on, the Project to determine effects on cultural resources that are listed in, or eligible for listing in, the NRHP.
Executive Order 11988, Floodplain Management	Addressed in EA	USACE	Evaluate the potential effects of the Project with regard to floodplains.
Executive Order 11990, Protection of Wetlands	Addressed in EA	USACE	Evaluate the potential effects of the Project with regard to wetlands.
Farmland Protection Policy Act of 1981, as amended	Addressed in EA	NRCS	Analysis of impacts of the Project on prime and unique farmland.
Water Resources Planning Act of 1965, as amended	Addressed in EA	USACE	Assessment of impacts of the Project on water resources and related land resources.
Wild and Scenic Rivers Act, as amended	Addressed in EA	USDI (NPS), USDA (USFS)	Analysis to determine impacts of the Project on specific river reaches or areas that are classified as “wild, scenic, or recreational.”
Estuary Protection Act, as amended	Addressed in EA	USEPA, NMFS	Evaluate the impacts of the Project on estuarine areas.
Archeological and Historic Preservation Act of 1974, as amended	Addressed in EA	NJHPO (NJDEP)	Evaluation of the impacts of the Project on archaeological and historical resources.

Permits and Approvals	Status	Agency	Action[1]
Rivers and Harbors Appropriation Act of 1899, as amended	Addressed in EA	USACE	Evaluate the impacts of the Project on navigable waters.
National Environmental Policy Act of 1969, as amended	Addressed in EA	USACE (Lead Agency)	Evaluation of the impacts of the Project on a broad range of environmental resources.
Coastal Barrier Resources Act (CBRA), Public Law 97-348 (96 Stat. 1653; 16 U.S.C. 3501 et seq.), enacted October 18, 1982	Not Applicable	USFWS	Evaluate potential impacts to coastal barrier systems.
Hazardous, Toxic and Radioactive Waste Guidance	Addressed in EA	USACE	Guidelines for managing hazardous wastes associated with the Project.
Magnuson-Stevens Fishery Conservation and Management Act of 1990	Completed	NMFS	Evaluate the impacts of the Project on anadromous fish species or fishery resources.
Safe Drinking Water Act	Not Applicable	USEPA	Evaluate compliance of the Project on public drinking water supplies.
State and Local			
NJDEP Rules and Regulations – Threatened, and Endangered Species	Completed	NJDEP	Consult on state and Federal listed threatened and endangered species.
NJDEP Rules and Regulations – Freshwater Wetland Protection Act Rules	Under Review	NJDEP	Evaluation of the effects of the Project on existing freshwater wetlands and associated transition areas.
NJDEP Rules and Regulations – Flood Hazard Area Act	Under Review	NJDEP	Evaluation of the effects of the Project on streams.
NJDEP Rules and Regulations – Waterfront Development Permit	Under Review	NJDEP	Evaluation of the effects of the Project on waterfront areas.
Review under State Historic Preservation Act (SHPA)	Completed	NJHPO (NJDEP)	Review to determine effects on properties listed in, or eligible for listing in, the NRHP.
Permit under the State Pollutant Discharge Elimination System (SPDES)	Not Applicable	NJDEP	Evaluation of the effects of the Project on discharges to water bodies.
Permit for Coastal Erosion Hazard Areas	Not Applicable	NJDEP	Evaluation of the effects of the Project on coastal erosion hazard areas.
Water Quality Certification	Under Review	NJDEP	Evaluation of the effects of the Project on water quality.
Soil Erosion and Sediment Control Plan		Hudson County	Plan for the control of soil erosion and sediments.
Transportation Permit		Jersey City	Permit from planning board for truck routing
City Easements		Jersey City	Temporary easement for construction access and activities

Notes: [1] Review of the Project's Draft EA and Final EA is required before the issuance of permits.

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7.0 LIST OF PREPARERS (INCLUDING USACE - 2006; AND NOAA - 2009)

Name	Position	Role in ERR/EA Preparation
National Oceanic and Atmospheric Administration – Restoration Center		
Carl Alderson	Marine Restoration Specialist	Preparation of Draft RPEA NOAA (2009).
John Catena	NOAA Restoration Center NE Regional Supervisor	Identification of Restoration Alternatives. Review and Comment on RPEA NOAA (2009).
Gwendolyn McCarthy	Legal Counsel	Review and comment on RPEA (NOAA 2009)
Shawn Kiernan	Marine Restoration Specialist	Assist with identification of restoration alternative; and, provide review and comments on the ERR/EA USACE (2006).
Bethany Bearmore	Marine Restoration Specialist	Provided technical assistance in design and development of restoration alternatives.
U.S. Army Corps of Engineers, New York District		
Melissa Alvarez	Project Biologist, Environmental Analysis Branch, Planning Division	Assisted in all phases of the Project. Prepared Clean Air Act Section 176 General Conformity – Draft RONA.
Dr. Josephine Axt	Environmental Team Leader, Environmental Analysis Branch, Planning Division	Assisted in all phases of the Project.
Edward Wrocenski	Project Manager, Plan Formulation Branch, Planning Division	Assisted in all phases of the Project.
John Killeen	Cultural Resources Specialist, Planning Division	Prepared Cultural Resources section; conducted all communication with NJHPO.
Steve McDevitt	GIS Specialist, Planning Division	Provided final preferred alternative (i.e., NER Plan) design.
Richard Dabal	HTRW, Planning Division	Provided technical assistance with HTRW section.
Johnny Chan	Economics Specialist, Planning Division	M-CACES
Marty Goff	Technical Manager, Civil Resources Branch, Engineering Division	Provided technical assistance in design and development of restoration alternatives and hydrological modeling.
Kerry Anne Donohue	Hydraulic Engineer, Civil Resources Branch; Engineering Division	Assisted in all phases of the Project. Developed and designed restoration alternatives; conducted hydrodynamic modeling, surveying, and tidal analysis; provided technical assistance with Topography, Geology, Soils and Water Resources sections; and, prepared Description of Restoration Alternatives and Costs.
Harry Donath	Cost Engineer. Civil Resources Branch; Engineering Division	Determined unit costs for restoration alternatives; and, calculated costs for preferred alternative using MCACES.

Name	Position	Role in ERR/EA Preparation
Tom Dannemann	CRB	
Bob Hass	Real Estate Division	
Ellen Simon	Office of Counsel	
Danny Lee	Construction Division	
New Jersey Department of Environmental Protection		
John Sacco	Research Scientist, Office of Natural Resource Damages	Assist with identification of restoration alternative; and, provide review and comments on the document.
David Bean	Office of Natural Resource Restoration	Lincoln Park West Lead Project Manager. Led all phases of the Project.
Grace Jacobs	Office of Natural Resource Restoration	Assistant to the Project manager.
Hudson County Division of Parks and Recreation		
Kenneth L. Jennings	Assistant Division Chief	Assist with identification of restoration alternative; prepare a conceptual design for the trail system for the site; and, provide review and comments on the document.
Northern Ecological Associates, Inc. (NEA)		
Dr. David J. Santillo	Principal	Project Director, Principal Review
Sarah C. Watts	Project Manager (NEA)	ERR/EA (2006) Manager, Technical Review. Assist with development of Restoration Alternatives;, and, prepare Introduction, Purpose and Need, Problem and Opportunity Identification, Existing Environment, Description of Benefits, CE/ICA, National Ecosystem Restoration Plan, Environmental Impacts, Project Implementation, Public and Agency Involvement and Scoping, Summary and Conclusions, Recommendations, and List of Preparers sections.
Kathleen Miller	Environmental Manager	Deputy EA Manager, Technical Review
Stacie L. Grove	Environmental Manager	QA/QC of EPW assessment, and FCI and FCU calculations.

Name	Position	Role in ERR/EA Preparation
Brad Schaeffer	Environmental Manager	Restoration Monitoring, Monitoring Costs.
Jack Wu	Environmental Scientist	Prepare Water Resources – Regional Hydrogeology & Groundwater, Surface Water, Tidal Influences, Fish and Wildlife – Shellfish, Finfish, Benthic Resources, T&E and Special Concern Species, Essential Fish Habitat, Socio-economics – Housing, Coastal Zone Management, HTRW, Navigation, CZM Consistency Statement, Clean Water Act Section 404(b)(1) Analysis sections; and, provide QA/QC of data entry for EPW assessment.
Patrick Fellion	Environmental Scientist	Prepare Land Use, Land Cover, and Zoning, Vegetation – Wetlands and Uplands, Fish and Wildlife – Reptiles and Amphibians, Birds, Mammals, Floodplains, Aesthetics and Scenic Resources, Recreation, Transportation, Air Quality, and Noise sections.
Stephenie Swiezynski	Environmental Scientist	Prepare Topography, Geology and Soils, Socio-economics – Population, Economy, Income, and Employment, and Education sections.
Karla Hyde	CAD/GIS Specialist	Prepare ERR/EA Figures and perform acreage calculations.
Janelle Lavallee	CAD/GIS Specialist	Prepare ERR/EA Figures and perform acreage calculations.
Beth Stuba	Editor	Provide Editorial and QA/QC Review.
The Louis Berger Group, Inc. (Berger)		
Donald Stevens, P.E.	Manager, Restoration Design	Responsible for restoration design; oversight of permit submittals and EA compilation.
Sachin Apte	Senior Engineer	Responsible for restoration design; oversight of permit submittals and EA compilation.
Steven Trainor, P.E.	Manager	Responsible for permit submissions relative to Flood Hazard Area Act and Soil Erosion and Sediment Control.
Ann Folli	Principal Scientist	Responsible for assistance with restoration design; compilation and submittal of permit applications, EA compilation.
Tom Shinskey	Principal Scientist	Responsible for EA compilation, sections relative to aquatic species, EFH.
Heather Shaw	Senior Scientist	Responsible for GIS graphic support and acreage calculations.

LIST OF APPENDICES

APPENDIX A
LIST OF ABBREVIATIONS AND ACRONYMS

LIST OF ABBREVIATIONS & ACRONYMS

APPENDIX	DEFINITION
BA	Before-After
BACI	Before-After-Control-Impact
BACI-P	Before-After-Control-Impact-Paired
Baykeeper	New York/New Jersey Baykeeper
BMPs	Best Management Practices
CADD	Computer Aided Drafting Design
CAFRA	Coastal Area Facility Review Act
CE/ICA	Cost-effectiveness and incremental cost analyses
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CIMIC	Rutgers University's Center for Information Management, Integration, and Connectivity
cm	centimeter
CI	Control-Impact
CY	cubic yard(s)
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act
dBA	"A"-weighted decibel
District	New York District
EA	Environmental Assessment
EFH	Essential Fish Habitat
EM	Engineer Manual
EPW	Evaluation for Planned Wetlands
ER	Engineer Regulation
ERR	Ecosystem Restoration Report
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FCI	Functional Capacity Index
FCU	Functional Capacity Unit
FEMA	Federal Emergency Management Agency
FONSI	Finding of No Significant Impact
ft	foot (feet)
FWCA	Fish and Wildlife Coordination Act
GPS	Global Positioning System
Harbor/Bight	New York-New Jersey Harbor Estuary and New York Bight
High marsh	*Spartina patens* marsh
HCDPR	Hudson County Division of Parks and Recreation
HCPB	Hudson County Planning Board

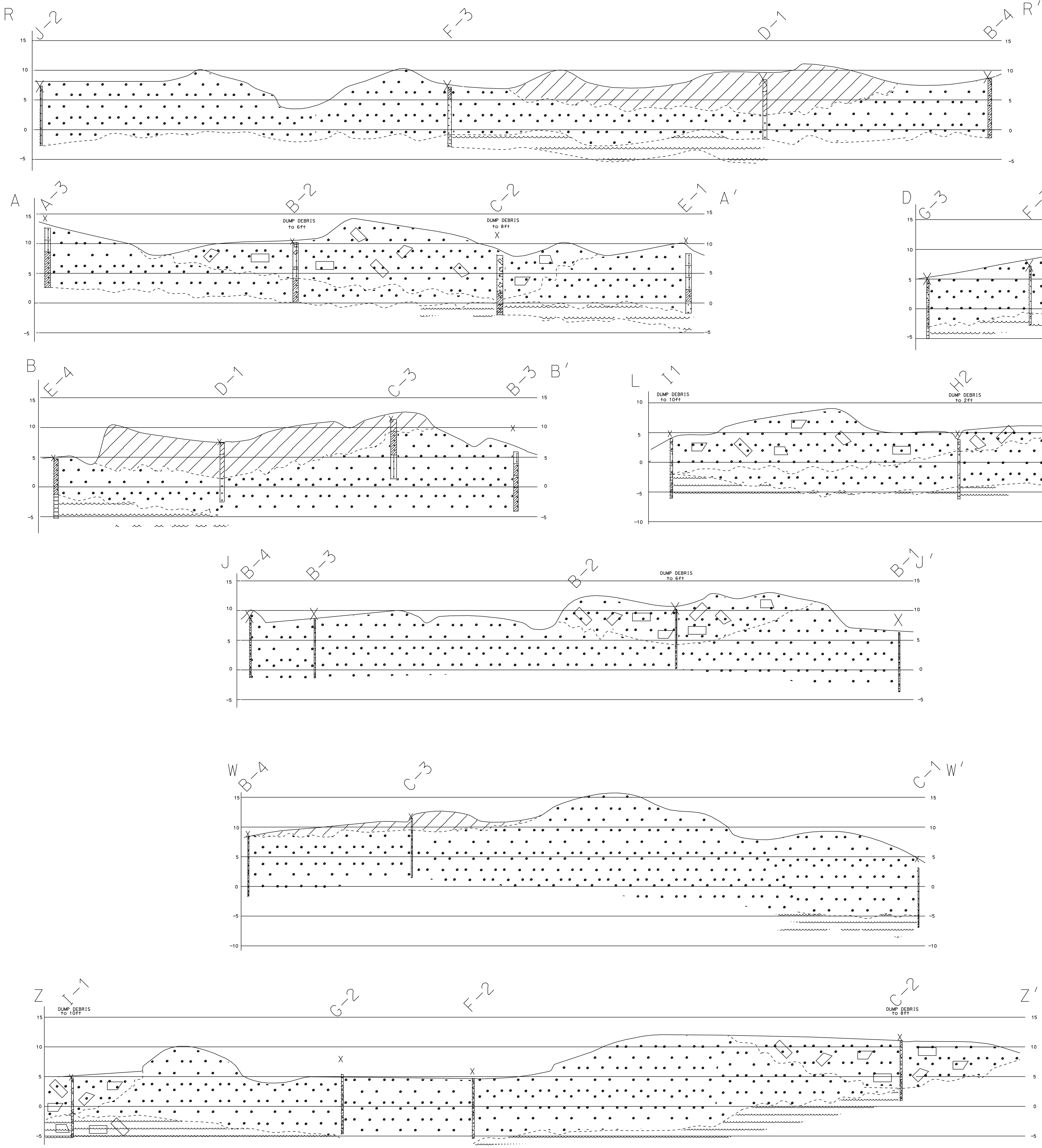
LIST OF ABBREVIATIONS & ACRONYMS (CONTINUED)

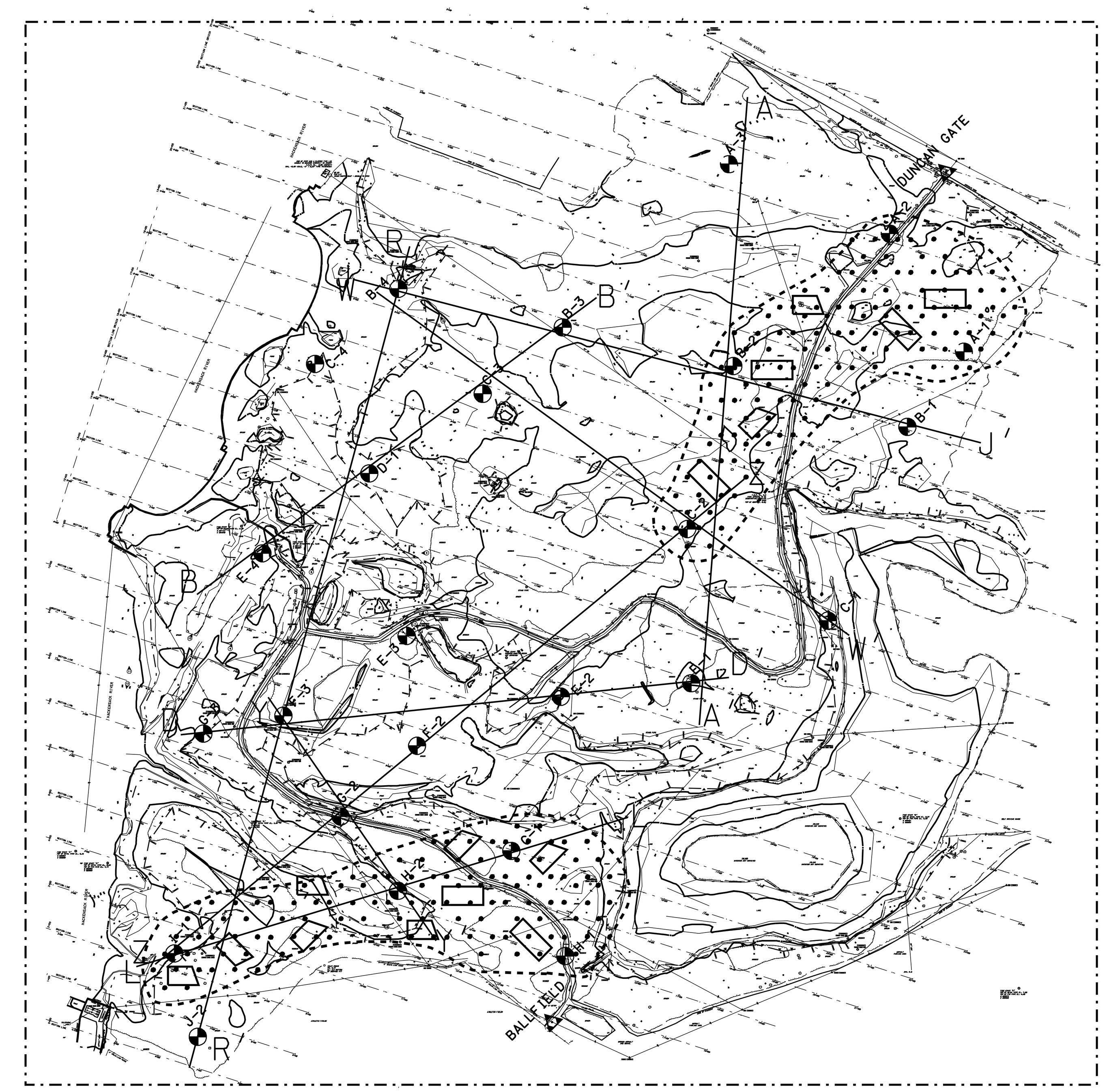
APPENDIX	DEFINITION
HEP	New York-New Jersey Harbor Estuary Program
IWR	Institute for Water Resources
lbs.	pounds
L_{dn}	Day-night noise level
Low marsh	*Spartina alterniflora* marsh
LPIL	Lowest possible identification level
LURP	Land Use Regulation Program
Louis Berger	Louis Berger Group
MERI	Meadowlands Environmental Research Institute
MHW	Mean High Water
MHHW	Mean Higher High Water
MHWS	Mean High Water Spring
MLW	Mean Low Water
MLLW	Mean Lower Low Water
m^2	meter squared
µg/L	micrograms/liter
mg/L	milligrams/liter
mi^2	square miles
MOM	macro-organic matter
MTL	Mean Tide
NAAQS	National Ambient Air Quality Standards
NAVD88	North American Vertical Datum of 1988
NEA	Northern Ecological Associates, Inc.
NED	National Economic Development
NEPA	National Environmental Policy Act
NER	National Ecosystem Restoration
NGVD29	National Geodetic Vertical Datum 1929
NJAC	New Jersey Administrative Code
NJDCR	New Jersey Department of Environmental Protection, Division of Coastal Resources
NJDEP	New Jersey Department of Environmental Protection, Office of Natural Resource Damages
NJFO	United States Fish and Wildlife Service, New Jersey Field Office
NJMC	New Jersey Meadowlands Commission
NJNHP	New Jersey Natural Heritage Program
NJSA	New Jersey State Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration

LIST OF ABBREVIATIONS & ACRONYMS (CONTINUED)

APPENDIX	DEFINITION
NOAA-RC	National Oceanic and Atmospheric Administration– Restoration Center
NOS	National Oceanic and Atmospheric Administration, National Ocean Service
NPL	National Priority List
NYCPRD	New York City Parks and Recreation Department
PCA	Project Cooperation Agreement
PCB	Polychlorinated biphenyl
ppt	parts per thousand
Project	Lincoln Park West Wetlands Restoration
PRP	Preliminary Restoration Plan
QA/QC	Quality assurance and quality control
reference area	Sawmill Creek Wildlife Management Area
RMA	Resource Management Associates
RPEA	Restoration Plan Environmental Assessment
RONA	Record of Non-Applicability
Rules	New Jersey's Rules on Coastal Zone Management
SAV	Submerged aquatic vegetation
SE-2	Saline Estuarine 2
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SPI	Sediment profile imagery
SVOC	Semi-volatile organic compound
2-D	Two-dimensional
T&E	Threatened and endangered species
USACE	United States Army Corps of Engineers
USDA-NRCS	United States Department of Agriculture – Natural Resources Conservation Service
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VOC	Volatile organic compound
WAA	Wetland Assessment Area
WRDA	Water Resources Development Act

APPENDIX B
USACE ENGINEERING
☐ GEOTECHNICAL DATA
☐ TIDAL DATA AND HYDRODYNAMIC MODEL





KEY

- SILT/CLAY
- SAND/GRAVEL
- DUMP DEBRIS
- PEAT

Revision	Description	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
NEW YORK, NEW YORK

Designed by:

Drawn by:

Checked by:

LINCOLN PARK WEST
ECOSYSTEM RESTORATION

SUBSURFACE EXPLORATION

BORING PLAN and CROSS SECTIONS

Reviewed by:
SECTION CHIEF
Concurred by:
CHIEF, DESIGN BRANCH

Approval Recommended:
CHIEF, ENGINEERING DIVISION
Approved by:
COLONEL, C.E. DISTRICT ENGINEER

SHEET REFERENCE NUMBER:

DATE:

SCALE: AS SHOWN

SHEET

A-1
Elevation: 8.5′ — 691536 / 605954

Sample	Classification of Materials (Description)	Remarks
S1–S5	Dark-brown to gray medium SAND, trace Silt and Clay, some Gravel (SP)	mottled; damp; ▽ 4′; wet; trace Organics; trace Organics, trace Dump Debris
		TD = -10.0′

A-2
Elevation: 9.5′ — 691808 / 605783

Sample	Classification of Materials (Description)	Remarks
S1	Dark-brown to black SILT, some fine Sand, trace Clay, some Cobble to Gravel-size Brick fragments (ML)	Top Soil; damp
S2–S3	Dark-brown SILT, little fine Sand, trace Gravel (ML-SP)	Dump Debris; wet; Gravel = Brick; some Organics coarse, some charred
S4	Dark-brown and brickred mixed SILT, some fine Sand, trace Clay (ML-SP)	
S5	Dark-brown medium to coarse SAND, some Silt, trace Gravel (SM)	trace Organics; damp
	TD = -10.0′	

A-3
Elevation: 14.3′ — 691968 / 605413

Sample	Classification of Materials (Description)	Remarks
S1	Dark-brown, fine SAND, little to some Silt, trace Clay (SM)	trace Organics; Cobbles
S2	Dark-brown fine SAND, little to some Silt, trace Clay, trace Gravel (SM)	trace Organics
S3–S5	Dark-brown fine SAND, little to some Silt, some Clay, trace Gravel (SC)	little Organics
		TD = -10.0′

B-1
Elevation: 8.3′ — 691363 / 605824

Sample	Classification of Materials (Description)	Remarks
S1–S2	Brown fine SAND, little to some Silt, trace Clay, trace Gravel (SM)	trace Organics; damp; ▽ 3′; wet
S3–S5	Dark-gray fine SAND, little to some Clay, trace Silt (SC)	some Organics
		TD = -10.0′

B-2
Elevation: 10.3′ — 691503 / 605423

Sample	Classification of Materials (Description)	Remarks
S1–S3	Dark-brown fine SAND, little to some Silt, some Clay (SM)	some Dump Debris; damp; trace Dump Debris; trace Dump Debris
S4–S5	Dark-brown fine SAND, little to some Clay, trace Gravel (SC)	trace Organics; very moist; ▽ 8′; trace Organics; wet
	TD = -10.0′	

B-3
Elevation: 9.4′ — 691592 / 605030

Sample	Classification of Materials (Description)	Remarks
S1	Dark-brown fine SAND, little to some Silt, trace Clay (SM)	some Roots; damp
S2	Dark-brown fine SAND, little to some Silt, some Clay (SC)	trace Organics; mottled
S3	Dark-brown to gray fine SAND, some Clay (SC)	very moist; ▽ 6′
S4–S5	Dark-gray fine SAND, little to some Clay (SC)	wet
		TD = -10.0′

B-4
Elevation: 8.8′ — 691681 / 604652

Sample	Classification of Materials (Description)	Remarks
S1–S3	Dark-brown fine SAND, little to some Silt, some Clay (SC)	some Roots; damp; ▽ 4′; some Roots; wet
S4–S5	Dark-brown fine SAND, little to some Clay, some Silt, trace Gravel (SC)	some Organics
		TD = -10.0′

C-1
Elevation: 4.5′ — 690917 / 605641

Sample	Classification of Materials (Description)	Remarks
S1–S3	Brown to gray fine to medium SAND, trace Silt and Clay (SP)	little Organics to 2′; ▽ 2′; trace Organics
S4	Brown to dark-gray mixed fine SAND, some Clay, trace Silt (SC)	decaying organic odor
S5	Dark-brown fine SAND, some Clay, trace Silt, mixed with Peat (PT-SC)	almost all Organics
	TD = -10.0′	

C-2
Elevation: 11.4′ — 691128 / 605317

Sample	Classification of Materials (Description)	Remarks
S1–S2	Dark-brown to black, medium SAND (SP)	some Dump Debris; damp; some Dump Debris (rags)
S3	Same as above with more Dump Debris and less sediment (SP)	little assorted Dump Debris
S4	Red-brown to dark-gray SAND, little to some Clay (SC)	▽ 6′; some Organics; wet
S5	Dark-gray to brown fine SAND, little to some Silt, little Clay (SC-SM)	trace Peat
	TD = -10.0′	

C-3
Elevation: 11.8′ — 691439 / 604846

Sample	Classification of Materials (Description)	Remarks
S1	Dark-gray Sandy CLAY, trace Silt (CL)	trace Organics; damp
S2–S3	Dark-brown fine SAND, little to some Clay, trace Silt (SC)	
S4–S5	Brown to black medium SAND, little Clay (SM)	damp
		TD = -10.0′

C-4
Elevation: 5.5′ — 691508 / 604460

Sample	Classification of Materials (Description)	Remarks
S1	Brown fine SAND, trace Silt and Clay (SP)	trace Organics; damp
S2	Dark-brown to black fine SAND, trace Silt, trace Gravel (SM)	trace Organics; ▽ 4.0′
S3–S4	Dark-brown fine SAND, little to some Clay (SC)	trace Organics; wet
S5	Dark-gray Sandy CLAY, trace Silt (CL)	
		TD = -10.0′

D-1
Elevation: 8.5′ — 691256 / 604585

Sample	Classification of Materials (Description)	Remarks
S1	Dark-gray to brown CLAY, little to some Sand, trace Silt (CL-SP)	trace Organics
S2–S3	Dark-gray to dull-brown, CLAY, little to some Sand, trace Silt, trace Gravel (CL)	damp
S4–S5	Dark brown-gray, fine SAND, trace Silt and Clay, trace Gravel (SP)	wet
		TD = -10.0′

E-1
Elevation: 10.3′ — 690773 / 605326

Sample	Classification of Materials (Description)	Remarks
S1	Dark-brown fine SAND, little to some Silt, trace Clay (SM)	trace Organics; damp
S2	Dark-brown, fine SAND, little to some Silt, trace Clay, trace Gravel (SM)	trace Organics
S3	Dark-brown fine SAND, little to some Silt, little Clay (SM)	trace Organics
S4	Dark-brown fine SAND, little to some Silt, some Clay (SC)	very moist; ▽ 8′
S5	Dark-brown fine SAND, trace Silt and Clay, trace Gravel (SP)	wet; TD = -10.0′

E-2
Elevation: 10.3′ — 690742 / 605026

Sample	Classification of Materials (Description)	Remarks
S1–S4	Brown medium SAND, some Clay, trace Silt (SC)	faint decaying organics odor; damp; trace Organics; ▽ 5′; wet; trace Organics
S5	Gray medium SAND, some Clay, trace Gravel and coarse Sand (SC)	
		TD = -10.0′

E-3
Elevation: 7.2′ — 690882 / 604671

Sample	Classification of Materials (Description)	Remarks
S1–S2	Dull brown SILT, some medium Sand, some Clay (ML)	
S3–S5	Dull brown fine SAND, little Clay, trace Silt (SP)	
		TD = -10.0′

E-4
Elevation: 4.9′ — 691072 / 604339

Sample	Classification of Materials (Description)	Remarks
S1–S3	Brown medium SAND, little to some Clay, trace Silt (SC)	little Organics; ▽ 2′; little Organics; wet
S4–S5	Dark-brown PEAT (PT)	wet
		TD = -10.0′

F-2
Elevation: 5.8′ — 690629 / 604695

Sample	Classification of Materials (Description)	Remarks
S1–S2	Dull brown medium SAND, little to some Clay, trace Silt (SC)	trace Organics; wet; trace Organic (plants); ▽ 4′
S3	Dull brown medium SAND, little Clay, trace Silt (SC)	trace Organics
S4–S5	Dark-gray medium SAND, trace Clay and Silt (SP)	
		TD = -10.0′

F-3
Elevation: 7.3′ — 690698 / 604387

Sample	Classification of Materials (Description)	Remarks
S1	Dull brown medium SAND, little to some Clay, trace Silt (SC)	trace Organics; damp
S2–S4	Brown to dull red-brown medium SAND, trace Silt and Clay (SP)	very moist; wet
S5	Same as S3, mixed with some dark-brown PEAT (SP-PT)	
		TD = -10.0′

G-1
Elevation: 6.8′ — 690387 / 604912

Sample	Classification of Materials (Description)	Remarks
S1	Dark-brown to black fine SAND, little to some Silt, some Clay, trace Cobble (SC)	concrete to 8″; damp to wet; Gravel to 1″; ▽ 3′
S2–S3	Dark-brown to black medium to coarse SAND, trace Clay and Silt, trace Gravel (SP)	
S4	Black to dark-brown SAND, little to some Clay, trace Silt (SC)	wet
S5	Dark-gray fine SAND, some Clay, trace Silt, trace Gravel (SC)	
		TD = -10.0′

G-2
Elevation: 7.8′ — 690466 / 604519

Sample	Classification of Materials (Description)	Remarks
S1	Brown medium SAND, little Clay, trace Silt (SP)	
S2–S5	Brown medium SAND, little to some Clay, trace Silt (SC)	trace Organics
		TD = -10.0′

G-3
Elevation: 5.0′ — 690657 / 604203

Sample	Classification of Materials (Description)	Remarks
S1	Pale brown and gray fine SAND, some Clay, trace Silt, trace Gravel (SC)	damp
S2	Dull brown medium SAND, trace Clay and Silt (SP)	
S3–S4	Dull brown fine SAND, little to some Clay (SC)	▽ 4′; wet
S5	Brown PEAT (PT)	decaying organic odor
	TD = -10.0′	

H-1
Elevation: 6.9′ — 690145 / 605036

Sample	Classification of Materials (Description)	Remarks
S1	Dark gray-brown medium SAND, some Clay, little Silt (SC)	trace coarse bricks; damp
S2	Same as S1 to 3.5′, then Dark-gray medium SAND, trace Clay and Silt (SP)	▽ 3.5′; some Dump Debris (wire, metal)
S3–S4	Dark-gray SAND, trace Silt and Clay (SP)	wet; trace Dump Debris
S5	Dark-gray fine SAND, little to some Clay (SC)	organic odor; TD = -10.0′

H-2
Elevation: 4.8′ — 690295 / 604651

Sample	Classification of Materials (Description)	Remarks
S1	Dull brown medium SAND, trace Clay and Silt (SP)	trace Dump Debris (wire); ▽ 2′; trace Organics
S2	Dull brown to dark-gray medium SAND, with some Gravel, trace Silt and Clay (SW)	
S3	Gray-brown GRAVEL, trace medium Sand (GP)	wet
S4	Dark-gray coarse SAND, little to some Gravel, trace Silt and Clay (SW)	
S5	Dark-brown to gray PEAT with some medium GRAVEL, little to some SAND (PT-GP)	TD = -10.0′

I-1
Elevation: 4.8′ — 690151 / 604136

Sample	Classification of Materials (Description)	Remarks
S1–S3	Brown to dark-gray fine SAND, trace Silt and Clay, trace coarse Dump Debris (SW)	trace Organics; very moist; ▽ 2.0′
S4–S5	Dark-brown, fine SAND, trace Gravel, little to some Peat, little Dump Debris (SW)	
		TD = -10.0′

J-2
Elevation: 7.3′ — 689959 / 604190

Sample	Classification of Materials (Description)	Remarks
S1–S5	Dark-brown fine SAND, little to some Silt, little Clay, trace coarse Gravel (SM)	trace Organics; damp; ▽ 4.0′; wet; trace Organics
		TD = -10.0′

Revision	Description	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
NEW YORK, NEW YORK

LINCOLN PARK WEST ECOSYSTEM RESTORATION

BORING LOGS

SUBSURFACE EXPLORATION

Designed by:

Drawn by:

Checked by:

Reviewed by: SECTION CHIEF

Concurred by: CHIEF, DESIGN BRANCH

Approval Recommended: CHIEF, ENGINEERING DIVISION

Approved by: COLONEL, C.E. DISTRICT ENGINEER

SHEET REFERENCE NUMBER:

DATE:

SCALE: AS SHOWN

SHEET

10

TIDAL DATA AND HYDRODYNAMIC MODEL
LINCOLN PARK WEST SECTION 1135 PROJECT
JERSEY CITY, NEW JERSEY

The Lincoln Park West Section 1135 Project, Ecosystem Restoration Report/Environmental Assessment proposes to transform a 26-acre parcel of the existing 90-acre parcel of land into an intertidal wetland dominated by *Spartina alterniflora*, which offers more ecological diversity than *Phragmites australis*. Improving the tidal circulation of an existing 9-acre pond was a secondary Project goal.

Fill placement and the bulkhead construction caused the existing tidal connection to the site to become severely restricted. This created prime conditions for *Phragmites* to invade. *Spartina* can be re-established at the site by reconnecting the tidal hydrodynamics throughout the site. The method proposed to accomplish this involves removing the *Phragmites* and lowering the grade to elevations similar to a reference patch of *Spartina* marsh found adjacent to the site and the Hackensack River. A network of tidal creeks would be necessary to convey the tide throughout the proposed 30-acre intertidal wetland.

The following sections describe the tidal data collection equipment and program, tidal analysis, hydrodynamic model, and biobenchmarks utilized in the development of restoration alternatives for the Project.

<u>Tidal Data Collection Equipment and Program</u>

The purpose of the tidal field data collection program was to provide a tidal hydrodynamic monitoring program by obtaining water levels in the open water areas of the Project area. The water level gages were taking measurements at the same time that bio-benchmarking topographical surveys were being done. The field effort involved continuous monitoring of the water level changes due to tides for a period of about six weeks. The locations of the gages are shown in Figure 1. The gages were placed at these locations for the following reasons, in order of priority: proximity to a proposed restoration site and reference site, a low energy environment (protected from vessel wakes, wind generated waves and currents), low accessibility to potential vandals, and depth of water at low tide. Every effort was made to satisfy the biologists and hydraulic engineer's request for location characteristics while ensuring the safety and optimal performance of the equipment.

The water level fluctuations were monitored using WaterLOG Model DH-21 Submersible Logger Pressure Tranducers. The DH-21 consists of a surface unit and subsurface probe that is typically mounted to a fixed structure or piling. It is a cylindrical subsurface unit that is less than 2 inches in diameter and about 24 inches in length. The sensor and logger are connected to a 1-1/4 inch polyethylene tubing (vented cable) that encloses the data cable and provides an atmospheric vent for the sensor. The instrument sensor and housing for the recorder are shown in Figure 2, and an installed gage is shown in Figure 3. The DH-21 is self-contained with an internal battery for unattended long-term data logging. Convenient user software executes on any IBM-compatible computer for instrument setup and data retrieval. The sampling interval for the water-level recorders was every 15 minutes.

Figure 1. Tide Gage Locations.

Figure 2. Instrument Sensor and Recorder Housing.

Figure 3. Installed Tide Gage.

Pressure transducers require minimal disturbance from waves and currents for the most accurate reading. To facilitate this requirement, the transducers were placed in a 3-inch slotted PVC pipe to dull as much disturbance as possible. These slotted PVC pipes were fixed to steel rods driven 3 to 9 ft into the ground. After the transducers and logger units were installed, a pressure reading was recorded, whereby the output was the distance from the sensor to the water surface. At the same time, the distance from the water surface to the top of the PVC pipe was measured. The top of all the PVC pipes were surveyed using real-time kinematic GPS, thus referencing the sensor to a known datum, National Geodetic Vertical Datum 1929 (NGVD29).

Tidal Analysis

The National Oceanic and Atmospheric Administration, National Ocean Service (NOS) predicts the tidal range (i.e., Mean Low Water [MLW] to Mean High Water [MHW]) at the confluence of the Hackensack River and Newark Bay (1 river mile downstream of the site) is 5.2 ft for mean tide and 6.29 ft for spring tide, and at the Amtrak RR Bridge (2.7 miles upstream of the site) is 5.29 ft for mean tide and 6.40 ft for spring tide (NOS 2001). Temporary water level recorders have been placed throughout the Hackensack River in recent years by various entities conducting studies or designing flood control or ecosystem restoration projects. The New Jersey Meadowlands Commission had maintained the longest tidal records in recent years, although there are numerous tidal records that continuously recorded water levels for 2 months or more. Along with the tidal range, many other tidal datums are useful in evaluating existing conditions and in designing a tidal wetland restoration project. Below are the tidal datums and their definitions.

- Mean High Water Spring (MHWS) – the average of the high tides that occur on the New and Full Moon
- Mean Higher High Water (MHHW) – the average of the higher of the high tides within a tidal cycle
- Mean High Water (MHW) – the average of all high tides
- Mean Tide Level (MTL) – the average of MHW and MLW
- Mean Low Water (MLW) - the average of all low tides
- Mean Lower Low Water (MLLW) – the average of the lower of the low tides within a tidal cycle
- Mean Low Water Spring (MLLS) – the average of the low tides that occur on the New and Full Moon

Table 1 summarizes many of the tidal datums from various tidal records in the area. It is important to note that most of these gages were not recording synoptically. Thus, storm surges, rainfall and runoff discharge patterns vary at all gage locations and for all record periods.

For this Project, six water level recorder gages were deployed throughout and adjacent to the Project area from 4 June 2002 through 16 August 2002. The location of gages in the Project area are shown in Figure 1. Table 2 summarizes the water level data records for these gages.

The methodology for the gage locations and the data observed were as follows:

Gage A (middle pond): This gage was placed in the middle pond, just upstream of the large pond in the proposed Project area as shown in Figure 1. The invert of the culvert that connected the two ponds regulated the water level in the middle pond. The fresh water input to the large pond was observed by this gage. Gage A recorded from June 8 – July 19 2001. The minimum, mean and maximum water surface elevations for this period were 2.1, 2.2 and 2.5 ft NGVD29.

While the culvert between the two ponds was outside the surveyed area, it appears that 2.2 ft NGVD29 is the controlling elevation for the pond. The runoff from the park spills into the downstream pond via the culvert. It is likely that pond levels drop below the invert of culvert via evaporation losses. The bottom of the pond had a layer of silty organic material at least 10 ft deep, judging from the 10 ft of 1-inch steel rod that was driven into the bottom with minimal effort. The normal rainfall amounts for June, July, and August in this area are 3.22, 4.50 and 3.91 inches. The rainfall during the gaging period was 4.38 inches total for the 6 weeks, less than the normal for that time of the year. While fresh water runoff contributes to the dynamics of the site, it is still an order of magnitude less than the tidal hydrodynamics influencing the Project site.

Gage B (west pond): This gage was placed in the large pond in the proposed Project area. One of the Project goals was to increase the tidal range of this pond, thus improving circulation in this water body. Gage B recorded the existing tidal range, and by comparing it to the fluctuations of the river, the frictional losses from the 1200 ft long culvert connecting the pond to the Hackensack River could be observed. Gage B recorded from June 26 – July 19, 2001. . The minimum, mean and maximum water surface elevations for this period were 1.1, 1.5 and 2.0 ft NGVD29. The MHHW, MHW, MLW and MLLW elevations were 1.75, 1.74, 1.31, and 1.30,

Table 1. Comparison of Tidal Datums in the Hackensack from Short Term Water Level Recorders.

	Tide Datums from Previous Studies				*Tide Datums Generated for Lincoln Park Project*		
	From New Jersey Meadowlands Commission, done by Woods Hole Group, Inc., 2000-2001			**From Louis Berger Marsh Resources Report, March 2001[4]**	**Raw Data from NJMC[5]**	**NOAA Tide Station 8518750[6]**	**Raw Data from USACE**
	Riverbend[1]	**Berry Creek[2]**	**Mill Creek[3]**	**Doctors Creek****	**Riverbend**	**Battery**	**Lincoln Park****
	June1999 - Dec 2000	June1999 - June 2000	May-Sep 1998	May-Nov 1998	June 8-July 19, 2001	June 8-July 19, 2001	June 8-July 19, 2001
River miles from Lincoln Park gage***	1.5 miles upstream	5.8 miles upstream	8.8 miles upstream	9.8 miles upstream	1.5 miles upstream	11.5 miles downstream	0 miles upstream
MHHW	3.80	4.01	4.43	4.33	3.69	3.38	3.41
MHW	3.50	3.71	4.15	4.04	3.68	3.08	3.39
MTL	0.75	0.85	1.44	1.46	1.04	0.93	0.93
MLW	-2.00	-2.02	-1.27	-1.12	-1.60	-1.23	-1.54
MLLW	-2.21	-2.25	-1.45	N/A	-1.64	-1.47	-1.62
Range****	5.50	5.73	5.42	5.16	5.28	4.31	4.93

Notes:
All elevations in ft National Geodetic Vertical Datum 1929 (NGVD29)
N/A = Not Available
*Difference between NGVD29 and NAVD (ft) = -1.11
**Gage missed some MLW and MLLW readings
***Approximate locations, measured along center of Hackensack River using USGS Topographic Maps
****Range is MLW to MHW
*****Great Diurnal Range is MLLW to MHHW
Sources:
[1] WHG 2001; [2] WHG 2000a; [3] WHG 2000b; [4] The Louis Berger Group 2001; [5] Hobbel 2001; [6] NOS 2001.

Table 2. Summary of Water Level Records Installed at Lincoln Park West.

Gage Period	**A**	**B**	**C**	**D**	**E**	**F**
Description	**middle lake**	**west lake**	**creek**	**north of path**	**south of path**	**Hackensack River**
Start of Record	6/7/2001	6/26/2001	6/4/2001	7/25/2001	7/19/2001	6/8/2001
End of Record	7/19/2001	7/19/2001	7/25/2001	8/16/2001	8/16/2001	7/19/2001
East NAD 83 ft	606080	605807	604309	604387	604290	603983
North NAD 83 ft	690070	690461	690440	691119	691134	690359
Water Level Statistics - in ft NGVD29						
Minimum	2.1	1.1	3.1	4.0	3.2	-2.7
Mean	2.2	1.5	3.3	4.2	4.0	1.0
Maximum	2.5	2.0	5.2	4.4	4.7	4.4
Total rainfall (inches)	4.38	1.93	4.80	1.44	1.85	4.38

with the mean tide range of 0.43 ft. The rainfall, evaporation losses and the lunar affects from the tide caused the mean water level in the pond to vary as much as 0.3 ft, although the tidal fluctuation range is consistently between 0.4 to 0.5 ft. The periods of higher and lower levels in the large pond are associated more with the spring tide events, as opposed to rainfall or dry spells. The 0.4-0.5 ft water level fluctuation twice a day indicates that the flap gate on the culvert connecting the pond was not operating.

Gage C (large creek): This gage was placed in the existing creek, 300 ft from the Hackensack River. Since many of the proposed tidal wetland restoration plans involved using this channel as the main conveyance of water to and from the Hackensack River, Gage C observed how well the existing channel configuration was conveying water. Gage C recorded from June 4 – July 25, 2001. The minimum, mean and maximum water surface elevations for this period were 3.1, 3.3 and 5.2 ft NGVD29. The creek does not have water over 70% of the time, which is one of the reasons why *S. alterniflora* is only found within 50 ft from the mouth of the creek. The creek in its current state is a poor conveyor of tidal water. The diurnal high tides in the creek phase between 15 to 45 minutes behind the river and are 1 ft higher than the river during most of the record. Full water inundation in the creek is severely limited. The highest water level corresponded to the Spring High Tide in the River on June 22, 2001, when the river reached 3.7 ft NGVD29. The invert of the creek at the gage location is 3.1 ft NGVD29.

Gages D (north of path) and E (south of path): These gages were placed just north and south, respectively, of the footpath, approximately 300 ft east from the concrete seawall. Various depressional areas that showed standing water in aerial photograph (photo taken December 2000) and at the start of the study had dried up by July 2001. Most of these ponds were not tidally influenced. The depressional areas at Gages D and E still had standing water by mid July. By comparing Gages D and E, the frictional losses of the tide going above or through the footpath were observed. Gage D recorded from July 25 – August 16 and Gage E recorded from July 16 to August 16 2001.

For Gage D, the minimum, mean and maximum water surface elevations for this period were 4.0, 4.2 and 4.4 ft NGVD29. Fluctuations in this body of water were very minimal. Spring tidal signals were not felt in this water body. However, rainfall events did create slight perturbations in the record. There is a possibility that this water body is supported by underground water seepage as a result of its proximity to the Hackensack River and to the concrete seawall that is no longer watertight. When compared to Gage E, south of the footpath, it appears that the footpath is impounding this water body, as its level remains constant even when the water level at Gage E drops.

For Gage E, the minimum, mean and maximum water surface elevations for this period were 3.2, 4.0 and 4.7 ft NGVD29. The water level fluctuations in this water body reflect both rainfall events and the daily MHHW events, although the fluctuations are minimal when compared to the river, Gage F or the large creek, Gage C. After the spring tide, it takes a number of tide cycles for the excess water to seep out of this water body.

Gage F (river)– The river gage observed the boundary tidal force influencing the western shoreline of the site. The magnitude of the tidal prism on the western shoreline is orders of magnitude greater than the rainfall runoff discharging into the Hackensack River adjacent to the Project site. Thus, this tidal force is the consistent boundary condition for both existing and proposed conditions. Gage F was originally placed approximately 30 ft west of the location indicated in Figure 1. However, limited access to the gage (boat access only) and excessive boat wakes rendered that location undesirable, so the gage was moved after 1 day to the location indicated in Figure 1. Unfortunately, extremely soft bottom conditions also limited accessibility from the land. As a result, the gage was not placed in deep enough water, and the MLLW elevations were not recorded by the instrument. The electronics of this gage malfunctioned on July 19, as a result of moisture entering the instrument from boat wakes. Gage F recorded from June 8 – July 19, and the minimum, mean and maximum water surface elevations for this period were –2.7, 1.0 and 4.4 ft NGVD29. For Gage F, a tidal datum analysis was conducted. This record represented the tidal forcing to the marsh before the inconsistent frictional affects from vegetation, culverts and bathymetry were felt. While Gage F collected water level fluctuations in the Hackensack River in the immediate vicinity of the Project area, a tidal datum reconstruction algorithm using a nearby reference gage had to be employed since Gage F lacked accurate MTL, MLW and MLLW elevations. Fortunately the NJMC Riverbend gage, only 1000 ft upstream, was operational for all of June and July. The tidal datums and tide range were computed from 4 June – 19 July for the NJMC - Riverbend gage. The algorithm took the difference in MHW for both the gages (0.28 ft) and MHHW (0.29 ft), and using the NJMC - Riverbend gage tide range, re-computed MTL, MLW and MLLW for Lincoln Park Gage F (river). Table 2 includes the reconstructed tidal datums at Gage F.

It is useful to compare open water tidal datums calculated from short-term records to the NOS Tidal Epoch of 1960-1978. This is done so the short-term record at a specific location can be compared to the official published NOS nautical charts for US coastal waters. The reconstructed Gage F tidal datums were used as input to this algorithm, and the entire gaging period was evaluated. The nearest NOS station that has both recent and NOS Tidal Epoch of 1960-1978 observations was the Battery, NOS Tide Station # 8518750. Refer to Table 3 for the conversion of Gage F to the Tidal Epoch of 1960-1978.

Table 3. Comparison of Hackensack River Tidal Datums in Tidal EPOCH June 8-July 19 2002.

	Raw Data from NJMC[1]	NOAA Tide Station 8518750[2]	Raw Data from USACE	Difference between Riverbend and USACE -MHW readings	Datums used in Lincoln Park Restoration Design	Notes on Adjustments
	Riverbend	Battery	Lincoln Park**		Adjusted to account for all MLW and MLLW readings	
	June 8 – July 19, 2001	June 8 – July 19, 2001	Jun 8 – July 19, 2001			
River miles from Lincoln Park gage***	1.5 miles upstream	11.5 miles downstream	0 miles upstream			
MHHW	3.69	3.38	3.41	0.28	3.44	Not Adjusted
MHW	3.68	3.08	3.39	0.29	3.38	Not Adjusted
MTL	1.04	0.93	0.93		0.75	Recomputed
MLW	-1.60	-1.23	-1.54		-1.89	Riverbend MLLW Average difference between MHHW and MHW from USACE and Riverbend
MLLW	-1.64	-1.47	-1.62		-2.00	Riverbend MLLW average difference between MHHW and MHW from USACE and Riverbend
Range	5.28	4.31	4.93		5.27	Recomputed
Great Diurnal Range	5.33	4.85	5.03		5.44	Recomputed

Notes:
All elevations in ft NGVD29*
*Difference between NGVD29 and NAVD (ft) = -1.11
**Gage missed some MLW and MLLW readings
***Approximate locations, measured along center of Hackensack River using USGS Topographic Maps
Sources:
[1] Hobbel 2001; [2] NOS 2001.

Hydrodynamic Model – Existing Conditions

Using the existing topography and bathymetry, an existing conditions hydrodynamic model was developed to replicate the behavior of the surface water within the proposed Project area. The hydrodynamic model is discussed further regarding the selected NER plan, below. The model allowed Project Delivery Team (PDT) to evaluate the duration of flooding in the proposed intertidal wetland, the tidal flushing in the pond, and the maximum velocities in the creek channels to determine if sedimentation or scouring would occur. The duration of flooding in the proposed intertidal marsh was validated against the current range of flooding in addition to the plant specific criteria for ***Spartina***, which requires inundation from 12 % to 69 % of the time.

The USACE TABS-MD two-dimensional (2-D) hydraulic model code, Resource Management Associates (RMA)-2 was the tool used to validate the hydrology design for the Project. RMA-2 numerically solves the depth-averaged form of the full Navier-Stokes equations. It is one of the models being applied in the ongoing USACE New York/New Jersey Harbor Deepening Study. The model is capable of simulating the complex non-linear interactions of the Project's existing hydraulic features in response to tides. After being calibrated to the existing conditions, the model could then be used to predict the hydraulic behavior of proposed regrading plans of the wetland. The model determines the water level and velocities in the channels and intertidal zones of the wetland. Briefly, the existing conditions model grid focused on where the river tide was currently influencing the Project area. It also focused only on features that would remain mostly intact after construction, so the tidal impact that is currently being felt would be incorporated into the proposed conditions model. Thus, the existing conditions grid focused on the west pond and its interaction with the river via the 36-inch diameter culvert. The large creek and the ponds that Gages D and E observed were not included in the existing conditions grid because its conveyance of tidal water was severely limited.

A 1200 ft long, 3 ft diameter concrete culvert connects the lake to the river. This flood control structure was incorporated into the numerical model. The connection was replicated by one-dimensional (depth and width averaged) elements. Reversible flow was assumed, and the relational coefficient was calculated based on the flow through the pipe with 1 ft of head difference between the lake and the pond. The lake end of the culvert had 2.5 ft of silt/muck in it. Thus, the assumed area of the culvert and the hydraulic radius were the average between the culvert nearly full of silt/muck, and a fully open culvert, representative of the river end of the culvert. A Manning's n value of 0.017 was used, as it was half way between concrete and an unconsolidated channel. Manning's Equation was used to calculate the flow.

The selected NER plan involved a major recontouring of those creeks, with much different vegetation and friction parameters, so knowing the specific hydrodynamic behavior of those areas had very limited use. More information about use of the hydrodynamic model for the NER Plan is presented below (i.e., Hydrodynamic Model – NER Plan).

Biobenchmarks

Creating an intertidal marsh with *Spartina* as the dominant vegetative species was the main goal of this Project. A parallel goal was eliminating *Phragmites*, as much as possible. Existing

Spartina stands are located on the western boundary of the Project area, on the banks of the Hackensack River. The ground elevation of 30 *Spartina* plants and 11 *Phragmites* plants were surveyed. The mean elevation for *Spartina* growth in the Project area was 1.7 ft NGVD29, with maximum and minimum elevations of 0.1 ft and 3.1 ft NGVD29. Of the survey points collected, the mean elevation for *Phragmites* was 3.3 ft NGVD29, with maximum and minimum elevations of 3.9 ft and 2.7 ft NGVD29. However, it appeared that *Phragmites* was thriving throughout the Project area at elevations greater than 3.9 ft. Thus, the minimum elevation of *Phragmites* is the most useful data point.

The biobenchmark statistics were plotted with the river tidal datums in Figure 4. The elevation ranges at which these plants currently indicate the duration of tidal flooding that is necessary for their survival. By combining the tidal datum information (Table 3) with the biobenchmark information, it can be concluded that *Spartina* is flooded 2.1–6.9 hours (18–57% of the time) per tidal cycle, with the mean duration of flooding being 4.6 hours. The maximum amount of flooding that *Phragmites* can withstand is 2.9 hours (24% of the time) in an average tide cycle. This information is summarized in Table 4.

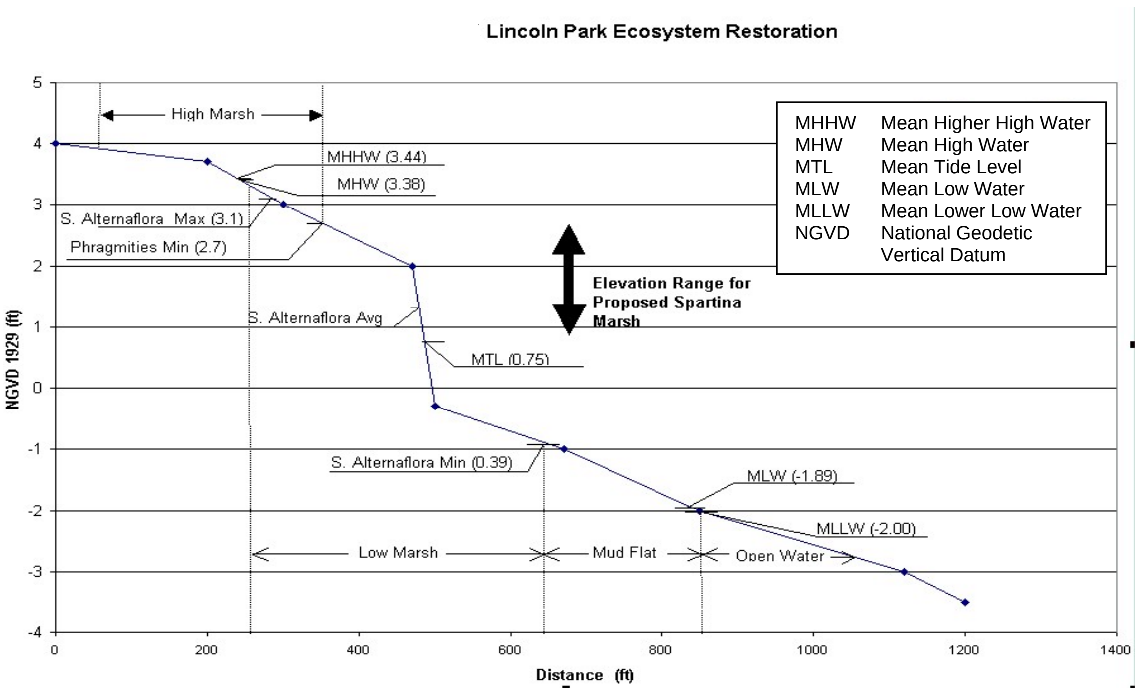


Figure 4. Elevation Range for Vegetative Communities Compared to Tidal Datums at Lincoln Park West.

Table 4. Summary of Biobenchmarking Data.

	All Elevations in ft NGVD29	Duration of Flooding for Average Tide Cycle*	
		Percent	Hours
Spartina minimum	0.1	57%	6.9
Spartina average	1.7	39%	4.6
Spartina maximum	3.1	18%	2.1
Phragmites minimum	2.7	24%	2.9
Phragmites average	3.3		
Phragmites maximum	3.9		

Notes:

* Based on Reconstructed River Gage, MTL at 0.75 ft and Tide Range of 5.29 ft

Hydrodynamic Model – NER Plan

A hydrodynamic model was used to refine the design of, model, and optimize the selected NER plan (Figure 5). These general goals were realized through the following specific Project goals:

1. Build a simulation tool to evaluate present water level fluctuations and velocities in the vicinity of the Project area.
2. Apply the modeling tool to evaluate tidal events and circulation in the existing system.
3. Apply tool to assist in the evaluation of regrading schemes in an effort to optimize water levels for the desired fauna and flora species habitat while minimizing the amount of excavation and placement of earth material, and bank stabilization treatments within the channels and inlets.

The model allowed the PDT to evaluate the duration of flooding in the proposed intertidal wetland, the tidal flushing in the pond, and the maximum velocities in the creek channels to determine if sedimentation or scouring would occur. The duration of flooding in the proposed intertidal marsh was validated against the current range of flooding in addition to the plant specific criteria for *Spartina*, which requires inundation from 18 % to 57 % of the time.

The RMA-2 model was used to determine the water levels and horizontal velocity vectors in two directions in the channels and intertidal zones of the wetland. The model domain is illustrated in Figure 5. The two-dimensional (2-D) depth-averaged grid portrays most of domain, with the exception of the one-dimensional elements that replicate the buried 3 ft diameter culvert that currently connects the Hackensack River to the northwestern portion of the lake. The input data consisted of the following:

1. Geometry data for the model was created based on looking at the existing topography and determining proposed regraded elevations with considerable attention paid to the biobenchmarks. Proposed elevations were mapped to the mesh by selecting different material properties and manually assigning the elevation values.

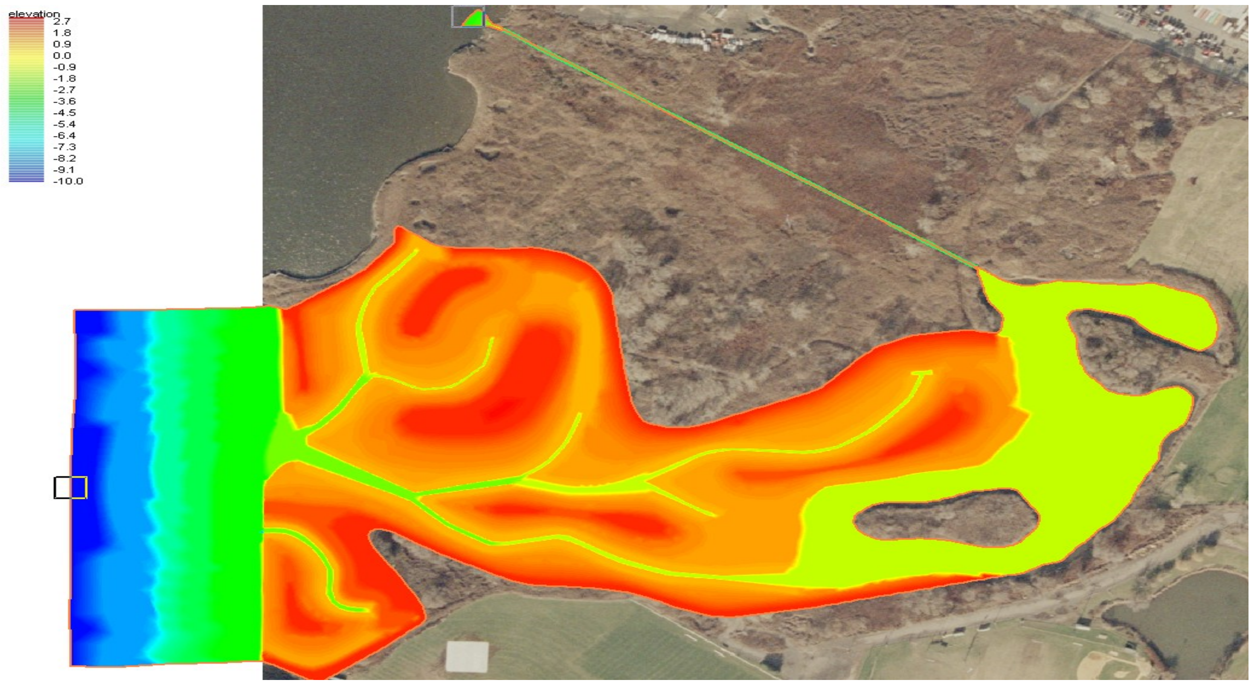


Figure 5: Proposed Elevations for the NER Plan, and the Model Domain

2. Boundary conditions were determined by the tidal datums calculated in the Hackensack River. It was determined that the tidal boundary condition was orders of magnitude greater than the fluvial events and thus only the tidal boundary condition was used. Refer to Table 5 for the tidal datums that generated the boundary conditions.
3. The hydrodynamic modeling parameters required for RMA-2 are presented in Tables 6 and 7. Refer to Figure 6 for the marsh material type designation.

Using the above-defined values, the dynamic boundary condition file was created assuming that the design tide has a sinusoidal shape. Manning's friction coefficient values were developed for varying material types and they varied with depth from the bottom, simulating the change in roughness in the water column due to the presence of vegetation and the boundary layer. Material assignments were utilized to assign proposed elevations, varying Manning's friction coefficients, Smagorinski coefficients, Peclet parameters, as well as eddy viscosities (Table 6 and Figure 6). The ability to manipulate the material properties allows the model to better represent actual flow conditions. The data ranges for the Manning's friction coefficients can be seen in Table 7 and in Figure 7. When using this method of mesh construction it allows the designer to create contour lines by assigning elevations to the numerical elements, and the designer can group elements into patches of common characteristics (similar roughness parameters, vegetation covers, flooding durations, etc.).

A 1200 ft long, 3ft diameter concrete culvert connected the lake to the river. This flood control structure had to be incorporated into the numerical model. The connection was replicated by one-dimensional (depth and width averaged) elements. The "FC Card" feature was utilized to simulate the culvert connection in RMA-2 (USACE, 2001). Reversible flow was assumed, and the relational coefficient was calculated based on the flow through the pipe with 1 ft of head

Table 5: Tidal Datums used for the Dynamic Boundary Condition.

Mean High Water (ft)*	3.39
Mean Tide Level (ft)*	0.75
Mean Low Water (ft)*	-1.89
Tide Range (ft)	5.28
Tidal Period used for Boundary Condition**	12 hours

*Referenced to NGVD 1929

** The actual tidal period is 12.24 hours. 12 hours was used because it allowed for equal time increments of 0.25 hours. By using 12 hours the velocities could be slightly higher thus making the model tidal period a conservative assumption.

Table 6: Hydrodynamic Modeling Parameters for Lincoln Park RMA2 Model.

PARAMETER	VALUES	DEFINITION
Manning's Roughness Coefficient	Varies With Depth	Measures the degree of bed resistance to flow.
Eddy Viscosity (lb-sec/ft2)	Varies With Depth	Characterizes the degree of turbulence of the moving flow.
Dynamic Depth Convergence (ft)	0.01	The Maximum allowed change in water depth at any node between two successive iterations is less than the dynamic depth convergence tolerance specified
Time Step (hr)	0.25	The time between two successive solutions.
Marsh Porosity Coefficients	AC1 = 4.5 AC2 = 2.0 AC3 = 0.02	Marsh porosity is an alternate method of wet/dry testing .(See RMA2 Manual)
Smagorinski	TBFACT = 0.5 TBFACT = 0.5 TBMINF = 20.0 TBMINFS = 0.5	Used for complex geometry to assign elements turbulence coefficient by adjusting the eddy viscosity in real time manner. (See RMA2 Manual)
Peclet	GPEC = 20 VPEC =0.5 EPSXX,EPSXY =1 EPSYX,EPSYY =1	The Peclet card allows real-time adjustments to the eddy viscosity based upon the computer average elemental velocity magnitude and individual size of each element.(See RMA2 Manual)

Table 7: Material Properties For Differing Material Types.

MATERIAL	MANNING'S ROUGHNESS	EDDY VISCOSITY
Deep Ocean	0.0095 to .052	20
Deep Marsh Channel	0.0220 to .071	100
Marsh Channel	0.0180 to 0.074	150
Channel Banks	0.0270 to 0.093	200
Base Marsh	0.0300 to 0.100	300
Tier 1,2,3 Banks	0.0330 to .13	300
Tier 4 Bank	0.0500 to 0.850	350
Lake Area	0.0100 to 0.270	100

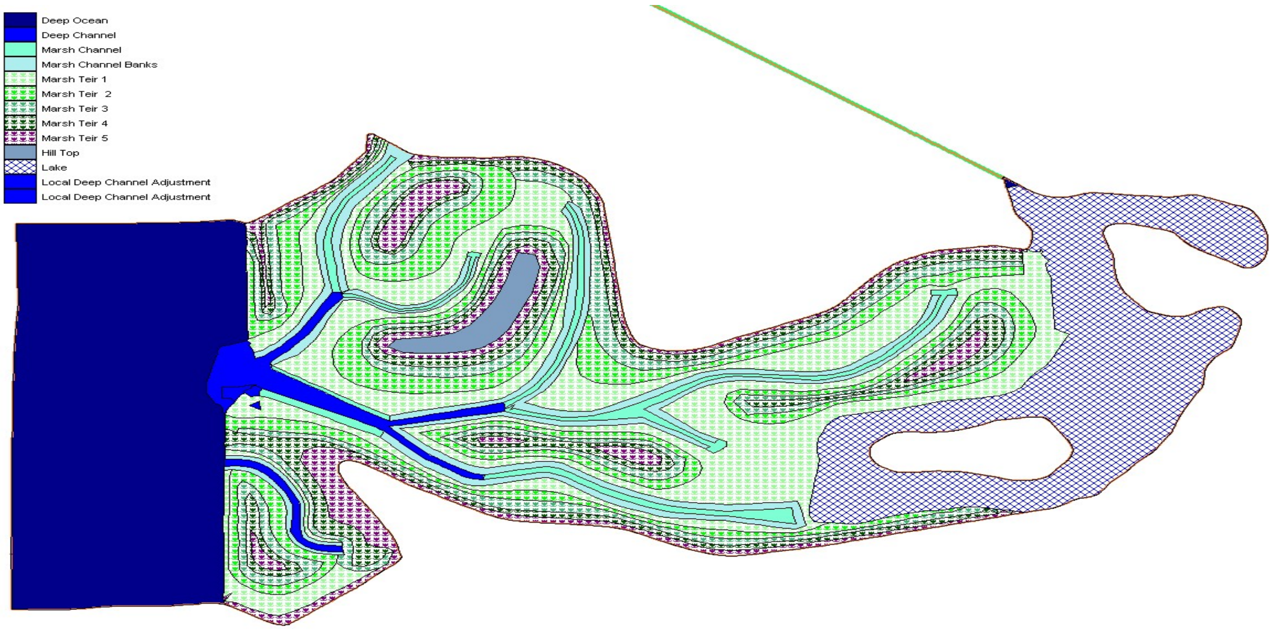


Figure 6: Material Type Assignments.

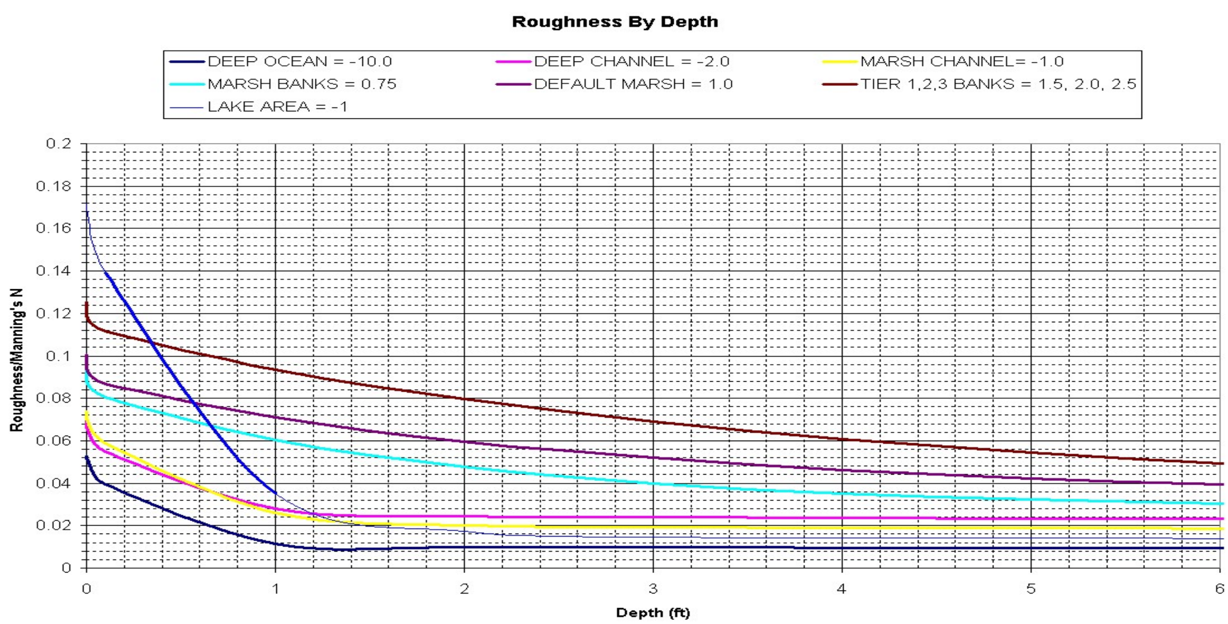


Figure 7: Roughness By Depth For Different Material Types.

difference between the lake and the pond. The lake end of the culvert had 2.5 ft of silt/muck in it. Thus, the assumed area of the culvert and the hydraulic radius were the average between the culvert nearly full of silt/muck, and a fully open culvert, representative of the river end of the culvert. A Manning's n value of 0.017 was used, as it was half way between concrete and an unconsolidated channel. Manning's Equation was used to calculate the flow.

Discussion

The study of tidal marshes is complicated due to the shallow water conditions, different vegetative communities, and marsh sensitivity to changing flow conditions. The RMA-2 hydrodynamic model was used to predict both the changing water elevations and velocities. The predicted water surface and velocity data were evaluated, and the proposed tidal creeks and surrounding marsh areas were modified via the geometry grid to produce velocities and water depths/durations that balanced deposition and scour of sediment and mimicked the hydrology of the referenced/biobenchmarked marsh.

Manning's roughness by depth, marsh porosity, eddy viscosity, Peclet turbulence control, and Smagorinski turbulence controls were used in combination to achieve realistic flow conditions. The application of Manning's roughness by depth accounts for the decrease in roughness as the depth of the water increases. Varying the Mannings roughness helps to predict the resistance the water encounters when flowing over and through the various planting at their assorted stages of growth. By adding Manning's boundary condition we are accounting for the dense planting on and near the marsh surface. Minimum and maximum Manning's n values were set for each material type, and the depth of vegetation. The application of this boundary condition to each of the materials offers a great deal of control over the way the tide flow through Lincoln Park is predicted. However, roughness by depth alone was not able to produce accurate flow circulation. The next boundary condition applied was eddy viscosity control.

The eddy viscosity parameter reproduces the effects of turbulent diffusion (mixing) by modeling it with friction. For this application eddy viscosity was increased with each material type to account for the increase in turbulence with height above the marsh. Eddy viscosity is higher (more turbulent) at low water depths, which occurs during low tide periods. After several runs using the global eddy viscosity and observing strange flow condition it was decided to make use of the Peclet boundary condition parameter. The Peclet algorithm is used in RMA2 to provide real time adjustments to the eddy viscosity based upon the computed velocity and individual size of each element. The automatic assignment of elemental turbulence coefficients (eddy viscosity) by the Peclet number is a powerful tool. The Peclet algorithm is based on the Peclet number (P) where P is recommended to be between 15 and 40. With in the boundary control conditions there is a variable VPEC (USACE, 2001) that allows for the establishment of a minimum velocity magnitude used for computation of the Peclet number control. RMA2 uses the VPEC variable as a substitute when the calculated average velocity drops below the pre-specified minimum value. For the Lincoln Park runs a values of P = 20 was used with a VPEC of 0.05 ft/s. The application of the Peclet control did offer substantially improved results but there were still some inaccurate flow conditions occurring in the main marsh channel. It was decide that the use of the Smagorinski parameter could greatly improve flow condition into and out of the main marsh channel. Similar to the Peclet algorithm the Smagorinski algorithm is a real time eddy viscosity calculation that, allowed RMA2 to calculate the appropriate eddy viscosities and thus show realistic flows.

The hydrodynamic analysis demonstrated that the velocities throughout the site during a tidal cycle are in the range of 0.02 to 2.83 feet per second (fps). The maximum velocities are concentrated within the channels and typically occur just after low tide. Table 8 summarizes the

Table 8: Velocities at Various Locations in the Marsh, Throughout One Tide Cycle.

Time After High Tide	Main -to Ocean	Main Inland	Back Main	Bend to Lake	Outside Lake	Back Branch	North Main	North North	North South	WSE
0	0.032	0.05	0.022	0.032	0.02	-0.01	-0.01	-0.01	0	3.39
1	-0.418	-0.465	-0.345	-0.238	-0.12	-0.165	0.261	0.063	-0.121	3.04
2	-1.221	-1.392	-1.092	-0.869	-0.401	-0.475	0.734	0.155	-0.376	2.07
3	-1.433	-1.95	-1.64	-1.773	-0.721	-0.929	0.667	0.226	-0.573	0.75
4	-1.098	-1.492	-1.039	-1.943	-0.801	-1.172	0.22	0.133	-0.273	-0.57
5	-1.214	-1.376	-0.745	-2.093	-0.741	-0.895	0.206	0.104	-0.197	-1.54
6	-1.067	-1.134	-0.643	-1.975	-0.66	-0.752	0.125	0.054	-0.121	-1.89
7	-0.556	-0.762	-0.532	-1.705	-0.57	-0.648	-0.081	-0.051	0	-1.54

Time After High Tide	North Marsh land low	North Marsh land med	North Marsh land High	South Marsh land -low	South Marsh land -med	South Marsh land -high	Lake SW	Lake Mid	Lake North	WSE
0	-0.02	0	-0.01	0	-0.014	0	0.032	-0.022	0	3.39
1	-0.094	-0.071	-0.04	-0.14	-0.071	-0.01	-0.032	-0.014	-0.014	3.04
2	-0.17	-0.13	-0.08	-0.199	-0.122	-0.014	-0.114	0.058	0.022	2.07
3	-0.114	-0.081	-0.07	-0.071	-0.06	-0.01	-0.13	0.045	-0.028	0.75
4	-0.045	-0.04	-0.04	-0.041	-0.045	-0.01	-0.112	0.032	-0.032	-0.57
5	-0.067	-0.041	-0.04	-0.071	-0.064	-0.01	-0.098	0.022	-0.03	-1.54
6	-0.054	-0.04	-0.03	-0.086	-0.064	0	-0.081	0.022	-0.03	-1.89
7	-0.02	-0.014	-0.014	-0.036	-0.036	0	-0.067	0.022	-0.03	-1.54

velocities variations for some of the critical channel locations (Figures 8 and 9). The results show that the maximum velocities were observed in the main channel, just outside the lake during ebb tide (Figure 10). This section of the main channel serves as the primary drainage channel for the Lincoln Park site. The maximum computed velocity in the main channel was approximately 2.83 fps. The Lincoln Park design allows for a proper tidal inundation and drainage of both the low marsh and high marsh areas as seen in Table 9. The 3-foot tidal range requirement in the lake does occur.

Conclusion

The USACE New York District – Engineering Division was presented with the challenge of reintroducing tidal inundation and circulation into a 26-acre area presently dominated by the invasive species, Phragmites. The restoration goal of the Project was to create as much low marsh, dominated by Spartina, as possible. The hydrodynamic model, RMA-2, was employed to validate the creek layout and regrading plan. Over 200,000 cubic yards (cy) of material will be excavated to create the chosen alternative, which will put the estimated construction cost for the Project above $5 million. Insuring that the tidal hydrodynamics would facilitate the creation of the 30-acre wetland will dictate the success of the Project.

The hydrodynamic analysis for the Lincoln Park –West Project posed may challenges. First, the tide barely penetrated the existing site. Besides a creek that felt the tidal signal only 300 ft inland, and a partially filled in 3 ft culvert, tidal flow had to be predicted over distances 1500 ft inland from the source of the tidal forcing, the Hackensack River. Predicting tidal inundation for that long of a distance using analytical methods would not have been as accurate. Thus a

Figure 8: Locations Where Velocity and Water Surface Elevations are Displayed in Tables 8 and 9.

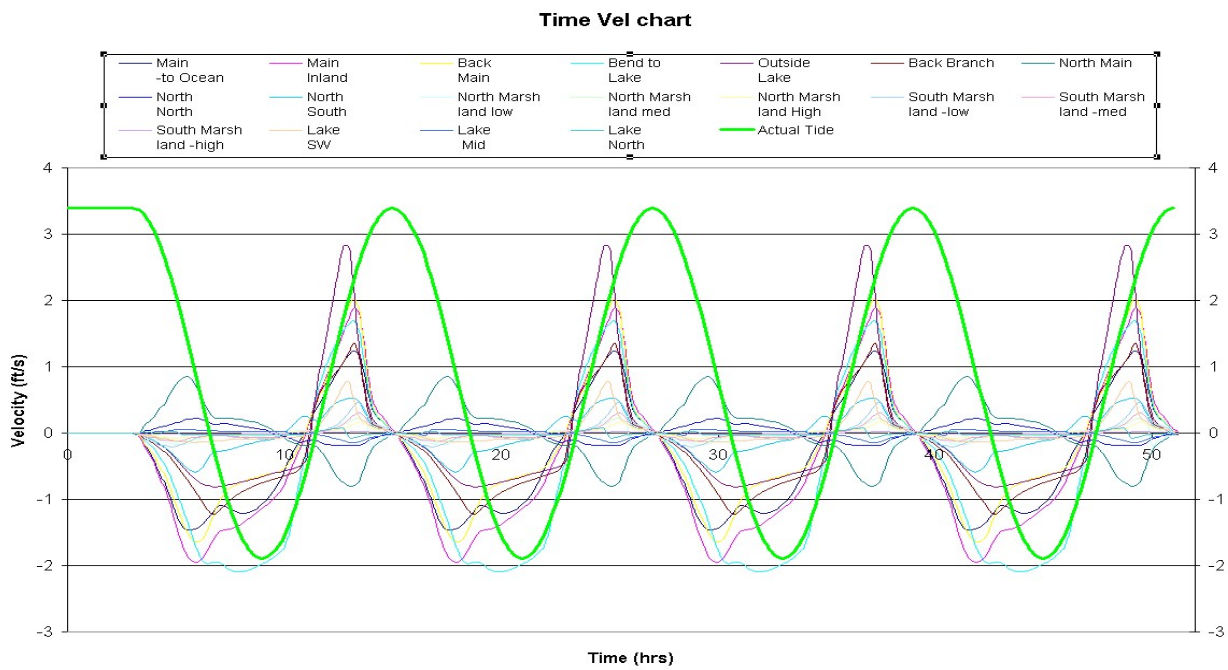


Figure 9: Velocities at Various Locations in the Marsh, Throughout the Tide Cycle.

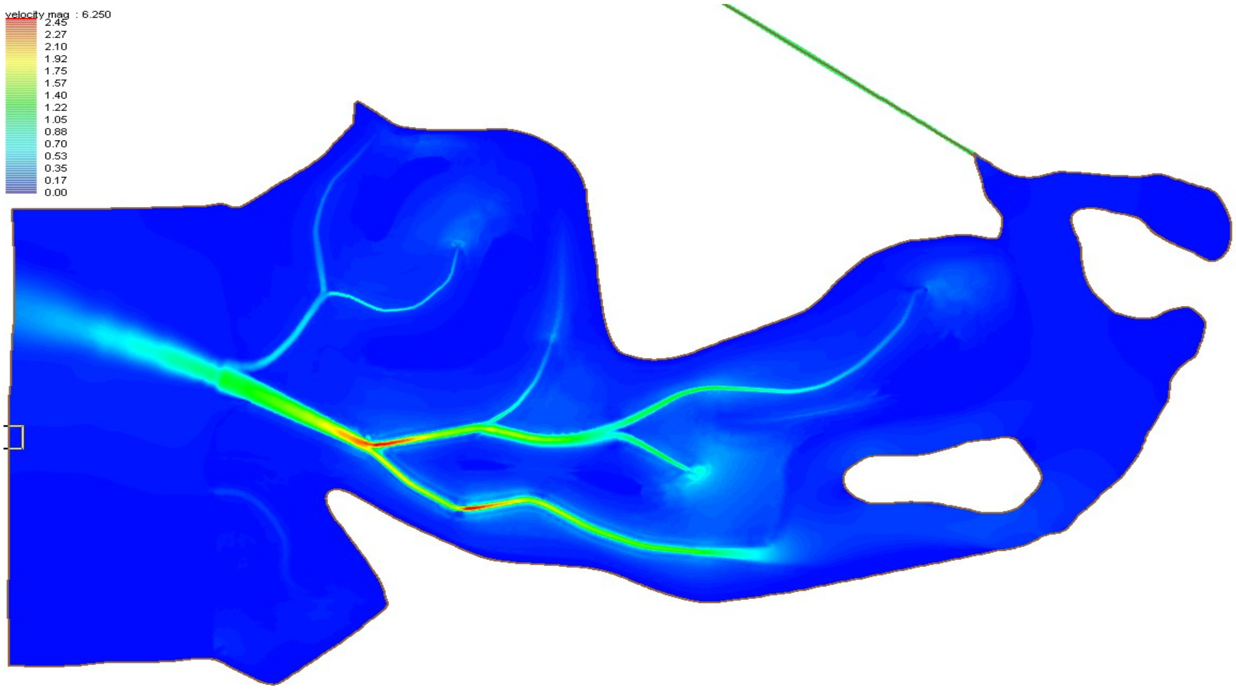


Figure 10: Velocity Results Model at Time Step Hour 44.

Table 9: Duration of Flooding at Various Locations in the Marsh, Throughout the Tide Cycle.

	Percent of Time Submerged for Several Location					
	North Marsh-land low	North Marsh-land medium	North Marsh-land high	South Marsh-land low	South Marsh-land medium	South Marsh-land high
Hours	6.9	6	5.2	6.67	6.5	4.37
Percent of Tide Cycle	58%	50%	43%	56%	54%	36%

numerical model was needed. Second, evaluating the 1200 ft long culvert, and numerically simulating that flood control structure was also difficult. Third, the low marsh (*Spartina*) target duration of flooding had to be met everywhere where low marsh was proposed. This was validated by the model results. Lastly, many tools within the RMA-2 code, and within SMS were utilized to adequately portray tidal inundation in the tidal creeks, inlets, lake areas, and the wetland surfaces that experienced wetting and drying every 6 hours. These tools included using 12 different material types, varying roughness, eddy viscosity by material type, Peclet turbulence control, and Smagorinski turbulence control where appropriate. The hydrodynamic model was used to validate the 30 percent design layout, which will be presented in the Ecosystem Restoration Report. Additional tasks in the plans and specifications phase of the Project include running a tidal boundary condition that represents the Mean Higher High Water and Mean Lower

Low Water tidal datum range (6.0 ft), evaluating the locations in the channels where reconfiguration of the channel cross section could lower the ebb velocities so permanent stabilization features (e.g. riprap) could be avoided. A rigorous sensitivity analysis of the model parameters will also be done.

Acknowledgements

The authors would like to extend their gratitude to the Joe Letter, Darla McVan, Barbara Donnell, and William Boyt at ERDC for their feedback, advice, technical expertise, and professional guidance, always given graciously and generously. The support from the USACE – Engineering Division was also invaluable in the accomplishment of the model development and verification.

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APPENDIX C

- USACE Hazardous, Toxic, And Radioactive Waste Assessment
- USACE. Volume 1, Technical Report on the Sampling and Testing of Sediment from Anchorage Channel S-AN-1 for Upland Beneficial Use in New Jersey and/or New York. Prepared by Aqua Survey, Inc: May 1, 2007.
- NOAA Geotechnical Grain Size Analysis
- NJDEP Sediment Contaminant Test Analysis

HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE (HTRW) ASSESSMENT LINCOLN PARK WEST SECTION 1135 PROJECT JERSEY CITY, NEW JERSEY

The New Jersey Department of Environmental Protection (NJDEP) conducted a hazardous, toxic, and radioactive waste (HTRW) assessment of the Lincoln Park West site in February 2000 in an effort to characterize the HTRW contaminants present onsite as a result of the sanitary landfill. The landfill occupies an approximately 30-acre area in the northern portion of Lincoln Park West. NJDEP performed extensive sub-surface characterization (Figure 1), by excavating a series of trenches approximately 4 feet wide by depths ranging from 6 to 13 feet, depending on the water table. Samples were collected and described in terms of material type (e.g., municipal waste, construction/demolition debris, backfill), color, moisture content (e.g., wet, saturated, dry), percent solid waste verses soil, and odor. A total of 78 soil samples were collected and analyzed for pesticides/polychlorinated biphenyls (PCBs), volatile organic analytes (VOAs), semi-volatile organic analytes (SVOAs), and metals. The NJDEP Non-Residential Direct Contact Soil Cleanup Criteria (NRDCSCC) was used as a benchmark for soil analysis. Representative compounds, the range of detected concentrations, NRDCSCC, and exceedences are presented in Table 1.

To ensure worker safety during sampling activities, NJDEP continuously monitored air quality, using FID and PID monitors, and radioactivity levels. However, neither air quality nor radioactivity approached threshold levels or required additional safety measures.

The landfill is reportedly composed of unclassified household garbage, and was closed prior to 1982. The desired end use is as a combined passive recreational area and restored wetlands. The southern portion of the site will be excavated and regraded to the desired elevations to create salt marsh habitat. Excavated material, including any existing contaminants, trash, and debris, will be relocated to the northern portion of the site, where the landfill is located. All excavated/restored areas will be lined with 1-foot of clean soil to protect restored wetland vegetation, wildlife, and the public from contact with contaminated soils/sediments. Additionally, the landfill and all deposited material will be regraded and capped with 1-foot of clean soil as part of the Landfill Closure Plan, to seal existing contaminants in place.

Table 1. Comparison of Soil Sampling Results and Non-Residential Direct Contact Soil Cleanup Criteria for the Lincoln Park West Site, Jersey City, New Jersey.

Compound	Range of Detected Concentrations (ppm) High	Non-Residential Direct Contact Soil Cleanup Criteria (NRDCCS) (ppm)	Exceedences
Metals			
Arsenic	136	20	16
Cadmium	123	100	2
Chromium	4110	6100	-
Copper	15,500	600	2
Lead	17,400	600	43
Mercury	153	270	-
Nickel	16,600	2400	1
Silver	188	4100	-

Compound	Range of Detected Concentrations (ppm) High	Non-Residential Direct Contact Soil Cleanup Criteria (NRDCCS) (ppm)	Exceedences
Metals (continued)			
Zinc	2570	1500	12
PCBs			
Arochlor 1016		2.0	-
Arochlor 1221		2.0	-
Arochlor 1232		2.0	-
Arochlor 1242		2.0	-
Arochlor 1248	1.300	2.0	-
Arochlor 1254	11.000	2.0	3
Arochlor 1260	5.200	2.0	2
Pesticides			
4-4'DDT	0.250	9	-
4-4' DDD	0.012	12	-
4-4' DDE	0.012	9	-
Aldrin	0.044	0.17	6
Chlordane	0.200	No set limit	-
Dieldrin	0.250	0.18	2
Endosulfan	0.054	6200	-
Endrin	0.110	310	-
Heptachlor	0.130	0.65	-
VOAs*			
Acetone	7.200	1000	-
Benzene	0.768	13	-
Toluene	7.150	1000	-
Ethylbenzene	150	1000	-
Xylene	340	1000	-
SVOAs*			
Acenapthene	96.000	10,000	-
Benzo(a)pyrene	66.000	0.66	20
Chrysene	74.000	40	3
Naphthalene	309.990	4200	-
Pyrene	129.990	10,000	-
Acenapthylene	18.990	No set limit	-
Anthracene	72.990	10,000	-
Benzo(a) anthracene	80.010	4	3
Benzo(k)flouranthene	76.000	4	13
Benzo(g,h,I)perylene	22.000	No set limit	-
Flouranthene	129.990	10,000	-
Dibenzo(a,h)anthracene	34.000	No set limit	-
Flourene	120.000	10,000	-
Ideno(1,2,3-cd) pyrene	27.000	4	9
2-methylnapththalene	150.000	No limit set	-
Phenanthrene	180.000	No limit set	-

Notes:
* Not all Compounds are shown.

APPENDIX C: Sub-section.

USACE. Volume 1, Technical Report on the Sampling and Testing of Sediment from Anchorage Channel S-AN-1 for Upland Beneficial Use in New Jersey and/or New York.

Prepared by Aqua Survey, Inc: May 1, 2007

Clean Sand Backfill will be obtained via the Army Corps of Engineers Navigational Deepening Program, Anchorage Channel Reach 1. Reports that specifically address toxicity and the suitability of this material are contained within this sub-section of Appendix C. The USACE New York District office performed standard EPA Toxicity tests throughout the Anchorage Reach. Reach 1 materials were selected for their suitability and conformance to NJDEP standards for reuse.

The *N. virens* used for testing were adults ranging from 4 to 6 inches in length, and were obtained from Seabait Maine, Franklin, ME.

After 28-days of exposure to the sediment composites, organisms were depurated for 24 hours in clean Manasquan water. Tissue from each exposure chamber was placed in individual glass jars, weighed and frozen before sending to Battelle by overnight courier for chemical analysis. Tissue samples were archived by Battelle.

Standard reference toxicant tests were performed for both species as cited in the work plan. Water quality and physical parameters were also monitored as per the work plan. A control chart for each species, as well as all supporting bioassay documentation data can be found in Volume III (Biological Raw Data).

IV. RESULTS AND DISCUSSION

Test results of all the bioassays as well as water quality parameters are summarized in the tables at the end of this volume. Raw data for physical characteristics, biological effects and water quality parameters, are presented in Volumes II and III.

A. Solid Phase Testing

Ampelisca abdita

After 10 days, survival of *A. abdita* organisms exposed to the composites was as follows:

A. abdita Survival		
Control	Reference	AC Composite
92%	90%	99% Reach 1 98% Reach 2

In accordance with the 1991 Federal Guidance (USEPA, 1991), samples are considered toxic if survival of animals exposed to test sediment are at least 20% less than the survival observed in the reference sediment <u>and</u> this difference is statistically significant ($p = 0.05$) after a ten-day test period.

These results indicate that the two AC composites are <u>not</u> acutely toxic to *A. abdita*.

Mysidopsis bahia

Static Non-renewal Bioassay

After the 10 day static test, the survival of organisms exposed to the sediment composites from Reaches 1 and 2 did not show a statistically significant reduction in survival when compared to organisms in the reference sediment.

Static Non-renewal Bioassay

M. bahia Survival		
Control	Reference	AC Composite
98%	95%	95% Reach 1 98% Reach 2

B. Suspended Particulate Phase Testing

Menidia beryllina

After 96 hours, *M. beryllina* exposed to the suspended particulate phase elutriate resulted in an LC_{50} of >100% for both Reach 1 and Reach 2.

M. beryllina Survival		
Concentration	AC Reach 1 Composite	AC Reach 2 Composite
Control	99%	
10%	97%	98%
50%	99%	99%
100%	98%	96%

Mysidopsis bahia

After 96 hours, *M. bahia* exposed to the suspended particulate phase elutriate resulted in an LC_{50} of >100% for both Reach 1 and Reach 2.

M. bahia Survival		
Concentration	AC Reach 1 Composite	AC Reach 2 Composite
Control	98%	
10%	95%	97%
50%	98%	96%
100%	97%	96%

Mytilus edulis

After 48 hours, *M. edulis* larvae exposed to the suspended particulate phase elutriate resulted in an EC_{50} for development of >100% for Reach 1, 70.7 % for Reach 2, and 22.4% for Reach 3 and an LC_{50} for survival of >100% for Reach 1 and an LC_{50} 90% for Reach 2.

M. edulis Survival		
Concentration	AC Reach 1 Composite	AC Reach 2 Composite
Control	95%	
10%	98%	90%
50%	86%	91%
100%	85%	36%

Control survival was greater than 90% for both *M. beryllina* and *M. bahia* and the number of *M. edulis* control embryos that resulted in live larvae with completely developed shells at the end of the test was greater than 70%; therefore, all three SPP tests passed the criteria for control survival.

C. Bioaccumulation Testing

Macoma nasuta

After 28 days, *M. nasuta* exposed to the composite sediments resulted in the following survival:

M. nasuta Survival		
Control	Reference	AC Composite
98%	100%	97% Reach 1 99% Reach 2

Nereis virens

After 28 days, *N. Virens* exposed to the composite sediments resulted in the following survival:

N. virens Survival		
Control	Reference	AC Composite
100%	99%	97% Reach 1 99% Reach 2

APPENDIX C: Sub-section.

GEOTECHNICAL ANALYSIS OF USACE GRAIN SIZE TEST RESULTS.

Clean Sand Backfill will be obtained via the Army Corps of Engineers Navigational Deepening Program, Anchorage Channel Reach 1. Reports that specifically address the geotechnical suitability of this material are contained within this sub-section of Appendix C. The USACE New York District office performed tests on Grain size throughout the Anchorage Channel. The Grain Size analysis was produced by NOAA using the results of USACE grain size results for the Anchorage Channel. Reach 1 materials were ultimately selected for their conformance to the criteria set forward by the NOAA Restoration Center.

GEOTECHNICAL ANALYSIS OF USACE GRAIN SIZE TEST RESULTS.

TITLE: Analysis of NY District ACOE Geotechnical Grain Size Distribution Test of Anchorage Channel Sediments to meet NOAA/NJDEP Required Specification for Grain Size Distribution. File name: *Anchorage Channel Grain Size Analysis Tables_ 07_29_2009.xls*

NOAA/NJDEP Required Specification for Grain size distribution is presented in three formats described in Tables 4-6. The specified grain distribution was determined to be optimal for growth performance of newly planted Low marsh (Spartina alterniflora seedlings) at Lincoln Park West, Jersey City NJ.

TABLE 1 consists of data provided by ACOE for Anchorage sites that were identified as potential sources for backfill. Asterisk indicates that ACOE test methods are unknown or undetermined as per NOAA/NJDEP Methods requirements specification described in Table 2 and Table 3.

TABLE 2: Lower left of spreadsheet. Specified Mesh Sizes for Grain Size Distribution Determination.

TABLE 3: Laboratory Tests Methods as needed.

TABLE 4: <u>Intertidal Marsh Backfill Specifications by % cobble, gravel, sand, and fines.</u> Performance standard for determination of suitability of materials. Color Key demonstrates suitability of those samples. Color highlighted fields flag the sample in TABLE 1 wherever it does not meet the criteria. The final column at the far end of the spreadsheet comments on how well the sediment faired against the criteria.

TABLE 5: <u>Intertidal Marsh Backfill Specifications by Percent Passing Sieve.</u> Performance standard for determination of suitability of materials. Color Key demonstrates suitability of those samples. Color highlighted fields flag the sample in TABLE 1 wherever it does not meet the criteria. The final column at the far end of the spreadsheet comments on how well the sediment faired against the criteria.

TABLE 6: <u>Intertidal Marsh Backfill Specification by % Diameter (D) Range.</u> Performance standard for determination of suitability of materials. Color Key demonstrates suitability of those samples. Color highlighted fields flag the sample in TABLE 1 wherever it does not meet the criteria. The final column at the far end of the spreadsheet comments on how well the sediment faired against the criteria.

TABLE 7: 2nd worksheet provides reference to the Unified Soil Classification System (ASTM D 2487).

Sediments need to be clean to meet NJ Confined disposal criteria. ACOE has provided Toxicological test results separately.

TITLE: Analysis of NY District ACOE Geotechnical Grain Size Distribution Test of Anchorage Channel Sediments to meet NOAA/NJDEP Required Specification for Grain Size Distribution.

TABLE 1: Test Results ASI # 26-387, Anchorage Channel*

Lab Sample ID	Sample ID	Location	Upper Depth (inch)	Lower Depth (inch)	Sampling Date	Visual Description	Bulk Density				TOC ppm	% TOC of dry weight	pH
* test methods unknown or undetermined as per Method requirement specification described in Table 2 and Table 3.							Wet Bulk Density lb/	Wet Bulk Density g/	Moisture Content	Dry Bulk Density lb/ft3			
20070016	AC-1	Anchorage Channel	n/a	n/a	2007	n/a	n/a	n/a	25.64	n/a	3,513	0.35	n/a
20070017	AC-2	Anchorage Channel	n/a	n/a	2007	n/a	n/a	n/a	23.79	n/a	3,210	0.32	n/a
20070009	AC-3	Anchorage Channel	n/a	n/a	2007	n/a	n/a	n/a	22.66	n/a	2,108	0.21	n/a
20070018	AC-4	Anchorage Channel	n/a	n/a	2007	n/a	n/a	n/a	23.74	n/a	1,419	0.14	n/a
20070029	AC-5	Anchorage Channel	n/a	n/a	2007	n/a	n/a	n/a	24.48	n/a	1,419	0.14	n/a
20070020	AC-6	Anchorage Channel	n/a	n/a	2007	n/a	n/a	n/a	22.84	n/a	1,904	0.19	n/a
20070019	AC-7	Anchorage Channel	n/a	n/a	2007	n/a	n/a	n/a	23.06	n/a	2,169	0.22	n/a
20070045	AC-8	Anchorage Channel	n/a	n/a	2007	n/a	n/a	n/a	26.35	n/a	3,167	0.32	n/a
20070046	AC-9	Anchorage Channel	n/a	n/a	2007	n/a	n/a	n/a	25.55	n/a	2,524	0.25	n/a
20070047	AC-10	Anchorage Channel	n/a	n/a	2007	n/a	n/a	n/a	25.4	n/a	2,427	0.24	n/a
20070048	AC-11	Anchorage Channel	n/a	n/a	2007	n/a	n/a	n/a	26.76	n/a	3,353	0.34	n/a
20070030	AC-12	Anchorage Channel	n/a	n/a	2007	n/a	n/a	n/a	24.98	n/a	3,218	0.32	n/a
20070031	AC-13	Anchorage Channel	n/a	n/a	2007	n/a	n/a	n/a	24.98	n/a	2,780	0.28	n/a
20070040	AC-14	Anchorage Channel	n/a	n/a	2007	n/a	n/a	n/a	24.27	n/a	3,106	0.31	n/a
20070041	AC-15	Anchorage Channel	n/a	n/a	2007	n/a	n/a	n/a	26.41	n/a	3,351	0.34	n/a
20070039	Reach 1	Anchorage Channel	n/a	n/a	2007	n/a	n/a	n/a	23.86	n/a	2,212	0.22	n/a
20070039 dup	Reach 1	Anchorage Channel	n/a	n/a	2007	n/a	n/a	n/a	23.75	n/a			n/a
20070039 trip	Reach 1	Anchorage Channel	n/a	n/a	2007	n/a	n/a	n/a	23.58	n/a			n/a
20070050	Reach 2	Anchorage Channel	n/a	n/a	2007	n/a	n/a	n/a	25.84	n/a	3,162	0.32	n/a
20070050 dup	Reach 2	Anchorage Channel	n/a	n/a	2007	n/a	n/a	n/a	25.74	n/a			n/a
20070050 trip	Reach 2	Anchorage Channel	n/a	n/a	2007	n/a	n/a	n/a	25.71	n/a			n/a

TABLE 2: Specified Mesh Sizes for Grain Size Determination

Mesh sizes used	size	micron conversion	Description
3	3"		Gravel: Material passing a 75-mm (3-inch) sieve and retained on a 4.75-mm (No. 4) sieve.
2	2"		
1.5	1.5"		
1	1"		
0.75	.75"		
0.375	0.375"		
#4	4.75mm		
#10	2.00mm		Sand: Material passing a 4.75-mm sieve (No. 4) and retained on a 0.075-mm (No. 200) sieve.
#20	.850mm	850microns	
#40	.425mm	425microns	
#60	.250mm	250microns	
#140	.106mm	106microns	
#200	.075mm	75microns	Silt: Material passing a 0.075-mm (No. 200) that is non-plastic, and has little strength when dry (PI < 4). Clay: Material passing a 0.075-mm (No. 200) that exhibits plasticity, and strength when dry (PI ³ 4).

Table 3: Laboratory Tests Methods as needed.

Grain Size/Sieve Analysis ASTM D-422 (sieve sizes are 3,2,1.5, 1, .75, 0.375, #4,10,40, 60,140, 200)
TOC
ph by probe
Bulk Density method is USCOE EM 1110
Density determined on disturbed smaples by hand compacting into a container of known volume, measuring mass of soil and calculating.
Moisture content determined by ASTM D2216 at 110^0 C

GRAIN SIZE (mm)								SIEVE TEST DATA																						
% cobbles	% Gravel			% Sand	% Fines			% Passing														Gradation Ranges (mm)								
	Coarse & Fine Combined			Coarse, Medium and Fine Combined	Silt	Clay		3"	2"	1.5"	1"	0.75"	0.375"	#4	#10	#20	#40	#60	#140	#200		D85	D60	D50	D30	D15	D10	C_c	C_u	Sutiable for:
	1.1			82.5	6.88	9.53																								
	3.4			84.5	5.06	6.99																								
	0.5			87.8	5.24	6.49																								
	0.0			89.4	4.2	6.39																								
	0.8			91	2.61	5.65																								
	0.2			88.7	5.33	5.78																								
	0.0			88	4.4	7.62		DATA FROM ANCHORAGE CHANNEL NOT PROVIDED IN THIS FORMAT														DATA FROM ANCHORAGE CHANNEL NOT PROVIDED IN THIS FORMAT								
	0.7			87.5	3.06	8.79																								
	0.4			87	4.39	8.15																								
	0.2			87.2	4.4	8.17																								
	0.5			79.5	9	11																								
	1.0			85.5	7.6	6.86																								
	1.0			85.5	6.33	7.13																								
	0.4			86	6.61	6.95																								
	0.3			87.4	4.45	7.86																								
	0.3			89.3	4.16	6.24																								
	0.4			89.8	3.63	6.1																								
	0.4			89	4.2	6.37																								
	0.5			85.2	5.21	9.07																								
	0.3			86.1	4.4	9.18																								
	0.3			85.4	5.43	8.89																								

TABLE 4: Intertidal Marsh Backfill Specifications by % cobble, gravel, sand, fines

Passing Range			**Table 4 Key**
by %			< accepted range (finer)
Cobble	0		> accepted range (coarser)
Gravel	0-10		
Sand	85-100		
Silt & Clay	0-15		

TABLE 5: Intertidal Marsh Backfill Specifications by Percent Passing Sieve

Passing Range		**Table 5 Key**
Sieve :	% Passing	< accepted range (finer)
3"	100	> accepted range (coarser)
1"	100	
#4	90-100	
#10	75-100	
#40	35-67	
#100	5.0-40	
#200	0-15	

TABLE 6: Intertidal Marsh Backfill Specification by % Diameter (D) Range

Acceptable Diameter (D) ranges for Sand Backfill						**Table 6 Key**
D85	D60	D50	D30	D15	D10	< accepted range (finer)
1.0-3.1	.31-1.1	.21-.74	.11-.34	.075-.21	.075-.18	> accepted range (coarser)

TABLE 7: Reference Unified Soil Classification System: ASTM D 2487.

The basic reference for the Unified Soil Classification System is ASTM D 2487. Terms include:

Coarse-Grained Soils	More than 50 percent retained on a 0.075 mm (No. 200) sieve
Fine-Grained Soils	50 percent or more passes a 0.075 mm (No. 200) sieve
Gravel	Material passing a 75-mm (3-inch) sieve and retained on a 4.75-mm (No. 4) sieve.
Coarse Gravel	Material passing a 75-mm (3-inch) sieve and retained on a 19.0-mm (3/4-inch) sieve.
Fine Gravel	Material passing a 19.0-mm (3/4-inch) sieve and retained on a 4.75-mm (No. 4) sieve.
Sand	Material passing a 4.75-mm sieve (No. 4) and retained on a 0.075-mm (No. 200) sieve.
Coarse Sand	Material passing a 4.75-mm sieve (No. 4) and retained on a 2.00-mm (No. 10) sieve.
Medium Sand	Material passing a 2.00-mm sieve (No. 10) and retained on a 0.475-mm (No. 40) sieve.
Fine Sand	Material passing a 0.475-mm (No. 40) sieve and retained on a 0.075-mm (No. 200) sieve.
Clay	Material passing a 0.075-mm (No. 200) that exhibits plasticity, and strength when dry (PI ³ 4).
Silt	Material passing a 0.075-mm (No. 200) that is non-plastic, and has little strength when dry (PI < 4).
Peat	Soil of vegetable matter.

APPENDIX C: Sub Section:
NJDEP Sediment Contaminant Test Analysis

The Louis Berger Group (Berger) conducted a sediment sampling program within specified areas of the park located in Jersey City, New Jersey (Site). The overall objective of the sampling was to determine if recent sedimentation within the small tidal area in Lincoln Park included contaminants such as semi-volatile organics, pesticides, PCBs, metals and dioxin; and if such contaminated sedimentation was occurring, what was its most likely origin. This information assisted with predictions about what might occur if tidal inundation is increased across the Site as a result of potential ecological restoration efforts.

THE Louis Berger Group, INC.
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August 13, 2007

Mr. David Bean
New Jersey Department of Environmental Protection
Division of Natural Resource Restoration
501 East State Street, 3rd Floor
P.O. Box 404
Trenton, NJ 08625-404

RE: DRAFT Sediment Sampling Results Report
Lincoln Park, Jersey City, New Jersey
NJDEP Term Contract for Remedial Design No. A- 54678

Dear Mr. Bean,

To assist the New Jersey Department of Environmental Protection (NJDEP) and its partner agencies in designing a restoration plan for the degraded salt marsh at the Lincoln Park Site, The Louis Berger Group (Berger) conducted a sediment sampling program within specified areas of the park located in Jersey City, New Jersey (Site). The overall objective of the sampling was to determine if recent sedimentation within the small tidal area in Lincoln Park included contaminants such as semi-volatile organics, pesticides, PCBs, metals and dioxin; and if such contaminated sedimentation was occurring, what was its most likely origin. This information will assist with predictions about what might occur if tidal inundation is increased across the Site as a result of potential ecological restoration efforts.

SITE CONDITIONS

The Site for the proposed habitat restoration is an approximately 90-acre parcel located on the eastern banks of the Hackensack River. The Site lies between the Hackensack River to the west, State Routes 1 and 9 to the south and east, and Duncan Avenue to the north (Figure 1) and is part of the Hudson County Division of Parks and Recreation Lincoln Park Complex. Approximately 30 acres in the northern section of the Site was used historically as a landfill which contains unclassified municipal, construction and demolition debris. It is understood that the landfill will be properly closed in conjunction with the restoration and development of the surrounding lands.

The area to be restored as tidal marsh is currently dominated by invasive plant species and tidal exchange is limited on Site due to disturbances over time, including a concrete bulkhead which forms an artificial barrier between the river and the majority of the Site

The NJDEP and its partner agencies [the National Oceanic and Atmospheric Administration (NOAA) and the Hudson County Department of Parks and Recreation] are developing design plans to restore a complex habitat system. The project goals include removing contaminated soil, restoring the tidal marsh and associated tidal hydrology and tidal channels, planting native species, and enhancing the existing pond located in the eastern portion of the Site by removing contaminated sediments and allowing for more efficient tidal exchange.

TECHNICAL OVERVIEW

Sediment sampling, performed on May 7, 2007, was conducted in accordance with the work order cost estimate and change order cost estimates dated November 27, 2006. No formal Site Investigation Sampling Plan (SSIP) was requested by NJDEP. The 12 sampling locations were selected in coordination with NJDEP and NOAA and were analyzed by Accutest Laboratories of Dayton, New Jersey, a NJDEP Certified Laboratory.

The sampling area is a small tidal channel connected to the Hackensack River located in the southwest portion of the Site (Photo1). The predominant vegetation in the area is *Phragmites australis* (common reed) with patches of *Spartina alterniflora* (saltmarsh cordgrass) and mudflat located in small areas along the channel and river. The channel generally contains a few inches to over five feet of water depending on tidal conditions, with the majority of the channel exposed during low tides and submerged during high tides.

Photo 1 – Small Tidal Channel on Lincoln Park Site

Twelve sediment samples were collected in May 2007 using NJDEP approved sampling devices including stainless steel bowls and trowels and a stainless steel hand auger. Boring locations were recorded using a global positioning system (GPS) and are shown on Figures 2 through 4. The sediment sampling was conducted as described below and a sample summary table is presented as Table 1.

- One sediment sample was collected from three locations along the center of the stream (SD01, SD02 and SD03). At each location, the sample was collected from the surface interval (0-2 centimeter below grade [cm bg]) and analyzed for Priority Pollutant (PP) analysis including semi-volatile organic compounds (base/neutral and acid extractable compounds) (PP SVOC+25), PP metals including cyanide and phenols, PP pesticides, polycyclic biphenyl's (PCBs) and Dioxins.

- Three core composite samples to 4 ft bg were collected from the center of the stream (C01, C02 and C03). At each location the four foot soil core recovered was composited and analyzed for PP SVOC+25, PP metals, PP pesticides, PCBs and Dioxins.

- Adjacent to each of the three core sample locations, a surface sample (0-2 cm bg) was collected from the high tide berm of each side of the stream bank for a total of six sample sites (SC1a and SC1b, SC2a and SC2b, and SC3a and SC3b). The pair of samples collected across from each other was composited and analyzed for PP SVOC+25, PP metals, PP Pesticides, PCBs and Dioxins.

FINDINGS

The laboratory data packages for SVOCs metals, PCBs, pesticides, and dioxin sediment sampling results, are provided as Attachment A. The sediment sampling results for SVOCs, metals, PCBs, and pesticides were compared to criteria listed in the NJDEP's *Guidance for Sediment Quality Evaluations* (November 1998) and are presented in Table 2.

The Effects Range Low (ER-L) marine/estuarine sediment screening guidelines are not used as action or trigger criteria but rather indicate concentrations at which adverse benthic impacts may begin to occur. The ER-L criteria represent a concentration at which adverse benthic impacts are found in approximately 10% of studies. The sediment samples were also compared to the Effect Range Median (ER-M), which indicate a greater than 50% incidence of adverse effects to sensitive species and/or life stages. It is important to note that an ER-L is not used as a decision-making threshold, but rather is a concentration at the low end of a continuum roughly relating bulk chemistry with toxicity and for many constituents the ER-L is exceeded almost universally within major water bodies that are adjacent to and downstream of urban centers. There is also no basis for assuming that multiple concentrations above an ER-L increase the probability of toxicity, and therefore, the ER-M is typically the more useful concentration for making comparisons and engineering and regulatory decisions. Nonetheless, for comparison and completeness purposes, Figures 2 through 4 present exceedances to both the ER-L and ER-M based on sample type and location.

<u>Semi-Volatile Organic Compounds (SVOCs)</u>

Because one of the sources of SVOCs is urban stormwater runoff from paved and other developed ground surfaces, the presence of some level of SVOCs is expected and unavoidable. Numerous SVOC analytes were predictably detected in all 10 of the sediment samples (9 samples and one duplicate sample). In particular, analytes including; acenapthalene, acenapthlyene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, indeno(1,2,3)pyrene, phenanthracene, and pyrene were detected at concentrations above the ER-L. However, these concentrations are below the ER-M criteria.

Locations that show the most SVOCs at concentrations greater than the ER-L and at higher concentrations appear to be located closer to the river and conversely those with less exceedances and lower concentrations are from samples collected farther up the tributary, indicating that there is no apparent SVOC source or contamination issue associated with this particular site. The results of the samples collected from 0 to 2 cm bg are consistent with the results of the composite samples from 0 to 4 ft bg.

Metals

Concentrations of numerous metals detected in the sediment exceed the ER-L criteria at all the sample locations. Metals which exceeded the ER-L include: arsenic, cadmium, chromium, copper, lead, nickel, silver, zinc and mercury. There are four metals detected at concentrations above the ER-M. Copper was detected above the ER-M at location SD03, lead was above the ER-M at locations CO2, SC03 and SD03, zinc is above the ER-M at location SD03, and mercury was found at concentrations above ER-M at locations CO1, CO2, CO3, SC02, SC03, SD01 and SD02.

Comparison of the concentrations to sample collection style and location do not appear to reveal any distinct differences regarding most of the metals, indicating that there is no apparent source or contamination issue associated with this particular site for those specific metals. However, with regard to copper, lead, and zinc there are slightly higher concentrations observed farther up the tributary and closer to the landfill, indicating at least the possibility for a local or immediately upland source that contributed to these elevated levels versus the river side of the site. Mercury is the most prevalent metal present above the ER-M at concentrations ranging from 0.3 mg/kg to 3.1 mg/kg, although it is noted that Mercury is known to be both an atmospheric (air quality related) and up-river contamination issue in this region (especially relating to the Hackensack River, but also the Passaic River).

Pesticides and PCBs

Because of the prevalent historic use of pesticides in urban areas, the presence of some level of pesticides is expected and unavoidable. Two pesticides, (4, 4-DDE and dieldrin) and one PCB (Aroclor 1260) were found at concentrations above the ER-L. Only 4,4-DDE was detected at a concentration above the ER-M in samples CO2 (at the river side of the Site) and SC01 (into the river), indicating little to no possibility for a local or immediately upland source that contributed to these elevated levels versus the river side of the Site. PCBs do not appear to be an issue at this Site.

<u>Effects Range Medium- Quotient</u>

In addition to comparing concentrations to the ER-L and ER-M criteria, ER-M values were used to calculate a mean ER-M quotient (ERM-Q). The ERM-Q is calculated by dividing each contaminant concentration by its respective ERM value, then summing the results for all contaminants detected and dividing by the total number of contaminants for each sample.

The mean ERM-Q represents an assessment for each sample of the cumulative sediment chemistry relative to the threshold values. The cumulative risks of effect to the benthic community can provide a mechanism to compare the different samples. This method has been used and evaluated by several researchers (Hyland et al. 1999, Carr et al. 1996, Chapman 1996, and Long et al. 1995) throughout the country. A table summarizing the ERM-Q values is presented as Table 3 and the values are also shown on the appropriate figures.

ERM-Q values were primarily below the medium-high effects level threshold of 0.50 in six of the nine samples. Samples CO2 (at the river side of the Site) and SC03 (at the upland side of the Site) exhibited values greater than the medium-high threshold at 0.61 0.57, respectively. The highest ERM-Q value was calculated for sample SD03 (1.59) which is greater than the high effect level threshold of 1.5 and indicates an issue at the upland side of the site closest to the landfill. The high ERM-Q for SD03 is driven by the high copper and lead concentration, which may very well be associated with the landfill located immediately upland of the Site and is consistent with what is often found near landfills that were/are not properly controlled with regard to leachate and/or stormwater run-off that ultimately discharges to nearby water bodies.

<u>Dioxins and Furans</u>

The dioxin results, presented as Table 4, were compared to the Agency for Toxic Substances and Disease Registry (ATSDR) *Dioxin and Dioxin-Like Compounds in Soil, Part 1: ATSDR Interim Policy Guideline* (August 1997). Dioxin results for sediments were converted to Toxic Equivalent Concentrations (TEQ) and compared to the Center for Disease Control (CDC) Action Levels for Soils, Sediment, or Fly Ash at a Superfund Site.

TEQ concentrations ranged from 44.9 to 255 picograms/gram (pg/g) which is below the action level of 1,000 pg/g. The highest TEQ concentrations were found in the 4-ft core sample at CO2 (269 pg/g) and the 2 cm discrete sample at SD03 (215 (pg/g). All other concentrations are below 200 pg/g. There does not appear to be any pattern to the distribution of dioxins, indicating that there is no apparent source or contamination issue associated with this particular Site.

CONCLUSIONS AND RECOMMENDATIONS

The initial sediment sampling program was intended to determine if a pattern of sediment contamination could be detected; and if such contaminated sedimentation was occurring, what was its most likely origin.

This information will assist with predictions about what might occur if tidal inundation is increased across the Site as a result of potential ecological restoration efforts.

Mercury is the most prevalent contaminant which exceeds the ER-M criteria at the site, but it is noted that the results indicate that the mercury is consistently distributed throughout the horizontal and vertical range of sediment investigated and is present at elevated levels in the river as well. This even distribution is indicative of consistent deposition from the river side of the site over an extended period of time (period required to deposit 4 feet of sediment), and is also the same pattern that has been noted to exist at many other sites near or along the lower end of the major rivers in the region (i.e., the Raritan River, Hackensack River, and Passaic River). [*It is also be noted that Berger previously performed a similar study of the mercury levels from the Raritan River for the successful Pine Creek Wetland Mitigation site on the lower Raritan River, and the Mercury levels detected at this site are consistent with those identified at the Pine Creek site*]. PAHs, which are all below the ER-M criteria, show a similar pattern, indicating they have a regional origin (not site-specific) and have likely been deposited from the river over time. Pesticides are also detected throughout the investigation area, although they appear to be at highest concentrations in the most recent sediments (0 to 2 cm bg) but are still detectable in the two 4-foot composites closest to the river, again indicating a regional origin (not site-specific). Conversely, it appears that copper, lead and zinc are potentially related to a site-specific inland source as opposed to coming from the river. This conclusion is based on the results of the furthest inland sample from 0 to 2 cm bg (SD03).

Table 5 summarizes selected analytes, and the ranges of concentrations found at the nearby sites in the region. In comparing the Lincoln Park results to publicly documented contaminant levels at nearby sites such as the Berry's Creek Site located along the lower Hackensack River in East Rutherford, the Lower Passaic River Site located in Newark and the Honeywell Site located at the mouth of the Hackensack River in Jersey City, the concentrations of metals, pesticides and SVOCs at the subject Lincoln Park site generally are below the concentrations found at the other sites in the region, with the exception of copper and lead which appear to warrant further study and evaluation.

It does not appear that increased tidal inundation would cause degradation of the site sediments. It appears that the level of contamination that may have been introduced from the river would be elevated if shallow river sediments were transported into the site. Any influx of current shallow river sediments would likely carry only low (i.e., regional background) levels of PAH compounds. Also, the other river-related contaminants appear to be at concentrations consistent with regional background. However, the copper, lead and zinc concentrations detected at 0 to 2 cm bg in SD03 (furthest inland sample) are above the ER-M and the copper and lead are also above the noted regional background. These results may warrant additional investigation to determine extent and potential source, which is likely to be associated with the upland landfill and may readily be controlled in the future as that landfill is properly closed.

Berger would be pleased to provide the NJDEP with a detailed cost estimate and work order proposal to perform additional investigations. Berger appreciates the opportunity to present this information and looks forward to working with you on future phases of this project. Please contact me at (973) 765-1920 if you have any questions or wish to further discuss the finding of this report.

Very truly yours,
THE LOUIS BERGER GROUP, Inc.

Terry Doss
Project Manager

Attachments

Cc: T. Lewis, R. Harding, C. Watt (Berger)

TABLE 1

New Jersey Department of Environmental Protection

Lincoln Park

Jersey City, New Jersey

Soil Sample Summary Table

Location ID	Sample ID	Lab ID	Interval	Analytical Parameters	Sampling Method	Lithology	Date
SC1A and SC1B	SC01	J60509-1	0.0 - 2.0 cm	PP SVOC+25, PP Metals, PP Pesticides, PCB and DIOXINS	Composite	Medium to fine SAND and Silt	5/7/2007
C01	C01	J60509-2	0.0 - 4.0 ft	PP SVOC+25, PP Metals, PP Pesticides, PCB and DIOXINS	Composite	Fine SAND with little Silt and Peat	5/7/2007
SD01	SD01	J60509-3	0.0 - 2.0 cm	PP SVOC+25, PP Metals, PP Pesticides, PCB and DIOXINS	Grab Sample	SILT with little medium to fine Sand and medium to fine Gravel	5/7/2007
SC2A and SC2B	SC02	J60509-4	0.0 - 2.0 cm	PP SVOC+25, PP Metals, PP Pesticides, PCB and DIOXINS	Composite	Medium to fine SAND and Silt	5/7/2007
C02	C02	J60509-5	0.0 - 4.0 ft	PP SVOC+25, PP Metals, PP Pesticides, PCB and DIOXINS	Composite	Medium to Fine SAND and Silt	5/7/2007
	DUP01	J60509-10					
SD02	SD02	J60509-6	0.0 - 2.0 cm	PP SVOC+25, PP Metals, PP Pesticides, PCB and DIOXINS	Grab Sample	SILT with little medium to fine Sand and medium to fine Gravel	5/7/2007
SC3A and SC3B	SC03	J60509-7	0.0 - 2.0 cm	PP SVOC+25, PP Metals, PP Pesticides, PCB and DIOXINS	Composite	SILT with little medium to fine Sand and little medium to fine Gravel	5/7/2007
C03	C03	J60509-8	0.0 - 4.0 cm	PP SVOC+25, PP Metals, PP Pesticides, PCB and DIOXINS	Composite	Coarse to fine SAND with some Silt and Peat	5/7/2007
SD03	SD03	J60509-9	0.0 - 2.0 cm	PP SVOC+25, PP Metals, PP Pesticides, PCB and DIOXINS	Grab Sample	Coarse SAND and fine Gravel with trace Silt	5/7/2007

Notes:
PP+25 = Priority Pollutant analysis including semi-volatile organic compounds, (base/neutral and acid extractables), (PP SVOC+25), PP metals and cyanide and phenols, PP pesticides, and polycyclic biphenyl's (PCB)

Lithologic descriptions derived from Unified Soil Classification System (USCS) where "and" indicates a percentage of 36-50%, "some" indicates a percentage of 21 35%, "little" indicates a percentage of 11-20% and "trace" indicates a percentage of 1-10%. (ASTM D 2478).

TABLE 2

New Jersey Department of Environmental Protection

Lincoln Park

Jersey City, New Jersey

Sediment Results Summary Table

		Location ID	C01	C02		C03	SC1A and SC1B	SC2A and SC2B	SC3A and SC3B	SD01	SD02	SD03
		Sample ID	C01	C02	DUP01	C03	SC01	SC02	SC03	SD01	SD02	SD03
		Lab Sample ID	J60509-2	J60509-5	J60509-10	J60509-8	J60509-1	J60509-4	J60509-7	J60509-3	J60509-6	J60509-9
		Sample Date	5/7/2007	5/7/2007	5/7/2007	5/7/2007	5/7/2007	5/7/2007	5/7/2007	5/7/2007	5/7/2007	5/7/2007
		Sample Interval	0-4 ft	0-4 ft	0-4 ft	0-4 ft	0-2 cm	0-2 cm	0-2 cm	0-2 cm	0-2 cm	0-2 cm
Priority Pollutant Metals	**ER-L**	**ER-M**										
Antimony	NC	NC	1.7 U	2 U	3.4 U	2.2 U	3.3 U	2.7 U	2.2 U	2.3 U	1.7 U	9.6
Arsenic	8.2	70	16.2	15.6	16.8	24.9	11.6	25.5	30.5	13.4	16.4	10.4
Beryllium	NC	NC	0.74	0.53	0.86 U	0.56	0.83 U	0.68	0.69	0.58 U	0.59	0.48 U
Cadmium	1.2	9.6	2.5	2.2	2.1	1.1	0.83 U	1.3	1.1	0.74	0.88	0.87
Chromium	81	370	103	156	176	104	45.7	108	155	76	105	31.1
Copper	34	270	137	135	146	112	71.6	115	200	102	159	5750
Lead	47	218	153	198	228	182	113	170	480	182	201	1530
Nickel	21	52	21.2	26.4	34.4	21	18.8	27.5	35.8	22	25.7	24.7
Selenium	NC*	NC*	2.8	2.1	3.4 U	2.2 U	3.3 U	2.7 U	2.8	2.3 U	2.1	2.4
Silver	1	3.7	0.86 U	1.4	1.9	1.1 U	1.7 U	1.4	1.8	1.2 U	1.6	0.97 U
Zinc	150	410	375	375	363	269	221	203	324	233	252	414
Mercury	0.15	0.71	1.2	3.1	2	1.5	0.6	1.9	2.6	1.1	1.9	0.3
Priority Pollutant Pesticides												
4,4-DDD	NC	NC	0.007	0.031	0.0257	0.0397	0.0392	0.0252	0.0454	0.0199	0.001 U	0.0127
4,4-DDE	0.002	0.027	0.0109	0.0421	0.0175	0.0008 U	0.0806	0.001 U	0.0242	0.00089 U	0.001 U	0.0047
Dieldrin	0.002	NC	0.00098 U	0.0091	0.0073	0.0008 U	0.0065	0.001 U	0.0012 U	0.00089 U	0.001 U	0.0011 U
Priority Pollutant PCBs												
Aroclor 1260	0.005	24	0.024 U	0.102	0.0574	0.02 U	0.016 U	0.026 U	0.03 U	0.022 U	0.026 U	0.028 U
Priority Pollutant Semivolatile Organic Compounds +25 (Base/Neutral Acid Extracables)												
Acenaphthene	0.016	0.5	0.206	0.0527	0.0197	0.0165	0.0256	0.0296	0.021 U	0.0328	0.017 U	0.0366
Acenaphthylene	0.044	0.64	0.0812	0.108	0.064	0.0924	0.117	0.0664	0.0837	0.0705	0.0482	0.0304
Anthracene	0.085	1.1	0.323	0.201	0.107	0.0803	0.144	0.127	0.0741	0.219	0.0654	0.122
Benzo(a)anthracene	0.261	1.6	0.463	0.564	0.322	0.305	0.559	0.418	0.311	0.499	0.231	0.289
Benzo(a)pyrene	0.43	1.6	0.408	0.499	0.291	0.345	0.581	0.34	0.298	0.451	0.203	0.184
Benzo(b)fluoranthene	NC	NC	0.335	0.42	0.223	0.261	0.462	0.436	0.387	0.359	0.265	0.271
Benzo(g,h,i)perylene	0.17	NC	0.282	0.286	0.153	0.198	0.31	0.206	0.177	0.264	0.119	0.0979
Benzo(k)fluoranthene	0.24	NC	0.216	0.345	0.206	0.187	0.176	0.117	0.111	0.304	0.088	0.0981
bis(2-Ethylhexyl)Phthalate	NC	NC	0.182	0.876	1.4	0.139 J	0.182	0.189	0.206 J	0.222	0.12 J	0.19 U
Chrysene	0.384	2.8	0.52	0.576	0.338	0.32	0.571	0.324	0.268	0.545	0.209	0.195
Fluoranthene	0.6	5.1	0.803	0.81	0.387	0.4	0.612	0.433	0.253	0.97	0.221	0.401
Fluorene	NC	NC	0.0358	0.0704	0.0196	0.015 U	0.031	0.027	0.021 U	0.0592	0.017 U	0.0389
Indeno(1,2,3-cd)Pyrene	0.2	NC	0.27	0.276	0.153	0.185	0.371	0.195	0.162	0.258	0.114	0.104
Naphthalene	0.16	2.1	0.0338	0.0256	0.015	0.0221	0.019	0.018 U	0.021 U	0.015 U	0.017 U	0.019 U
Phenanthrene	0.24	1.5	0.261	0.451	0.164	0.072	0.212	0.24	0.121	0.836	0.108	0.357
Pyrene	0.665	2.6	0.775	0.815	0.417	0.437	0.772	0.409	0.278	1.07	0.223	0.368
Other												
Phenols	NC	NC	13.9	13.4	3.9	4.4 U	4 U	5.4 U	15.5	6.3	5.2 U	7.1 U

Notes :

All results in mg/kg unless otherwise indicated

BN/AE, PP+25 = Base Neutrals / Acid Extractables and Priority Pollutants (search for 25 non-target tentatively identified compounds (TICS))

ER-M = Effects Range Medium, *NJDEP Guidance for Sediment Quality Evaluations* (November 1998)

ER-L = Effects Range Low, *NJDEP Guidance for Sediment Quality Evaluations* (November 1998)

NC = No criteria

U = Indicates the compound was analyzed for but not detected.

J = Indicates an estimated value. All tentatively identified compounds (TICs) and results below the MDL receive this qualifier.

* = Contaminant is a known biomagnifier that may warrant case-by-case evaluation

Bold values indicate positive detections.

Bold and shaded values meet or exceed ER-L

Bold and shaded values meet or exceed ER-M

TABLE 3

New Jersey Department of Environmental Protection

Lincoln Park

Jersey City, New Jersey

ERM-Q Summary Table

Analyte		C01		C02		DUP01		C03		SC01		SC02		SC03		SD01		SD02		SD03	
Metals	**ER-M**	**Conc.**	**Conc/ERM**	**Conc.**	**Conc/ERM**	**Conc.**	**Conc/ERM**	**Conc.**	**Conc/ERM**	**Conc.**	**Conc/ERM**	**Conc.**	**Conc/ERM**	**Conc.**	**Conc/ERM**	**Conc.**	**Conc/ERM**	**Conc.**	**Conc/ERM**	**Conc.**	**Conc/ERM**
Arsenic	70	**16.2**	0.23	**15.6**	0.22	**16.8**	0.24	**24.9**	0.36	**11.6**	0.17	**25.5**	0.36	**30.5**	0.44	**13.4**	0.19	**16.4**	0.23	**10.4**	0.15
Cadmium	9.6	**2.5**	0.26	**2.2**	0.23	**2.1**	0.22	**1.1**	0.11	0.83	0.09	**1.3**	0.14	**1.1**	0.11	**0.74**	0.08	**0.88**	0.09	**0.87**	0.09
Chromium	370	**103**	0.28	**156**	0.42	**176**	0.48	**104**	0.28	**45.7**	0.12	**108**	0.29	**155**	0.42	**76**	0.21	**105**	0.28	**31.1**	0.08
Copper	270	**137**	0.51	**135**	0.50	**146**	0.54	**112**	0.41	**71.6**	0.27	**115**	0.43	**200**	0.74	**102**	0.38	**159**	0.59	**5750**	21.30
Lead	218	**153**	0.70	**198**	0.91	**228**	1.05	**182**	0.83	**113**	0.52	**170**	0.78	**480**	2.20	**182**	0.83	**201**	0.92	**1530**	7.02
Nickel	52	**21.2**	0.41	**26.4**	0.51	**34.4**	0.66	**21**	0.40	**18.8**	0.36	**27.5**	0.53	**35.8**	0.69	**22**	0.42	**25.7**	0.49	**24.7**	0.48
Silver	3.7	0.86	0.23	**1.4**	0.38	**1.9**	0.51	1.1	0.30	1.7	0.46	**1.4**	0.38	**1.8**	0.49	1.2	0.32	**1.6**	0.43	0.97	0.26
Zinc	410	**375**	0.91	**375**	0.91	**363**	0.89	**269**	0.66	**221**	0.54	**203**	0.50	**324**	0.79	**233**	0.57	**252**	0.61	**414**	1.01
Mercury	0.71	**1.2**	1.69	**3.1**	4.37	**2**	2.82	**1.5**	2.11	**0.6**	0.85	**1.9**	2.68	**2.6**	3.66	**1.1**	1.55	**1.9**	2.68	**0.3**	0.42
Pesticides																					
4,4-DDE	0.027	**0.0109**	0.40	**0.0421**	1.56	**0.0175**	0.65	0.0008	0.03	**0.0806**	2.99	0.001	0.04	**0.0242**	0.90	0.00089	0.03	0.001	0.04	**0.0047**	0.17
PCB																					
Aroclor 1260	24	0.024	0.00	**0.102**	0.00	**0.0574**	0.00	0.02	0.00	0.016	0.00	0.026	0.00	0.03	0.00	0.022	0.00	0.026	0.00	0.028	0.00
SVOC																					
Acenaphthene	0.5	**0.206**	0.41	**0.0527**	0.11	**0.0197**	0.04	**0.0165**	0.03	**0.0256**	0.05	**0.0296**	0.06	0.021	0.04	**0.0328**	0.07	0.017	0.03	**0.0366**	0.07
Acenaphthylene	0.64	**0.0812**	0.13	**0.108**	0.17	**0.064**	0.10	**0.0924**	0.14	**0.117**	0.18	**0.0664**	0.10	**0.0837**	0.13	**0.0705**	0.11	**0.0482**	0.08	**0.0304**	0.05
Anthracene	1.1	**0.323**	0.29	**0.201**	0.18	**0.107**	0.10	**0.0803**	0.07	**0.144**	0.13	**0.127**	0.12	**0.0741**	0.07	**0.219**	0.20	**0.0654**	0.06	**0.122**	0.11
Benzo(a)anthracene	1.6	**0.463**	0.29	**0.564**	0.35	**0.322**	0.20	**0.305**	0.19	**0.559**	0.35	**0.418**	0.26	**0.311**	0.19	**0.499**	0.31	**0.231**	0.14	**0.289**	0.18
Benzo(a)pyrene	1.6	**0.408**	0.26	**0.499**	0.31	**0.291**	0.18	**0.345**	0.22	**0.581**	0.36	**0.34**	0.21	**0.298**	0.19	**0.451**	0.28	**0.203**	0.13	**0.184**	0.12
Chrysene	2.8	**0.52**	0.19	**0.576**	0.21	**0.338**	0.12	**0.32**	0.11	**0.571**	0.20	**0.324**	0.12	**0.268**	0.10	**0.545**	0.19	**0.209**	0.07	**0.195**	0.07
Fluoranthene	5.1	**0.803**	0.16	**0.81**	0.16	**0.387**	0.08	**0.4**	0.08	**0.612**	0.12	**0.433**	0.08	**0.253**	0.05	**0.97**	0.19	**0.221**	0.04	**0.401**	0.08
Naphthalene	2.1	**0.0338**	0.02	**0.0256**	0.01	**0.015**	0.01	**0.0221**	0.01	**0.019**	0.01	0.018	0.01	0.021	0.01	0.015	0.01	0.017	0.01	0.019	0.01
Phenanthrene	1.5	**0.261**	0.17	**0.451**	0.30	**0.164**	0.11	**0.072**	0.05	**0.212**	0.14	**0.24**	0.16	**0.121**	0.08	**0.836**	0.56	**0.108**	0.07	**0.357**	0.24
Pyrene	2.6	**0.775**	0.30	**0.815**	0.31	**0.417**	0.16	**0.437**	0.17	**0.772**	0.30	**0.409**	0.16	**0.278**	0.11	**1.07**	0.41	**0.223**	0.09	**0.368**	0.14
		Sum	7.84	Sum	12.12	Sum	9.14	Sum	6.58	Sum	8.20	Sum	7.39	Sum	11.40	Sum	6.91	Sum	7.10	Sum	32.05
		Count	20	Count	20	Count	20	Count	20	Count	20	Count	20	Count	20	Count	20	Count	20	Count	20
		ERM-Q	**0.39**	**ERM-Q**	**0.61**	**ERM-Q**	**0.46**	**ERM-Q**	**0.33**	**ERM-Q**	**0.41**	**ERM-Q**	**0.37**	**ERM-Q**	**0.57**	**ERM-Q**	**0.35**	**ERM-Q**	**0.35**	**ERM-Q**	**1.60**

Notes:

All results in mg/kg unless otherwise indicated

ER-M = Effects Range Medium,*NJDEP Guidance for Sediment Quality Evaluations* (November 1998)

ER-L = Effects Range Low,*NJDEP Guidance for Sediment Quality Evaluations* (November 1998)

Bold values indicate positive detections.

Bold and shaded values meet or exceed medium-high effects range

Bold and shaded values meet or exceed hign effects range

TABLE 4

New Jersey Department of Environmental Protection

Lincoln Park

Jersey City, New Jersey

Sediment Dioxin Results Table

Location ID		C01		C02				C03		SC1A and SC1B		SC2A and SC2B		SC3A and SC3B		SD01		SD02		SD03	
Sample ID		C01		C02		DUP01		C03		SC01		SC02		SC03		SD01		SD02		SD03	
Lab Sample ID		J60509-2		J60509-5		J60509-10		J60509-8		J60509-1		J60509-4		J60509-7		J60509-3		J60509-6		J60509-9	
Sample Date		5/7/2007		5/7/2007		5/7/2007		5/7/2007		5/7/2007		5/7/2007		5/7/2007		5/7/2007		5/7/2007		5/7/2007	
Sample Interval (ft)		0.0 - 4.0		0.0 - 4.0		0.0 - 4.0		0.0 - 4.0		0.0 - 2.0 cm		0.0 - 2.0 cm		0.0 - 2.0 cm		0.0 - 2.0 cm		0.0 - 2.0 cm		0.0 - 2.0 cm	
Analyte	TEF		TEQ		TEQ		TEQ		TEQ		TEQ		TEQ		TEQ		TEQ		TEQ		
Dioxins																					
2,3,7,8-TCDD	1	9.84 Q	9.84	64.0 Q	64	119 Q	119	20.3 Q	20.3	29.2 Q	29.2	104	104	49.3	49.3	35.4	35.4	31.2 Q	31.2	7.47	7.47
1,2,3,7,8-PeCDD	1	1.81A	1.81	2.65 QA	2.65	7.14 A	7.14	1.24 A	1.24	1.29 QA	1.29	1.22 A	1.22	2.55 A	2.55	1.65 *	1.65	3.47 QA	3.47	1.34 *	1.34
1,2,3,4,7,8-HxCDD	0.1	ND	ND	2.25 A	0.225	5.60 A	0.56	1.12 A	0.112	1.30 A	0.13	0.991 *	0.0991	2.32 A	0.232	1.79 A	0.179	2.29 A	0.229	3.30 A	0.33
1,2,3,6,7,8-HxCDD	0.1	5.03 A	0.503	10.3	1.03	21.5	2.15	3.83 A	0.383	4.92 A	0.492	3.90 A	0.39	8.98 A	0.898	8.45 A	0.845	9.60 A	0.96	99.40	9.94
1,2,3,7,8,9-HxCDD	0.1	2.28 *	0.228	5.03 A	0.503	10.9	1.09	2.47 A	0.247	2.67 A	0.267	2.77 A	0.277	6.01 A	0.601	5.23 A	0.523	5.24 A	0.524	11.5 *	1.15
1,2,3,4,6,7,8-HpCDD	0.01	62.4	0.624	148	1.48	267	2.67	58.3	0.583	69.0	0.69	58.0	0.58	137	1.37	175	1.75	80.2	0.802	1120	11.2
OCDD	0.0001	616	0.0616	1260	0.126	2270	0.227	730	0.073	688	0.0688	606	0.0606	1300	0.13	1380	0.138	615	0.0615	9520 E	0.952
Furans																					
2,3,7,8-TCDF	0.1	7.77	0.777	11.0 Q	1.1	17.7 Q	1.77	3.20 *	0.32	4.26 Q	0.426	3.43	0.343	7.20	0.72	5.75	0.575	3.93 Q	0.393	3.75	0.375
1,2,3,7,8-PeCDF	0.05	17.5	0.875	11.8 Q	0.59	45.3 Q	2.2685	6.08 QA	0.304	5.90 QA	0.295	3.90 QA	0.195	6.45 QA	0.3225	4.71 QA	0.2355	4.60 QA	0.23	12.0	0.6
2,3,4,7,8-PeCDF	0.5	25.4	12.7	19.1 Q	9.55	62.8 Q	31.4	7.78 Q	3.89	10.2 Q	5.1	9.52 QA	4.764	14.9 QA	7.45	14.0 Q	7	9.40 QA	4.7	41.2	20.6
1,2,3,4,7,8-HxCDF	0.1	238	23.8	147	14.7	512	51.2	68.9	6.89	51.6	5.16	66.5	6.65	75.3	7.53	65.9	6.59	60.3	6.03	105	10.5
1,2,3,6,7,8-HxCDF	0.1	45.2	4.52	31.0	3.1	146	14.6	16.2	1.62	11.8	1.18	12.6	1.26	15.9 A	1.59	14.3	1.43	13.5	1.35	54.1	5.41
2,3,4,6,7,8-HxCDF	0.1	14.7	1.47	17.8	1.78	65.2	6.52	8.86	0.886	6.21 A	0.621	6.05 A	0.605	10.6 A	1.06	8.10 A	0.8101	8.86 A	0.886	72.9	7.29
1,2,3,7,8,9-HxCDF	0.1	2.24 QA	0.224	2.78 QA	0.278	8.66	0.866	1.25 QA	0.125	0.964 QA	0.0964	1.70 A	0.17	2.02 QA	0.202	2.38 QA	0.238	2.15 QA	0.215	35.0	3.5
1,2,3,4,6,7,8-HpCDF	0.01	832	8.32	568	5.68	2560	25.6	319	3.19	178	1.78	253	2.53	342	3.42	266	2.66	303	3.03	13000 E	130
1,2,3,4,7,8,9-HpCDF	0.01	14.4	0.144	9.88	0.0988	36.8	0.368	5.83 A	0.0583	4.89 A	0.0489	6.23	0.0623	7.80 A	0.078	8.67 A	0.0867	7.57 A	0.0757	45.2	0.452
OCDF	0.001	1020	1.02	571	0.571	2550	2.55	369	0.369	229	0.229	366	0.366	485	0.485	463	0.463	401	0.401	4270	4.27
ACTION LEVEL																					
Total TEQ	1000		66.9166		107.4618		269.9795		40.5903		47.0741		123.572		77.9385		60.5733		54.5572		215.379

Notes:

Results are pg/g (picograms/gram, or, parts per trillion), dry weight

TEF = World Health Organization Toxicity Equivalency Factors (Van den Berg, et al 1998)

TEQ = Toxic Equivalent concentration; calculated by multiplying the sample concentration by the TEF

U = Not detected above the estimated detection limit

A = Amount detecetd is less than the Lower Method Calibration Limit

Q = Indicates the presence of a quantitative interference. This situtation may result in a underestimation of the affected analyte(s).

* = Estimated maximum possible concentration

E = Amount detected is greater than the upper calibration limit

ND = Non Detected

The TOTAL TEQ is defined as the sum of the products of the concentration for each compound
and the TEF for each compound.

The ACTION LEVEL is that established by the Center for Disease Control for soil,
sediment or fly ash at a Superfund Site.

Bold and shaded values meet or exceed CDC Action Levels

TABLE 5

New Jersey Department of Environmental Protection

Lincoln Park

Jersey City, New Jersey

Analytes of Concern ComparisonTable

Analyte of Concern	ER-L	ER-M	Lincoln Park (Jersey City, NJ)	Passaic River* (Newark, NJ)	Honeywell** (Jersey City, NJ)	Berry's Creek*** (East Rutherford, NJ)	Pine Creek**** (Sayerville, NJ)
			Analyte Concentration Range per Location				
PP Metals							
Arsenic	8.2	70	**11.6 - 30.5**	0.47 - ***4700***	1.3 - ***113***	ND - **69.3**	**4.7** - ***110***
Chromium	81	370	31.1 - **176**	1 - ***2160***	2.2 - ***9190***	19.5 - ***636***	8.8 - **167**
Copper	34	270	**71.6** - ***5750***	0.2 - ***11400***	1.8 - 1550	NA	6.9 - **391**
Lead	47	218	**113** - ***1530***	***1 - 22000***	***1.9 - 883***	7.6 - **316**	7.4 - ***262***
Nickel	21	52	18.8 - **35.8**	0.2 - ***369***	4.9 - ***3453***	NA	**6.0 - 46.8**
Zinc	150	410	**203** - ***414***	8.8 - ***8630***	11.3 - ***1960***	25.2 - ***3200***	**20 - 325**
Mercury	0.15	0.71	**0.3** - ***3.1***	0.001-***758***	0.03 - ***79.2***	ND - ***124***	**0.092 - 2.6**
PP Pesticides							
4,4-DDE	0.002	0.027	ND - ***0.0806***	0.0002 - ***3.8***	**0.0042** - ***0.11***	NA	ND - **0.240**
PP SVOC							
Acenaphthylene	0.016	0.5	ND - **0.206**	0.003 - ***80***	**0.110 - .480**	ND - **0.208**	ND - **0.14**
Benzo (a) anthracene	0.261	1.6	0.203 - **0.559**	0.046 - ***320***	***7.2 - 1.6***	ND - **0.745**	ND - **0.33**
Phenantherene	0.24	1.5	0.108 - **0.836**	0.026 - ***1,200***	**0.420** - ***2.1***	ND - **0. 367**	ND - **0.48**
Pyrene	0.665	2.6	0.223 - **0.815**	0.077 - ***650***	***2.9 - 11***	ND - 0.633	ND - **0.78**

Notes:

All values reported in parts per thousand (mg/kg) unless otherwise indicated

ND = Not detected above analytical limits

NA = Not analyzed

* = Data Obtained from TAMS Malcolm Pirnie *Final Data Summary and Evaluation Report* , May 2005

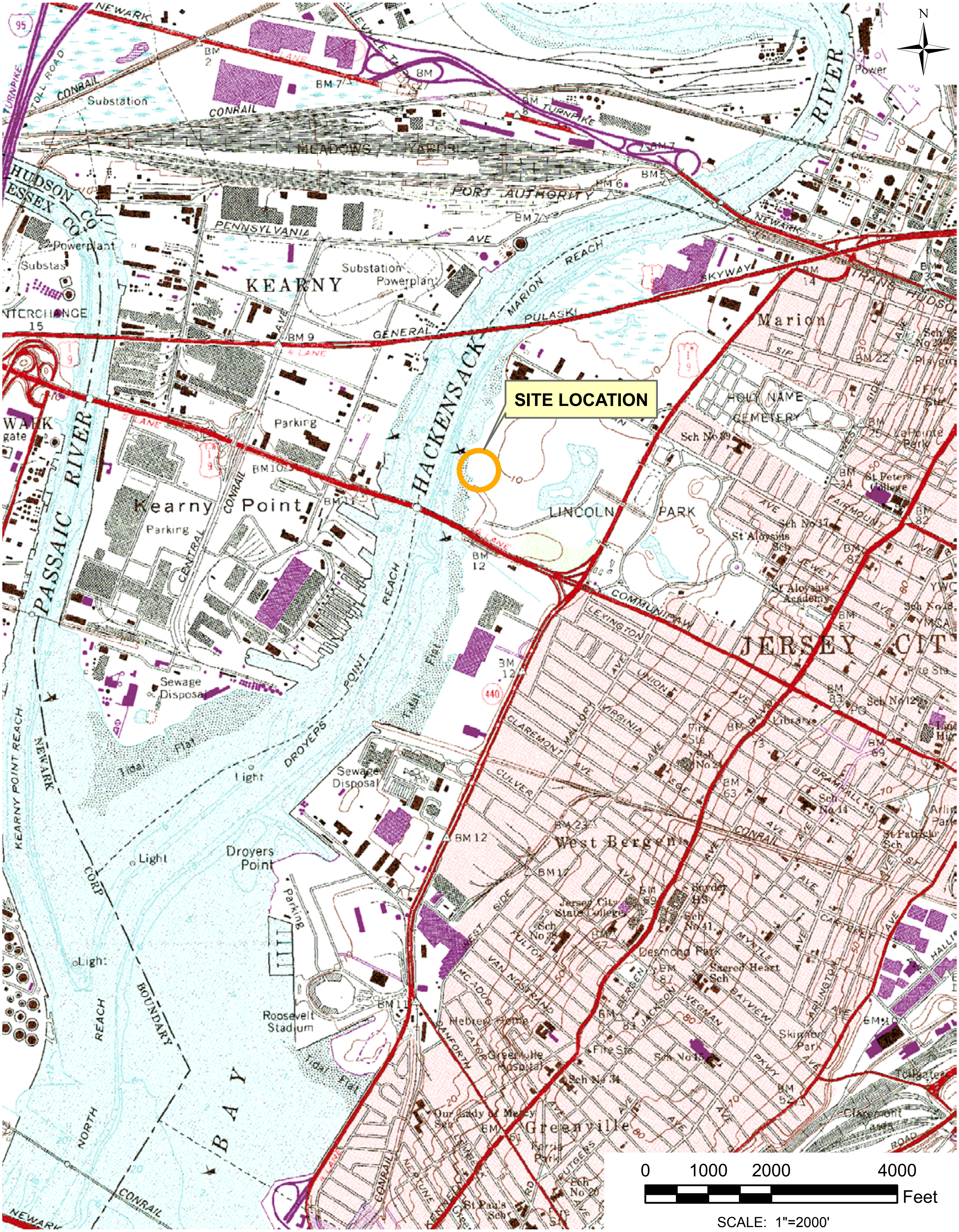
** = Data Obtained from Tetra Tech *Remedial Investigation Report* , 2002

*** = Data Obtained from ongoing Berger investigations

****= Data Obtained from Berger Letter Report to NJDEP, 2001

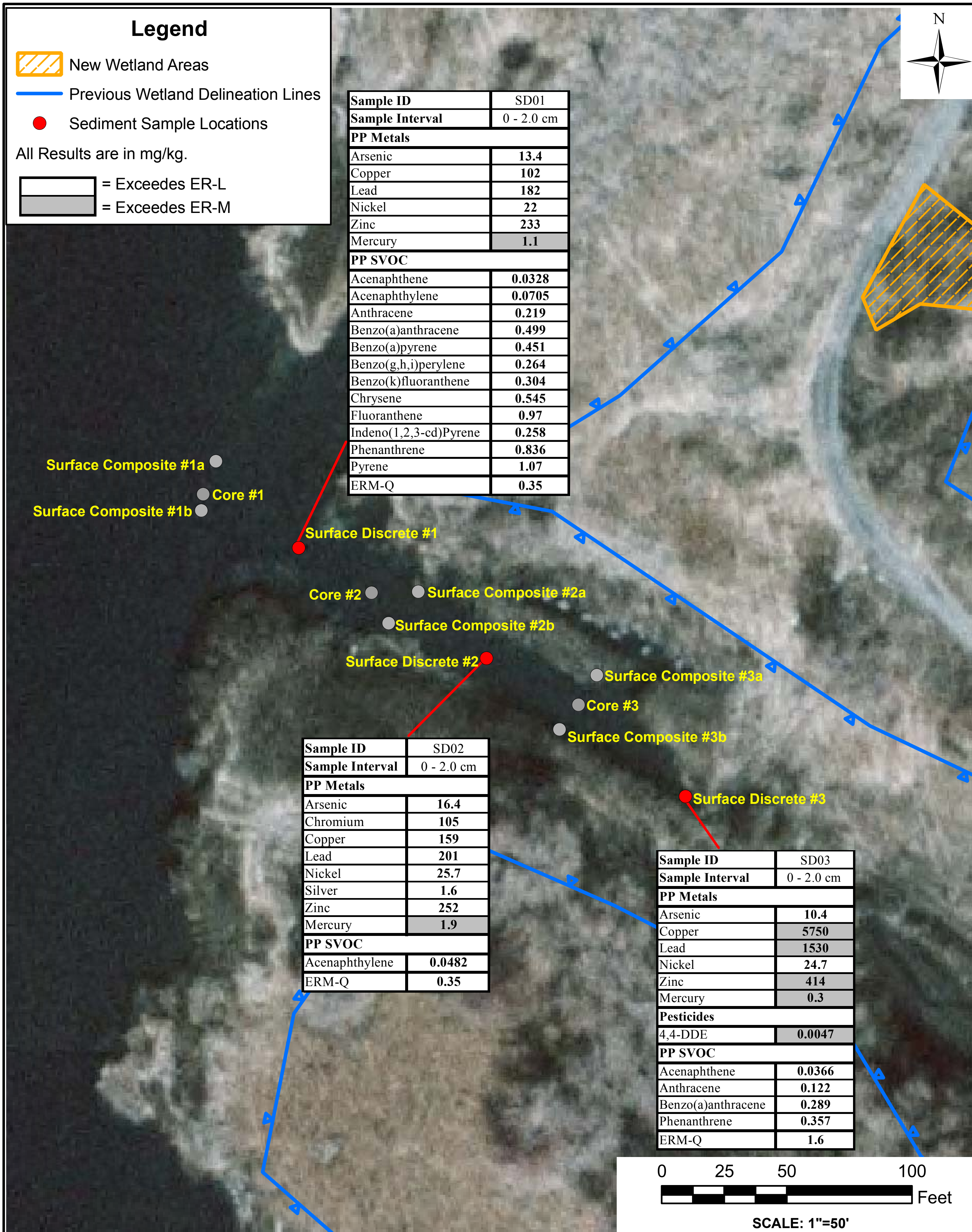
Bold values meet or exceede ER-L

Bold and italisized values meet or exceede ER-M



FILE_PATH&NAME/02JUN05

N.J. Department of Environmental Protection	LINCOLN PARK, JERSEY CITY, NEW JERSEY **SITE LOCATION MAP** NJDEP CONTRACT No. A-54678	**The Louis Berger Group, Inc.** 30 Vreeland Road Florham Park, NJ	**FIGURE 1**



Sample ID	SD01
Sample Interval	0 - 2.0 cm
PP Metals	
Arsenic	13.4
Copper	102
Lead	182
Nickel	22
Zinc	233
Mercury	1.1
PP SVOC	
Acenaphthene	0.0328
Acenaphthylene	0.0705
Anthracene	0.219
Benzo(a)anthracene	0.499
Benzo(a)pyrene	0.451
Benzo(g,h,i)perylene	0.264
Benzo(k)fluoranthene	0.304
Chrysene	0.545
Fluoranthene	0.97
Indeno(1,2,3-cd)Pyrene	0.258
Phenanthrene	0.836
Pyrene	1.07
ERM-Q	0.35

Sample ID	SD02
Sample Interval	0 - 2.0 cm
PP Metals	
Arsenic	16.4
Chromium	105
Copper	159
Lead	201
Nickel	25.7
Silver	1.6
Zinc	252
Mercury	1.9
PP SVOC	
Acenaphthylene	0.0482
ERM-Q	0.35

Sample ID	SD03
Sample Interval	0 - 2.0 cm
PP Metals	
Arsenic	10.4
Copper	5750
Lead	1530
Nickel	24.7
Zinc	414
Mercury	0.3
Pesticides	
4,4-DDE	0.0047
PP SVOC	
Acenaphthene	0.0366
Anthracene	0.122
Benzo(a)anthracene	0.289
Phenanthrene	0.357
ERM-Q	1.6

N.J. Department of Environmental Protection

LINCOLN PARK, JERSEY CITY, NEW JERSEY

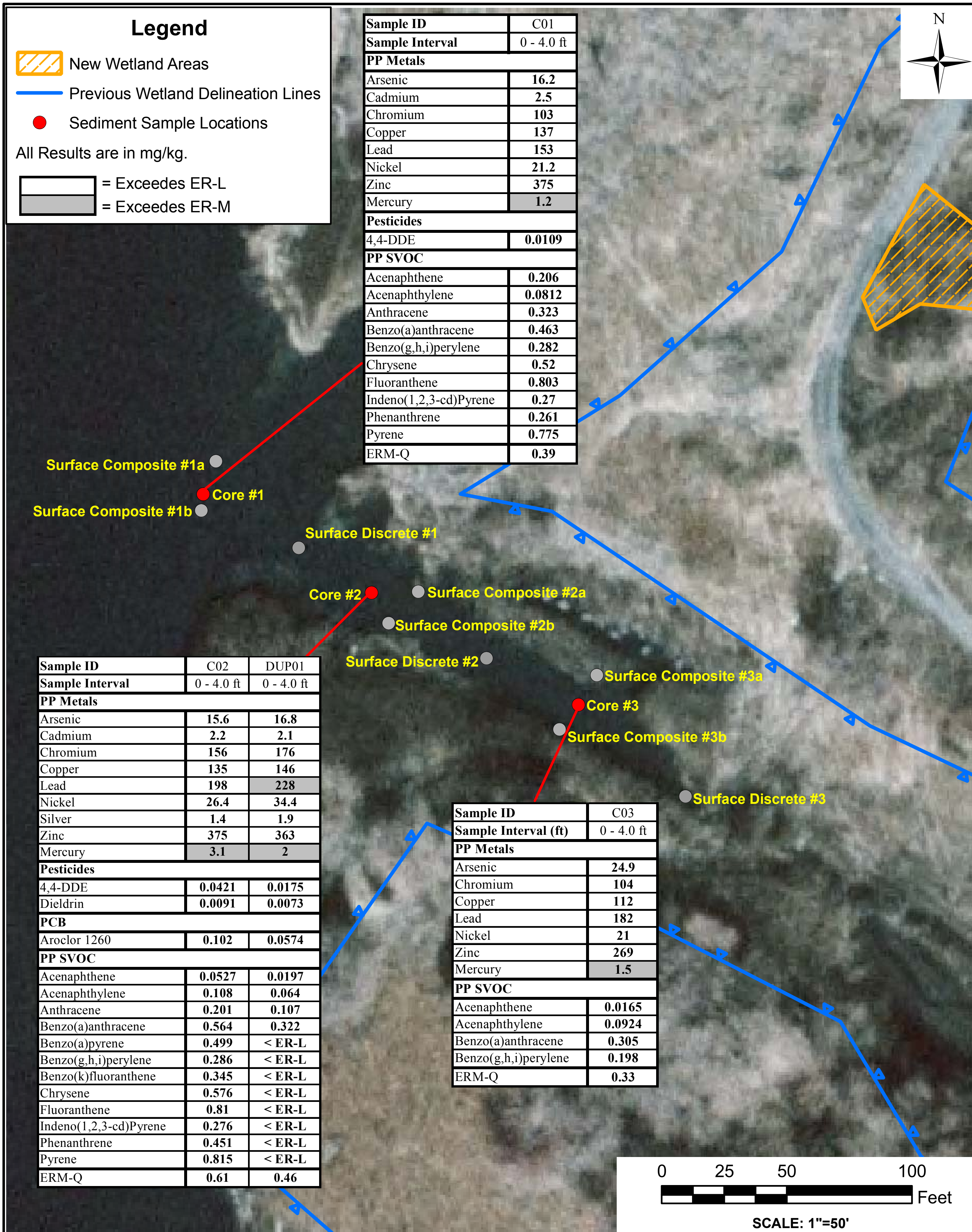
Surface Discrete Sediment Sample Location and Exceedance Map

NJDEP CONTRACT No. A-54678

The Louis Berger Group, Inc.
30 Vreeland Road
Florham Park, NJ

FIGURE 2

FILE_PATH&NAME/02JUN05



Sample ID	C01
Sample Interval	0 - 4.0 ft
PP Metals	
Arsenic	16.2
Cadmium	2.5
Chromium	103
Copper	137
Lead	153
Nickel	21.2
Zinc	375
Mercury	1.2
Pesticides	
4,4-DDE	0.0109
PP SVOC	
Acenaphthene	0.206
Acenaphthylene	0.0812
Anthracene	0.323
Benzo(a)anthracene	0.463
Benzo(g,h,i)perylene	0.282
Chrysene	0.52
Fluoranthene	0.803
Indeno(1,2,3-cd)Pyrene	0.27
Phenanthrene	0.261
Pyrene	0.775
ERM-Q	0.39

Sample ID	C02	DUP01
Sample Interval	0 - 4.0 ft	0 - 4.0 ft
PP Metals		
Arsenic	15.6	16.8
Cadmium	2.2	2.1
Chromium	156	176
Copper	135	146
Lead	198	228
Nickel	26.4	34.4
Silver	1.4	1.9
Zinc	375	363
Mercury	3.1	2
Pesticides		
4,4-DDE	0.0421	0.0175
Dieldrin	0.0091	0.0073
PCB		
Aroclor 1260	0.102	0.0574
PP SVOC		
Acenaphthene	0.0527	0.0197
Acenaphthylene	0.108	0.064
Anthracene	0.201	0.107
Benzo(a)anthracene	0.564	0.322
Benzo(a)pyrene	0.499	< ER-L
Benzo(g,h,i)perylene	0.286	< ER-L
Benzo(k)fluoranthene	0.345	< ER-L
Chrysene	0.576	< ER-L
Fluoranthene	0.81	< ER-L
Indeno(1,2,3-cd)Pyrene	0.276	< ER-L
Phenanthrene	0.451	< ER-L
Pyrene	0.815	< ER-L
ERM-Q	0.61	0.46

Sample ID	C03
Sample Interval (ft)	0 - 4.0 ft
PP Metals	
Arsenic	24.9
Chromium	104
Copper	112
Lead	182
Nickel	21
Zinc	269
Mercury	1.5
PP SVOC	
Acenaphthene	0.0165
Acenaphthylene	0.0924
Benzo(a)anthracene	0.305
Benzo(g,h,i)perylene	0.198
ERM-Q	0.33

N.J. Department of Environmental Protection

LINCOLN PARK, JERSEY CITY, NEW JERSEY

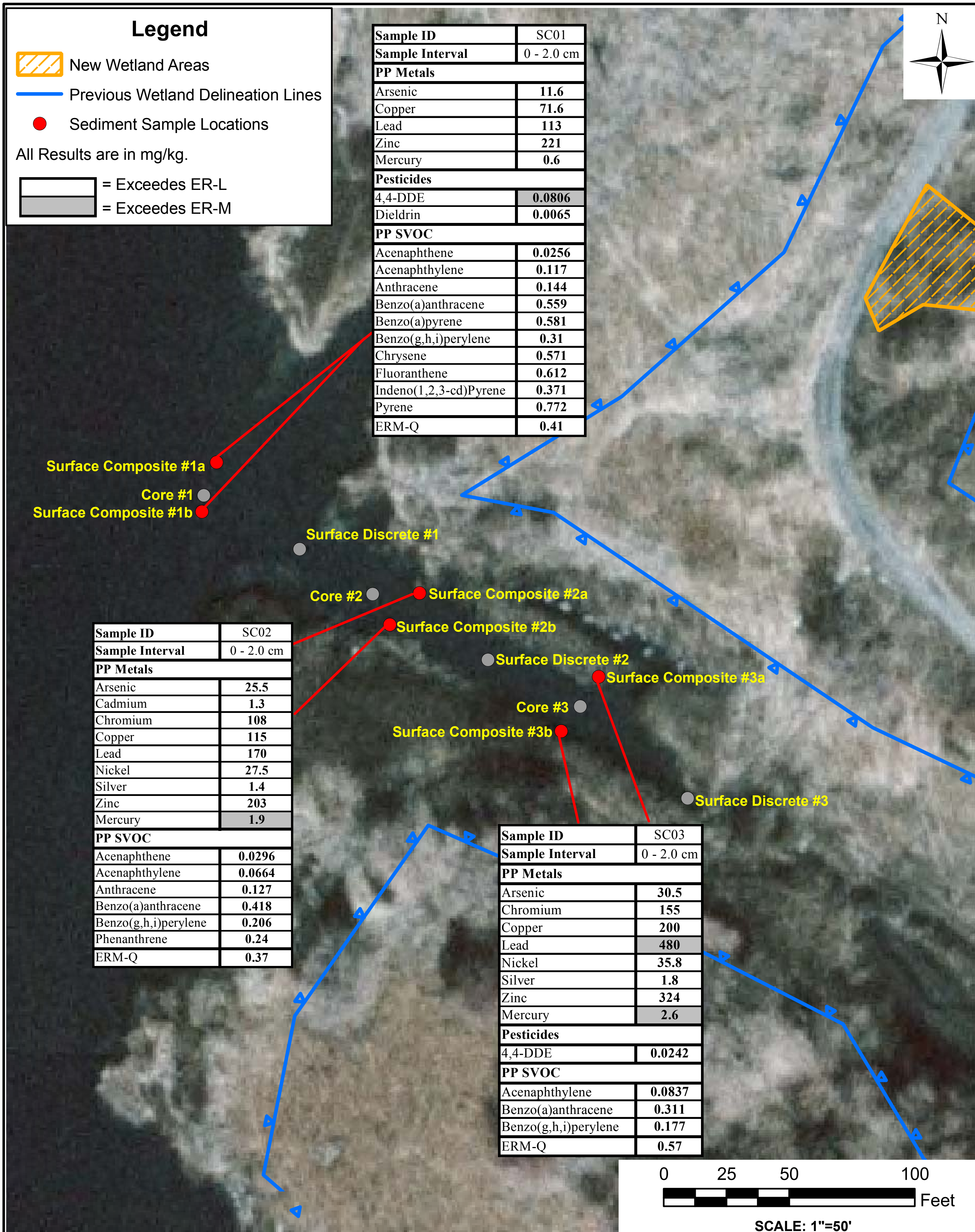
Sediment Core Sample Location and Exceedance Map

NJDEP CONTRACT No. A-54678

The Louis Berger Group, Inc.
30 Vreeland Road
Florham Park, NJ

FIGURE 3

FILE_PATH&NAME/02JUN05



Sample ID	SC01
Sample Interval	0 - 2.0 cm
PP Metals	
Arsenic	11.6
Copper	71.6
Lead	113
Zinc	221
Mercury	0.6
Pesticides	
4,4-DDE	0.0806
Dieldrin	0.0065
PP SVOC	
Acenaphthene	0.0256
Acenaphthylene	0.117
Anthracene	0.144
Benzo(a)anthracene	0.559
Benzo(a)pyrene	0.581
Benzo(g,h,i)perylene	0.31
Chrysene	0.571
Fluoranthene	0.612
Indeno(1,2,3-cd)Pyrene	0.371
Pyrene	0.772
ERM-Q	0.41

Sample ID	SC02
Sample Interval	0 - 2.0 cm
PP Metals	
Arsenic	25.5
Cadmium	1.3
Chromium	108
Copper	115
Lead	170
Nickel	27.5
Silver	1.4
Zinc	203
Mercury	1.9
PP SVOC	
Acenaphthene	0.0296
Acenaphthylene	0.0664
Anthracene	0.127
Benzo(a)anthracene	0.418
Benzo(g,h,i)perylene	0.206
Phenanthrene	0.24
ERM-Q	0.37

Sample ID	SC03
Sample Interval	0 - 2.0 cm
PP Metals	
Arsenic	30.5
Chromium	155
Copper	200
Lead	480
Nickel	35.8
Silver	1.8
Zinc	324
Mercury	2.6
Pesticides	
4,4-DDE	0.0242
PP SVOC	
Acenaphthylene	0.0837
Benzo(a)anthracene	0.311
Benzo(g,h,i)perylene	0.177
ERM-Q	0.57

N.J. Department of Environmental Protection

LINCOLN PARK, JERSEY CITY, NEW JERSEY

Surface Composite Sediment Sample Location and Exceedance Map

NJDEP CONTRACT No. A-54678

The Louis Berger Group, Inc.
30 Vreeland Road
Florham Park, NJ

FIGURE 4

APPENDIX D
PERMITS
- State Permits
- Federal Permits

State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION

JON S. CORZINE
Governor

MARK N. MAURIELLO
Acting Commissioner

Office of Dredging and Sediment Technology
P.O. Box 028
Trenton, NJ 08625
(609) 292-1251
Fax (609) 777-1914

July 21, 2009

Donald Stevens, PE
The Louis Berger Group, Inc.
P.O. Box 1946
412 Mount Kemble Avenue
Morristown, NJ 07963-1946

RE: Waterfront Development Permit/ FWW GP#16/Water Quality Certificate
Application No(s): 0906-07-0009.2 WFD090002 In-Water & WFD090001 Upland
Lincoln Park Wetland Restoration
Jersey City, County of Hudson

Dear Mr. Stevens:

Enclosed, please find an approved construction permit. Please read the permit and its terms and Conditions carefully. If you consider yourself aggrieved by our decision regarding your application, you may request a hearing by completing the requirements of the attached *administrative hearing request checklist and tracking form.* Unless you request a hearing to contest this permit or its conditions, you have accepted its terms and conditions.

You are required to keep a copy of your permit and the approved drawings at the construction site for the duration of the project. Failure to do so is a violation of the permit.

If you are required to record a Grant of Conservation Restriction/Easement, you must present the Department with proof that you have recorded it within ninety (90) days of issuance of this permit. You may NOT COMMENCE CONSTRUCTION until you have properly recorded the Division of Land Use Regulation approved Grant of Conservation Restriction/Easement documents and fulfilled the pre-construction conditions of this permit.

If a tidelands grant, lease or license is required as a condition of this permit, you may not begin construction until the Bureau of Tidelands Management has delivered the necessary conveyances. Construction prior to the receipt of the necessary conveyances is in violation of State law and will subject you to fines up to $1,000.00 plus $100.00 per day. Furthermore, the cost for the tidelands instrument may be higher since the property claimed will be appraised as improved property. You may be required to remove any unauthorized structures placed in tidelands claimed areas.

Please do not hesitate to contact the Office's project manager, listed on the first page of the permit, to discuss any concerns or questions you may have. Thank you for working with the staff of the Office to protect our state's natural resources.

Sincerely,

Suzanne U. Dietrick, Chief
Office of Dredging and Sediment Technology
Site Remediation Program

w/attachments

C: Bureau of Coastal and Land Use Enforcement – Trenton
New York Army Corps of Engineers – Richard Tomer
Jersey City Municipal Clerk

ADJUDICATORY HEARING REQUEST CHECKLIST AND TRACKING FORM

I. Permit Being Appealed:

____

Facility Name

__________________________ __________________________

Issuance Date of Final Permit Decision | Permit Number

II. Person Requesting Hearing:

__________________________ __________________________

Name/Organization | Name of Attorney (if applicable)

__________________________ __________________________

__________________________ __________________________

__________________________ __________________________

Address | Address of Attorney

__________________________ __________________________

Telephone Number | Telephone Number of Attorney

III. Please include the following information as part of your request:

A. The date the permittee received the permit;
B. A copy of the Denial of Permit and a list of all issues being appealed;
C. The legal and factual questions at issue;
D. A statement as to whether you raised each legal and factual issue during the public comment period;
E. An estimate of the amount of time required for the hearing;
G. A request, if necessary, for a barrier-free hearing location for disabled persons;
H. A clear indication of any willingness to negotiate a settlement with the Department prior to the Department's processing of your hearing request to the Office of Administrative Law; and
I. This form, completed, signed and dated with all of the information listed above, including attachments, to:

1. Office of Legal Affairs
   ATTENTION: Adjudicatory Hearing Requests
   Department of Environmental Protection
   401 East State Street
   PO Box 402, Trenton, New Jersey 08625-0402
2. Suzanne Dietrick, Chief
   Office of Dredging and Sediment Technology
   401 East State Street
   PO Box 028, Trenton, New Jersey 08625-0029
3. Any other person named on the permit (if you are a permittee under that permit).
4. The permittee(s) (if you are a person seeking consideration as a party to the action).

IV. Signature: ______________________________ Date: __________

PROJECT COMPLETION REPORT

This Project Completion Report must be mailed or faxed to the proper address below. Please circle the appropriate permit type(s).

Please mail notice of completion of projects authorized under a **Freshwater Wetlands Individual, General Permit or Transition Area Waiver, Major or Minor Stream Encroachment Permit, or Highlands Approval** to:

State of New Jersey
Department of Environmental Protection
Coastal & Land Use Compliance & Enforcement
P.O. Box 422
Trenton, NJ 08625-0422
Attention: Manager, Coastal & Land Use Compliance & Enforcement
Fax to: (609) 633-6798

Please mail notice of completion of projects authorized under an **Individual CAFRA or Waterfront Development Permit or Coastal General Permit** to:

State of New Jersey
Department of Environmental Protection
Coastal & Land Use Compliance & Enforcement
1510 Hooper Avenue
Toms River, NJ 08753
Attention: Manager, Coastal & Land Use Compliance & Enforcement
Fax to: (732) 255-0877

Permit Information

Project Manager: ______________________________
Permit Number(s):____
____
____
Date of Completion: ____

The undersigned hereby certifies that all activities approved by the Department within the above referenced permit/s have been constructed and completed in accordance with the plans approved therein, that said project is in compliance with all terms and conditions of the permit, and that any unauthorized encroachments have been removed.

Engineer's Signature and Seal: ____
New Jersey License Number: ____
Date: ______________________________

CONSTRUCTION REPORT

This Project Commencement Report must be mailed or faxed to the proper address below. Please circle the appropriate permit type(s).

Please mail notice of commencement of projects authorized under a **Freshwater Wetlands Individual, General Permit or Transition Area Waiver, Major or Minor Stream Encroachment Permit, or Highlands Approval** to:

State of New Jersey
Department of Environmental Protection
Coastal & Land Use Compliance & Enforcement
P.O. Box 422
Trenton, NJ 08625-0422
Attention: Manager, Coastal & Land Use Compliance & Enforcement
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Department of Environmental Protection
Coastal & Land Use Compliance & Enforcement
1510 Hooper Avenue
Toms River, NJ 08753
Attention: Manager, Coastal & Land Use Compliance & Enforcement
Fax to: (732) 255-0877

Permit Information

Project Manager: ______________________________
Permit Number(s): ______________________________
____
____
Date of Commencement: ______________________________

I hereby give notice that construction will begin on the above noted project on the date stated above (must give at least 7 days notice). Also, as required by the permit, a copy of the above referenced permit(s) along with all approved drawings shall be available for inspection at the project site throughout construction.

Engineer's Signature and Seal: ______________________________
New Jersey License Number: ______________________________
Date: ____________________

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
SITE REMEDIATION PROGRAM
OFFICE OF DREDGING AND SEDIMENT TECHNOLOGY
401 East State Street, P.O. Box 028
Trenton, NJ 08625

PERMIT

In accordance with the laws and regulations of the State of New Jersey, the Department of Environmental Protection hereby grants this permit to perform the activities described below. This permit is revocable with due cause and is subject to the limitations, terms and conditions listed below and on the attached pages. For the purpose of this document, "permit" means "approval, certification, registration, authorization, waiver, etc." Violation of any term, condition or limitation of this permit is a violation of the implementing rules and may subject the permittee to enforcement action.	Approval Date: July 21, 2009 Expiration Date: July 21, 2014

Permit Number/s:	Type of Approval/s:	Enabling Statute/s
0906-07-0009.2 WFD090002 & WFD090001	Waterfront Development – IP In Water Waterfront Development – IP Upland Water Quality Certificate Acceptable Use Determination Freshwater Wetland General Permit #16	NJSA 12:5-3 NJSA 58:10A

Applicant:	Project Location:
NJDEP-Office of Natural Resource Restoration 501 East State Street, 3rd Floor Trenton, NJ 08625	Lincoln Park, Jersey City, Hudson County Block(s): 1702.1 Lot(s): 1

Description of Authorized Activities and Limit of Disturbance:

The restoration of 33.53 acres of tidal wetlands, open water and mudflats through the removal of 205,700 cubic yards of sediment and debris. A temporary water exclusion berm will be constructed prior to initiation on dredging. Dredging will be accomplished via land reach excavator. Removed material associated with this restoration will be placed at the adjacent existing landfill to aid in its closure. Clean fill in the amount of 74,000 cubic yard of sand will then used to create desired elevation in the restoration area.

The construction of a temporary 7.05-acre confined disposal facility (CDF) will be constructed to accept the above referenced sand. The CDF will be constructed from clean fill from the Laurel Hill site in Secaucus, New Jersey. The weir structure will discharge into the adjacent man-made pond.

Description of authorized activities continues on the following page.

By issuance of this permit, the State of New Jersey does not relinquish tidelands ownership or claim to any portion of the subject property or adjacent properties. The permittee shall allow an authorized Division representative the right to inspect the construction pursuant to N.J.A.C. 7:7E-1.5(b)4.

Prepared by Gary Nikerson

Received or Recorded by County Clerk

THIS PERMIT IS NOT EFFECTIVE AND NO CONSTRUCTION APPROVED BY THIS PERMIT, OR OTHER REGULATED ACTIVITY, MAY BE UNDERTAKEN UNTIL THE APPLICANT HAS SATISFIED ALL PRE-CONSTRUCTION CONDITIONS AS SET FORTH IN THIS PERMIT PURSUANT TO N.J.A.C. 7:7E-1.5(b)4.

This permit is not valid unless authorizing signature appears on the last page.

Description of Authorized Activities and Limit of Disturbance continued:

The construction of a temporary dredge material off-loading barge directly adjacent to the landfill. The barge will connect to the CDF via a 2,400' pipeline. Approximately 300,000 cubic yards of sand will be delivered to the CDF over a period of eight to ten weeks.

Approximately 2,439 feet of public access walkway will be constructed along the perimeter of the restored wetland.

This permit is authorized under, and in compliance with the following Rules on Coastal Zone Management, N.J.A.C. 7:7E-1.1 et seq., specifically: the Rules of Coastal Zone Management (N.J.A.C. 7:7E) governing; Finfish migratory pathways (7:7E-3.5), Intertidal and subtidal shallows (7:7E-3.15), Wetlands (7:7E-3.27), Endangered or threatened wildlife or plant species habitats (7:7E-3.38), Lands and waters subject to public trust rights (7:7E-3.50), New dredging (7:7E-4.7), Dredged material disposal (7:7E-4.8), Dredged material placement on land (7:7E-7.12), Marine Fish and Fisheries (7:7E-8.2), and Water Quality (7:7E-8.4), & Public trust rights (7:7E-8.11).

STANDARD CONDITIONS:

1. **Extent of approval:**

   a. This document grants permission to perform certain activities that are regulated by the State of New Jersey. The approved work is described by the text of this permit and is further detailed by the approved drawings listed herein. All work must conform to the requirements, conditions and limitations of this permit and all approved drawings.

   b. If you alter the project without prior approval, or expand work beyond the description of this permit, you may be in violation of State law and may be subject to fines and penalties. Approved work may be altered only with the prior written approval of the Department.

   c. You must keep a copy of this permit and all approved drawings readily available for inspection at the work site.

2. **Acceptance of permit:** If you begin any activity approved by this permit, you thereby accept this document in its entirety, and the responsibility to comply with the terms and conditions. If you do not accept or agree with this document in its entirety, **do not begin** construction. You are entitled to request an appeal within a limited time as detailed on the attached *Administrative Hearing Request Checklist and Tracking Form.*

3. **Recording with County Clerk:** You must record this permit in the Office of the County Clerk for each county involved in this project. You must also mail or fax a copy of the front page of this permit to the Department showing the received stamp from each County Clerk within 30 days of the issuance date

4. **Notice of Construction:** You must notify the Department in writing at least 7 days before you begin any work approved by this permit by submitting the attached construction report. The Construction Reports are also available at www.nj.gov/dep/landuse.

5. **Expiration date:** All activities authorized by this permit must be completed by the expiration date shown on the first page unless otherwise extended by the Division. At that time, this permit will automatically become invalid and none of the approved work may begin or continue until a replacement permit is granted. (Some permits may qualify for an extension of the expiration date. Please contact the Department for further information.)

6. **Rights of the State:**

a. This permit is revocable and subject to modification by the State with due cause.

b. Representatives from the State have the statutory authority to enter and inspect this site to confirm compliance with this permit and may suspend construction or initiate enforcement action if work does not comply with this permit.

c. This permit does not grant property rights. The issuance of this permit shall not affect any action by the State on future applications, nor affect the title or ownership of property, nor make the State a party in any suit or question of ownership.

7. Other responsibilities: You must obtain all necessary local, Federal and other State approvals before you begin work. All work must be stabilized in accordance with the *Standards for Soil Erosion and Sediment Control in New Jersey,* and all fill material must be free of toxic pollutants in toxic amounts as defined in section 307 of the Federal Act.

SPECIAL CONDITIONS IN ADDITION TO THE STANDARD CONDITIONS:

8. The permittee shall immediately inform the Department of any unanticipated adverse effects on the environment not described in the application or in the conditions of this permit.

9. Any regulated activities undertaken on the site before a copy of this recorded restriction is submitted to the Department will be considered in violation of the implementing rules and this permit.

10. All necessary local, Federal, and other State approvals must be obtained by the applicant prior to the commencement of the herein-permitted activities.

11. Issuance of this permit does not in any way relinquish the State's ownership interest in the subject property, if any exists. The project site is located on Tidelands / Wetlands Map 686-2154

12. The drawings hereby approved are:

"LINCOLN PARK WETLAND RESTORATION, JERSEY CITY, HUDOSN COUNTY, NEW JERSEY", signed by Donald B. Stevens, of the Louis Berger Group, Inc..

a. "SITE LOCATION MAP", (Sheet 1 of 8), dated February 09
a. "EXISTING CONDITIONS PLAN", (Sheet 2 of 8), dated February 09
b. "PROPOSED CONDITIONS PLAN ", (Sheet 3 of 8), dated February 09, revised May 09
c. "CROSS SECTION A-A' ", (Sheet 4 of 8), dated February 09, revised May 09
d. "CONSTRUCTION DETAILS", (Sheet 5 of 8), dated February 09
e. "SOIL EROSION AND SEDIMENT CONTROL PLAN ", (Sheet 6 of 8), dated February 09, revised May 09
f. "CROSS SECTION A-A' ", (Sheet 7 of 8), dated February 09
g. "PROPOSED PLAN PIER 'C' ", (Sheet 8 of 8), dated February 09

"TEMPORARY SAND CONTAINMENT AND DEWATERING FACILITY (CDF), LINCOLN PARK WEST, ECOLOGICAL RESTORATION/LANDFILL CLOSURE/PUBLIC GOLF COURSE", signed by Sanjay M. Patel, P.E. of PS&S LLC.

a. "OVERALL PLAN", (Sheet CDF-01), dated June 4, 2009
b. "SITE PLAN OF SAND CONTAINMENT CELLS", (Sheet CDF-02), dated June 4, 2009
c. "CROSS SECTION OF SAND CONTAINMENT CELLS", (Sheet CDF-03), dated June 4, 2009

"LINCOLN PARK WETLAND RESTORATION, CONTRACT NO. A-68677, JERSEY CITY, HUDSON COUNTY, NEW JERSEY," by the Louis Berger Group, Inc.

a. "PROPOSED HABITAT TYPES," Figure 11, by the Louis Berger Group, Inc.

Physical Conditions

13. The Permittee shall comply with all conditions set forth in the May 20, 2009, Closure and Post-Closure Plan Approval for the Hudson County Lincoln Park Landfill (Lincoln Park West Landfill).

14. No timing restrictions are required for this project. However, the temporary berm that will be constructed along the river shall not be breached from 3/1 to 6/30. If the construction schedule requires the berm to be breached during this time, the permittee may petition the Department after coordinating with NMFS.

15. Silt curtains shall be installed around the area of dredging to minimize turbidity in adjacent water areas. The curtains shall remain in place until the completion of dredging operations.

16. The Applicant shall comply with the soil erosion and sediment control plan depicted on approved plan sheet, "SOIL EROSION AND SEDIMENT CONTROL PLAN ", (Sheet 6 of 8), dated February 09, revised May 09.

Confined Disposal Facility Operating Conditions

17. The CDF will be constructed from clean fill from the Laurel Hill site in Secaucus, New Jersey. Any change in construction material requires written approval from the Department.

18. A minimum of two feet (2') of freeboard below the top of the CDF berms shall be maintained <u>at all times</u>. Pumping of dredged material into the CDF shall cease if a minimum of two feet (2') of freeboard can not be maintained at any given time.

19. The CDF shall be visually inspected during active hydraulic dredging to ensure adequate freeboard requirements, and integrity of the berms.

20. Pumping into the CDF must cease when the facility has been filled to within two feet (2') of the top of the berm.

21. The minimum retention time of the dredged material in the CDF shall be no less than 24 hours to allow for sufficient settling prior to discharge of the return water to surface waters of the State.

22. The discharge outlet must be designed and maintained such that no scouring or erosion occurs from the pipe or its discharge.

23. Upon termination of construction activities, the permittee shall remove all pipelines from waterways and wetlands.

7/21/09
DATE

Suzanne U. Dietrick
Suzanne U. Dietrick, Chief
Office of Dredging and Sediment Technology

DEPARTMENT OF THE ARMY
NEW YORK DISTRICT, CORPS OF ENGINEERS
JACOB K. JAVITS FEDERAL BUILDING
NEW YORK, N.Y. 10278-0090

AUG 24 2009

REPLY TO
ATTENTION OF:
Regulatory Branch

SUBJECT: Permit Application Number 2009-00653-WRY
by New Jersey Department of Environmental Protection,
Office of Natural Resource Restoration

David Breen
New Jersey Department of Environmental Protection
Office of Natural Resource Restoration
501 East State Street, 3rd Floor
Trenton, NJ 08625

Dear Mr. Breen:

On May 12, 2009, the New York District of the U. S. Army Corps of Engineers received a request from the New Jersey Department of Environmental Protection, Office of Natural Resource Restoration for Department of Army authorization to perform aquatic habitat restoration, establishment, and enhancement activities in the Lincoln Park complex. In a letter dated May 22, 2009, this office received an additional request from the New Jersey Department of Environmental Protection for Department of Army authorization to perform the closure of the Lincoln Park West Sanitary Landfill. The site consists of approximately 40 acres and is located in the Hackensack River watershed at Lincoln Park West in Jersey City, Hudson County, New Jersey.

The subsequent submittals entitled "Lincoln Park Wetland Restoration, Jersey City, Hudson County, New Jersey", prepared by Louis Berger Group, Inc dated April 2009; "County of Hudson Landfill Disruption and Closure Plan, Lincoln Park West Landfill, Jersey City, New Jersey", prepared by Hatch Mott MacDonald dated December 2008; and the revised design report dated May 14, 2009 indicate that the proposed project consists of the restoration of tidal wetland hydrology through the excavation of tidal creeks, regrading of the project site, and the closure of the existing landfill. Specifically, the project is described as the restoration of 33.53 acres of tidal wetlands, open water and mudflats through the removal of 205,700 cubic yards of sediment and debris. A temporary water exclusion berm is proposed to be constructed prior to the initiation of wetland dredging. The proposed dredging will be accomplished via land reach excavator. Removed material associated with this restoration will be placed at the adjacent, existing landfill to aid in its closure. Clean fill in the amount of 74,000 cubic yards of sand, currently proposed to be from the Federal channel and Anchorage dredging projects, will be used to create the desired elevation in the restoration area. The upland construction of a temporary 7.05 acre confined disposal facility (CDF) has been proposed to accept the above referenced sand. The CDF will be constructed from clean fill and a weir structure will discharge into the adjacent pond. The permittee has proposed a temporary dredged material off-loading barge facility to be constructed directly adjacent to the landfill. The barge will connect to the CDF via a 2,400 foot pipeline. Approximately 300 cubic yards of sand will be delivered to the CDF over a period of eight to ten weeks. Approximately 2,439 feet of public access walkway will be constructed along the perimeter of the restored wetland. The Lincoln Park West Landfill will be closed in a manner consistent to facilitate the development of a future nine-hole golf course.

Based on the information submitted to this office, and accomplishment of notification in accordance with the applicable federal requirements, our review of the project indicates that an individual permit is not required. It appears that the activities within the jurisdiction of this office could be accomplished under Department of the Army Nationwide General Permit Number 27 and 38. The nationwide permits are prescribed as an Issuance of Nationwide Permits in the Federal Register dated March 12, 2007 (FR Vol. 72, No. 47). The work may be performed in accordance with the attached plans without further authorization from this office provided the activity complies with the permit conditions listed in Section B, No 27 and 38, Section C, any applicable New York District regional conditions, and any applicable regional conditions added by the State of New Jersey, copies enclosed.

This determination covers only the work described in the submitted material. Any major changes in the project may require additional authorizations from the New York District.

Care should be taken so that construction materials, including debris, do not enter any waterway to become drift or pollution hazards. You are to contact the appropriate state and local government officials to ensure that the subject work is performed in compliance with their requirements.

This verification is valid for a period of two years from the date of this letter, unless the nationwide permit is modified, reissued, or revoked. This verification will remain valid for two years from the date of this letter if the activity complies with the terms of any subsequent modifications of the nationwide permit authorization. If the nationwide permits are suspended, revoked, or modified in such a way that the activity would no longer comply with the terms and conditions of a nationwide permit, and the proposed activity has commenced, or is under contract to commence, the permittee shall have 12 months from the date of such action to complete the activity.

Within 30 days of the completion of the activity authorized by this permit and any mitigation required by this permit, you are to sign and submit the attached compliance certification form to this office.

If any questions should arise concerning this matter, please contact Stephan Ryba, of my staff, at (917) 790-8512.

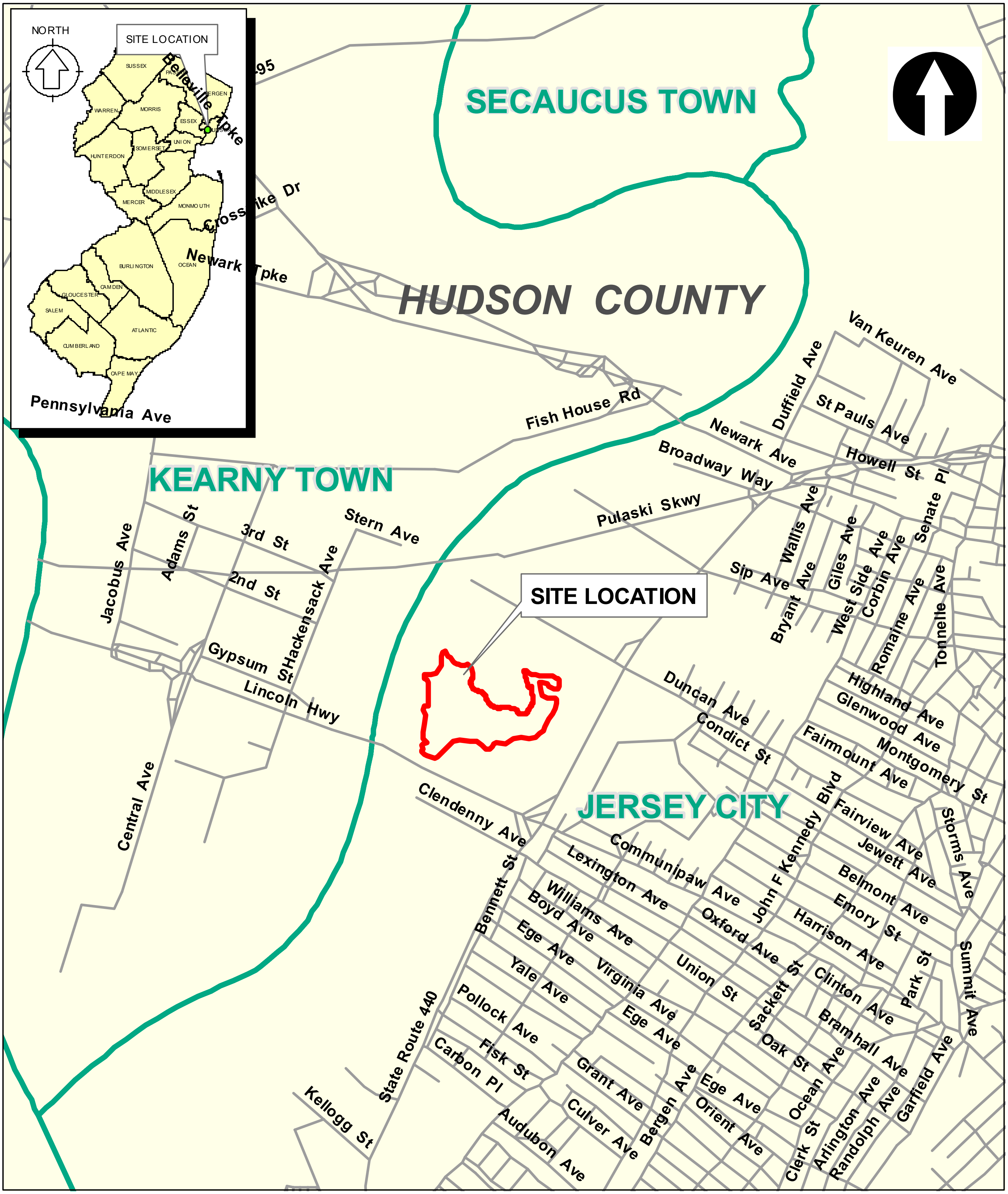
Sincerely,

Christopher S. Mallery

Christopher S. Mallery, PhD.
Chief, Western Permits Section

Enclosures
cf: Donald Stevens

APPENDIX E
Figures 1 – 20



Sources: NJDEP, USGS Tiger Line Files.

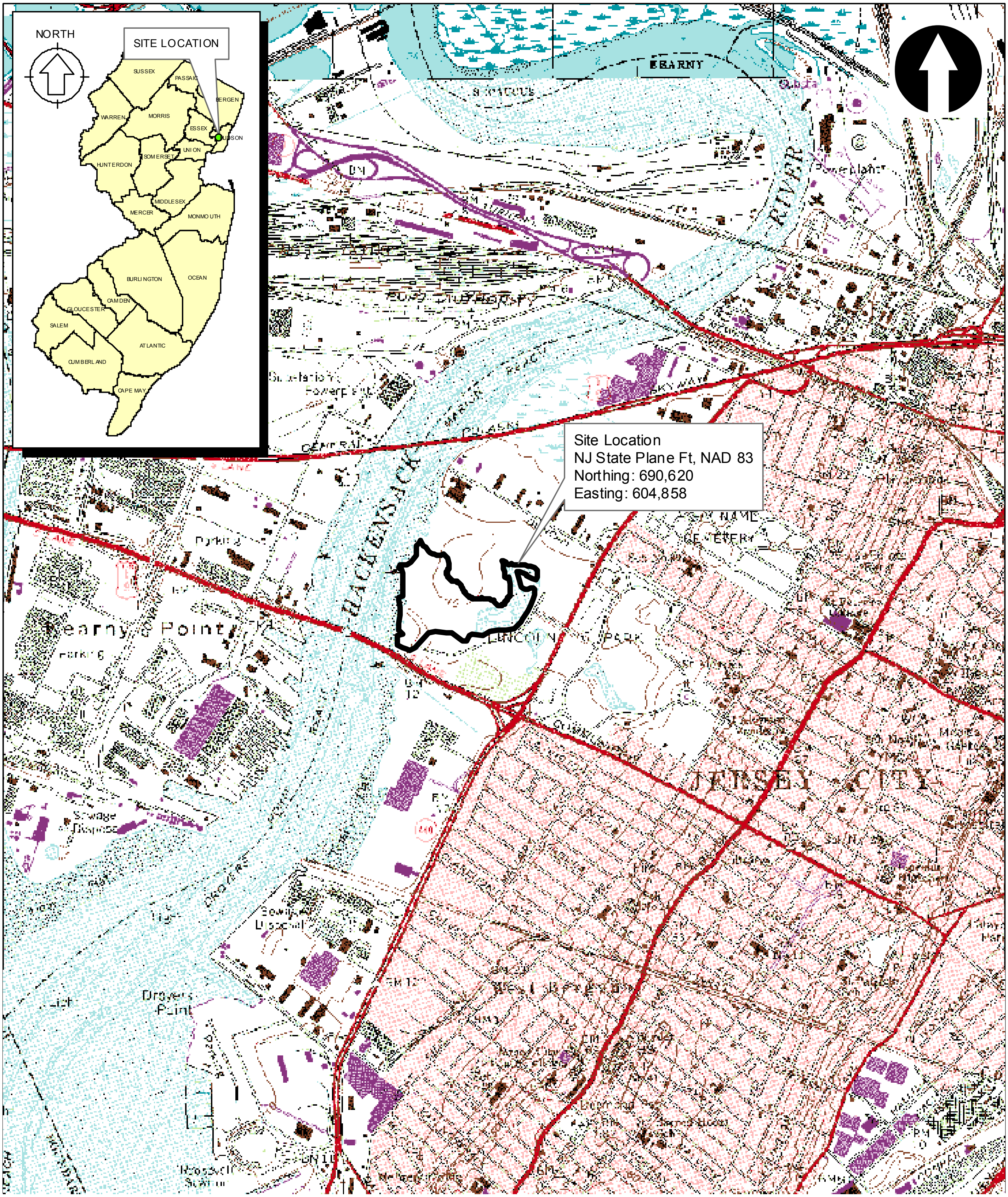
N.J. Department of Environmental Protection

Lincoln Park Wetland Restoration
Contract No. A-68677
Jersey City, Hudson County, NEW JERSEY

REGIONAL LOCATION

The Louis Berger Group, Inc.
412 Mount Kemble Ave
Morristown, NJ 07962

FIGURE 1



0 1,000 2,000
Feet

Source: Base Map - 7.5 Minute USGS Topographic Maps, Jersey City and Weehawken, NJ Quadrangles.

N.J. Department of Environmental Protection	Lincoln Park Wetland Restoration Contract No. A-68677 Jersey City, Hudson County, NEW JERSEY **SITE LOCATION MAP**	The Louis Berger Group, Inc. 412 Mount Kemble Ave Morristown, NJ 07962	Figure 2

500 250 0 500 1,000 Feet

LEGEND

Project Boundary

Source: USACE, 2002

N.J. Department of Environmental Protection

Lincoln Park Wetland Restoration
Contract No. A-68677
Jersey City, Hudson County, NEW JERSEY

AERIAL VIEW

The Louis Berger Group, Inc.
412 Mount Kemble Ave
Morristown, NJ 07962

Figure 3

500 250 0 500 1,000 Feet

LEGEND

Project Boundary

Contour Elevations

-6	0	5	10	15
-5	1	6	11	16
-4	2	7	12	17
-3	3	8	13	18
-2	4	9	14	19
-1				20

Source: USACE 2002.

N.J. Department
of Environmental
Protection

Lincoln Park Wetland Restoration
Contract No. A-68677
Jersey City, Hudson County, NEW JERSEY

EXISTING TOPOGRAPHY

The Louis Berger Group, Inc.
412 Mount Kemble Ave
Morristown, NJ 07962

Figure
4

Source: Base Map - NJ Office of Information Technology, 2007.
Soils Data - USDA, SCS, General Soils Map of Essex and Hudson Counties, 1994.

0 300 600 Feet

N.J. Department of Environmental Protection

Lincoln Park Wetland Restoration
Contract No. A-68677
Jersey City, Hudson County, NEW JERSEY

SOILS MAP

The Louis Berger Group, Inc.
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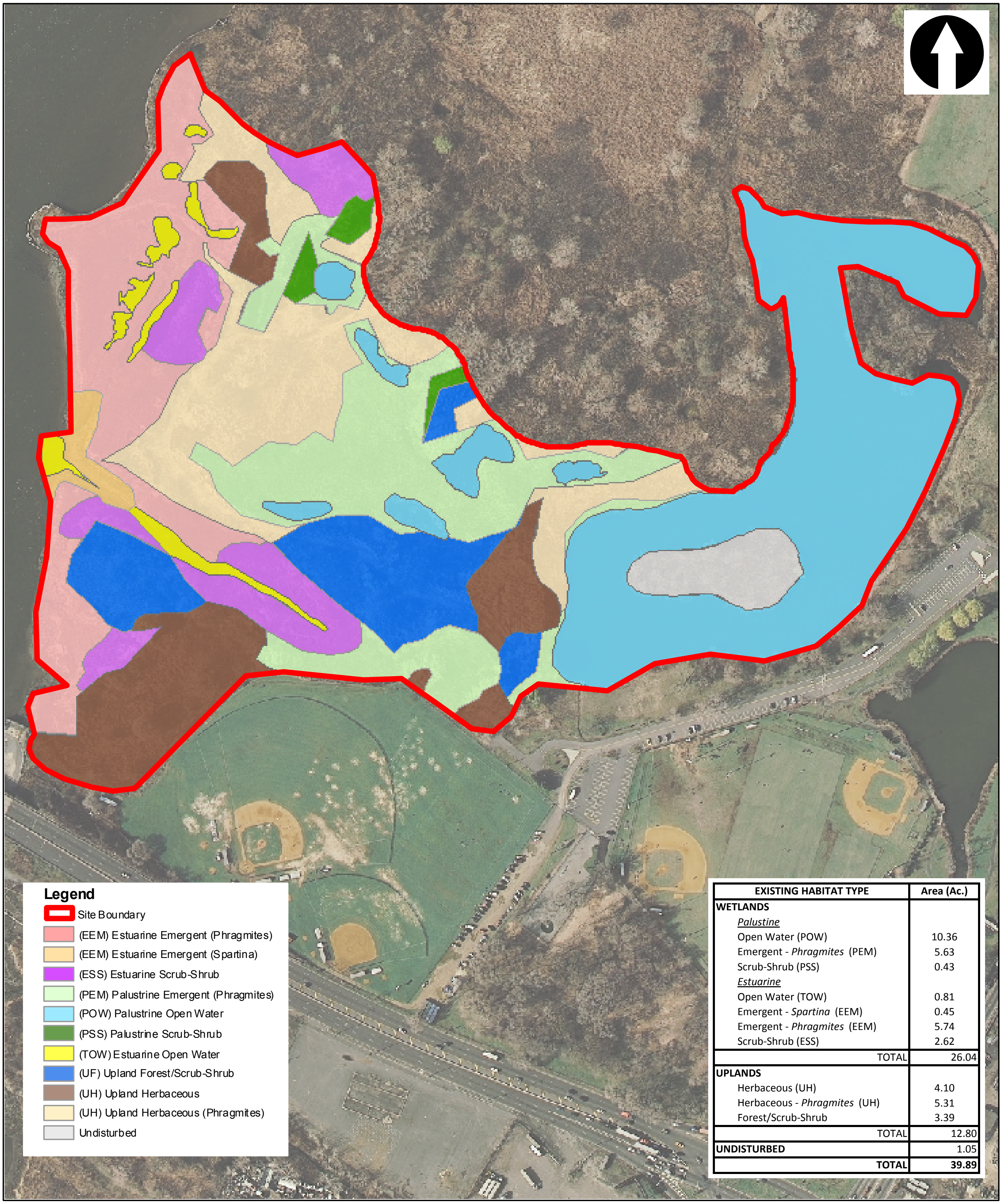
Figure 5



EXISTING HABITAT TYPE	Area (Ac.)
WETLANDS	
Palustine	
Open Water (POW)	10.36
Emergent - *Phragmites* (PEM)	5.63
Scrub-Shrub (PSS)	0.43
Estuarine	
Open Water (TOW)	0.81
Emergent - *Spartina* (EEM)	0.45
Emergent - *Phragmites* (EEM)	5.74
Scrub-Shrub (ESS)	2.62
TOTAL	26.04
UPLANDS	
Herbaceous (UH)	4.10
Herbaceous - *Phragmites* (UH)	5.31
Forest/Scrub-Shrub	3.39
TOTAL	12.80
UNDISTURBED	1.05
TOTAL	**39.89**

Source: Base Map - NJ Office of Information Technology, 2007.
Habitat Types - Berger, 2009.

N.J. Department of Environmental Protection

Lincoln Park Wetland Restoration
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EXISTING HABITAT TYPES

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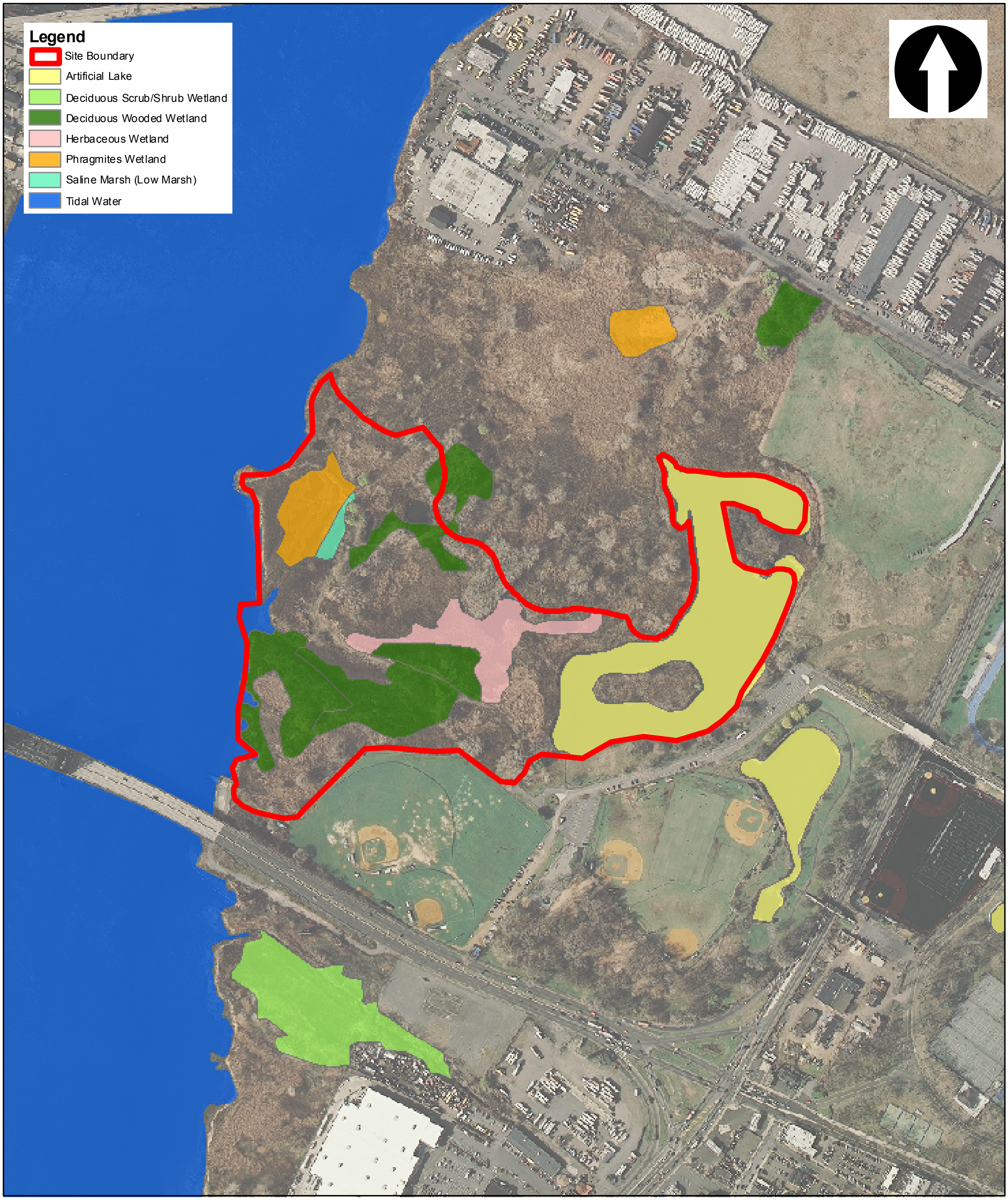
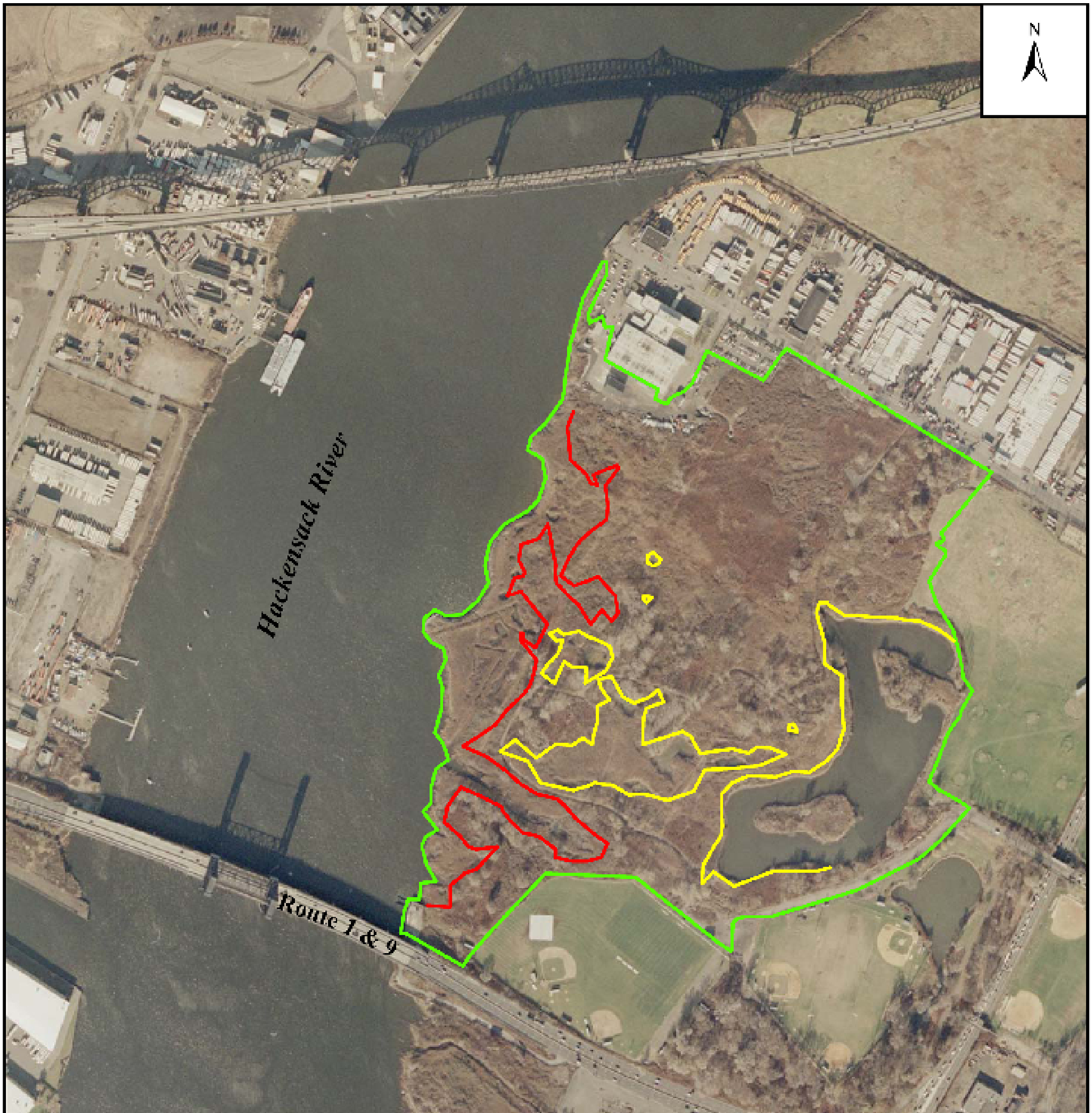
Figure 6



Source: Base Map - NJ Office of Information Technology, 2007.
Wetlands - NJDEP Landuse/Landcover Data, 2002.

0 350 700 Feet

N.J. Department of Environmental Protection	Lincoln Park Wetland Restoration Contract No. A-68677 Jersey City, Hudson County, NEW JERSEY **NJDEP WETLANDS MAP**	The Louis Berger Group, Inc. 412 Mount Kemble Ave Morristown, NJ 07962	Figure 7



500 250 0 500 1,000 Feet

LEGEND

Project Boundary

Wetland Types

Estuarine

Palustrine

Source: USACE, 2002b.

c on Gollum: m:/projects/l-park/apps/2004-eae-nov07.apr

N.J. Department of Environmental Protection

Lincoln Park Wetland Restoration
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Jersey City, Hudson County, NEW JERSEY

Estuarine and Palustrine Wetlands

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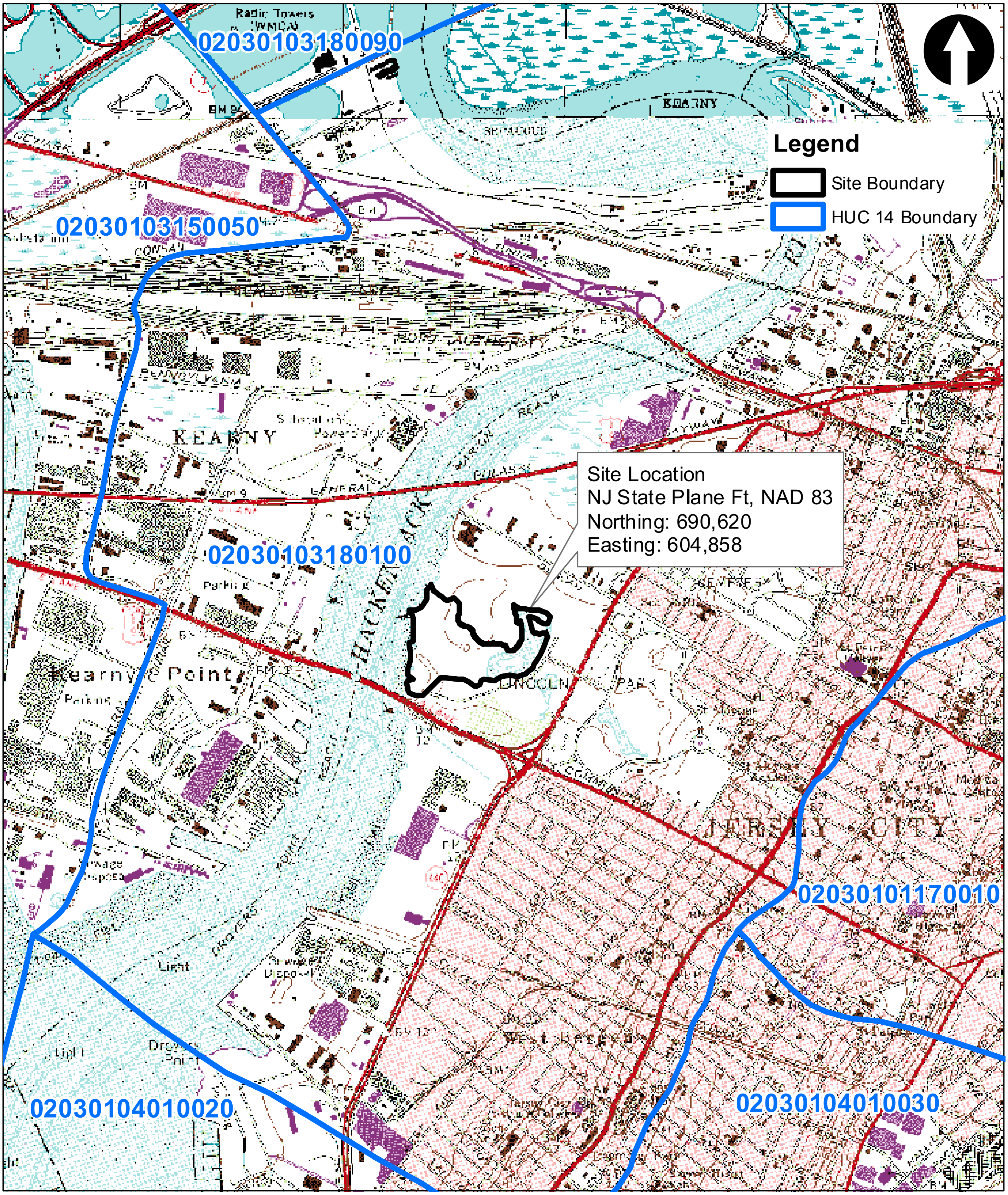
Figure 8



Source:
Base Map - 7.5 Minute USGS Topographic Maps, Jersey City and Weehawken, NJ Quadrangles.
NJDEP HUC-14.

0 1,000 2,000
Feet

N.J. Department of Environmental Protection	Lincoln Park Wetland Restoration Contract No. A-68677 Jersey City, Hudson County, NEW JERSEY **HUC-14 Watersheds**	The Louis Berger Group, Inc. 412 Mount Kemble Ave Morristown, NJ 07962	Figure 9

500 250 0 500 1,000 Feet

LEGEND

Project Boundary

Tide Gage Locations

Source: USACE, 2002.

e on Collum:/projects/l-park/aprs/2004/waterrev07.apr

N.J. Department of Environmental Protection

Lincoln Park Wetland Restoration
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Jersey City, Hudson County, NEW JERSEY

Tide Gage Locations

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Figure 10

Source: Base Map - NJ Office of Information Technology, 2007.
FEMA - Federal Emergency Management Agency, Q3 Flood Data, 1996.

0 350 700 Feet

N.J. Department of Environmental Protection

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Jersey City, Hudson County, NEW JERSEY

TIDAL FLOOD HAZARD AREAS

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Figure 11

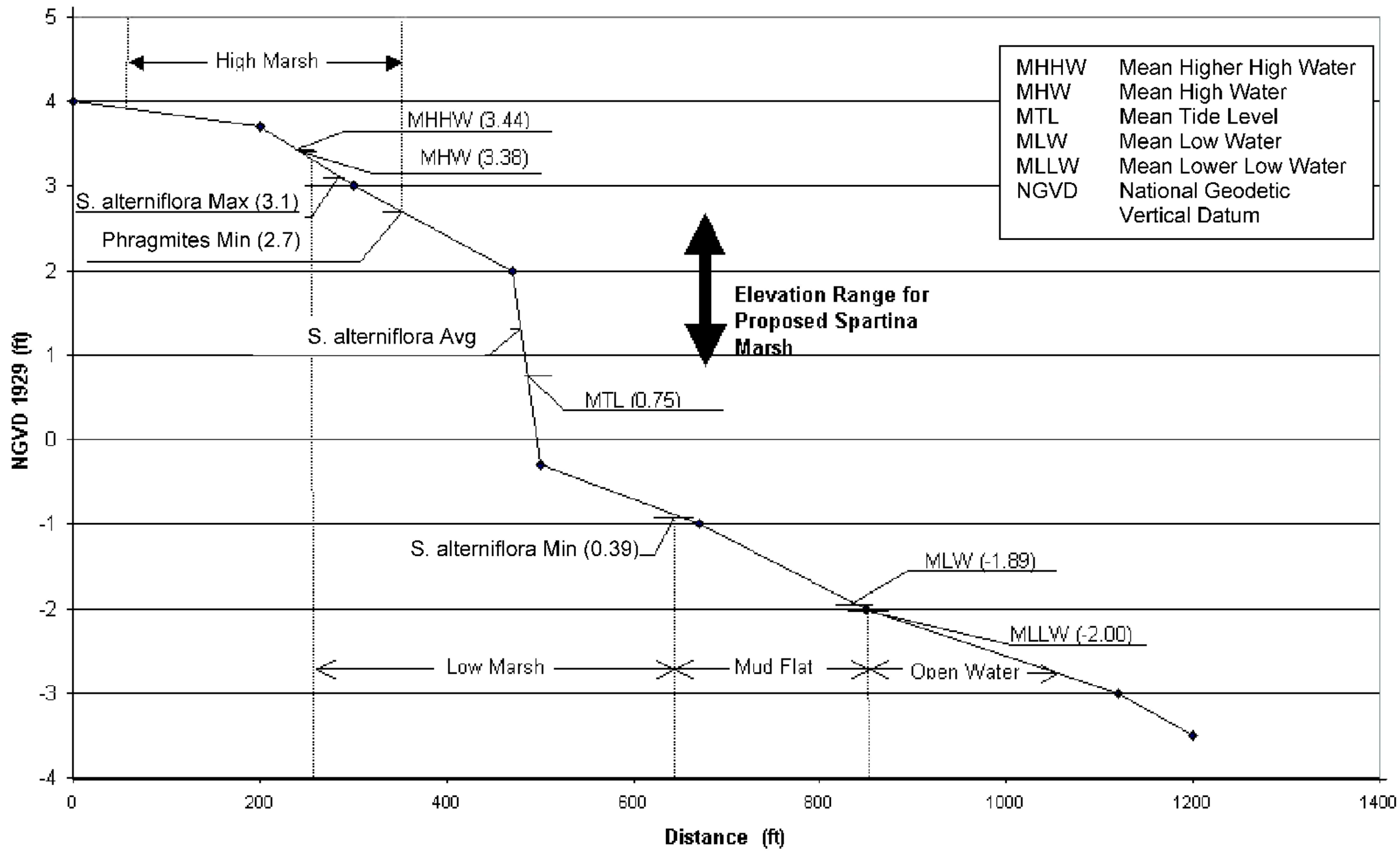
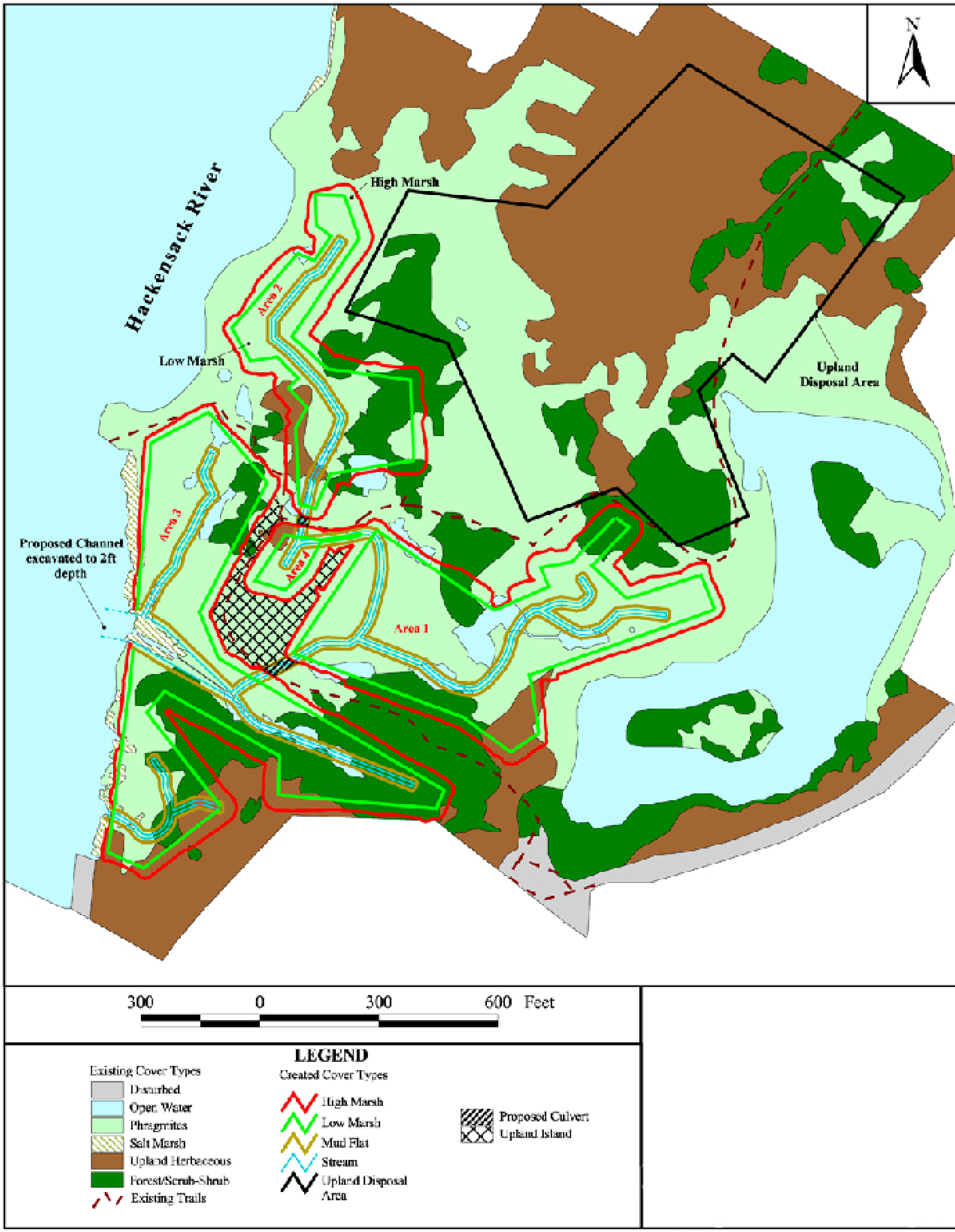


Figure 7. Elevation Range for Vegetative Communities Compared to Tidal Range for the Lincoln Park West Section 1135 Project, Jersey City, New Jersey.

N.J. Department of Environmental Protection	Lincoln Park Wetland Restoration Contract No. A-68677 Jersey City, Hudson County, NEW JERSEY **Elevation Range for Vegetative Communities Compared to Tidal Range**	The Louis Berger Group, Inc. 412 Mount Kemble Ave Morristown, NJ 07962	Figure 12



N.J. Department of Environmental Protection

Lincoln Park Wetland Restoration
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Conceptual Design for Restoration Alternative 1.1

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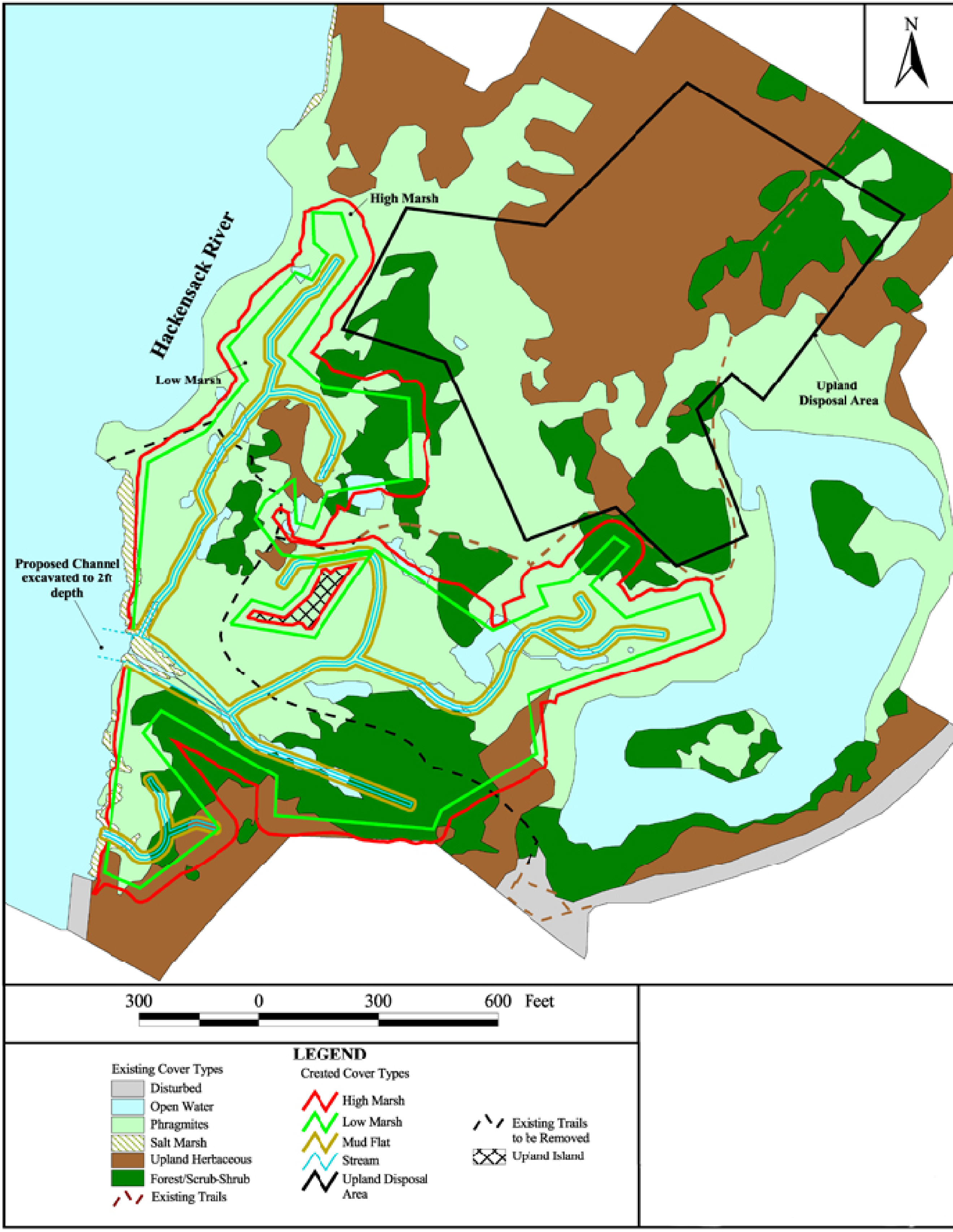
Figure 13



e on Gollum:/projects/l-park/aprs/2304/eaerrev04.apr

N.J. Department of Environmental Protection

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Conceptual Design for Restoration Alternative 1.2

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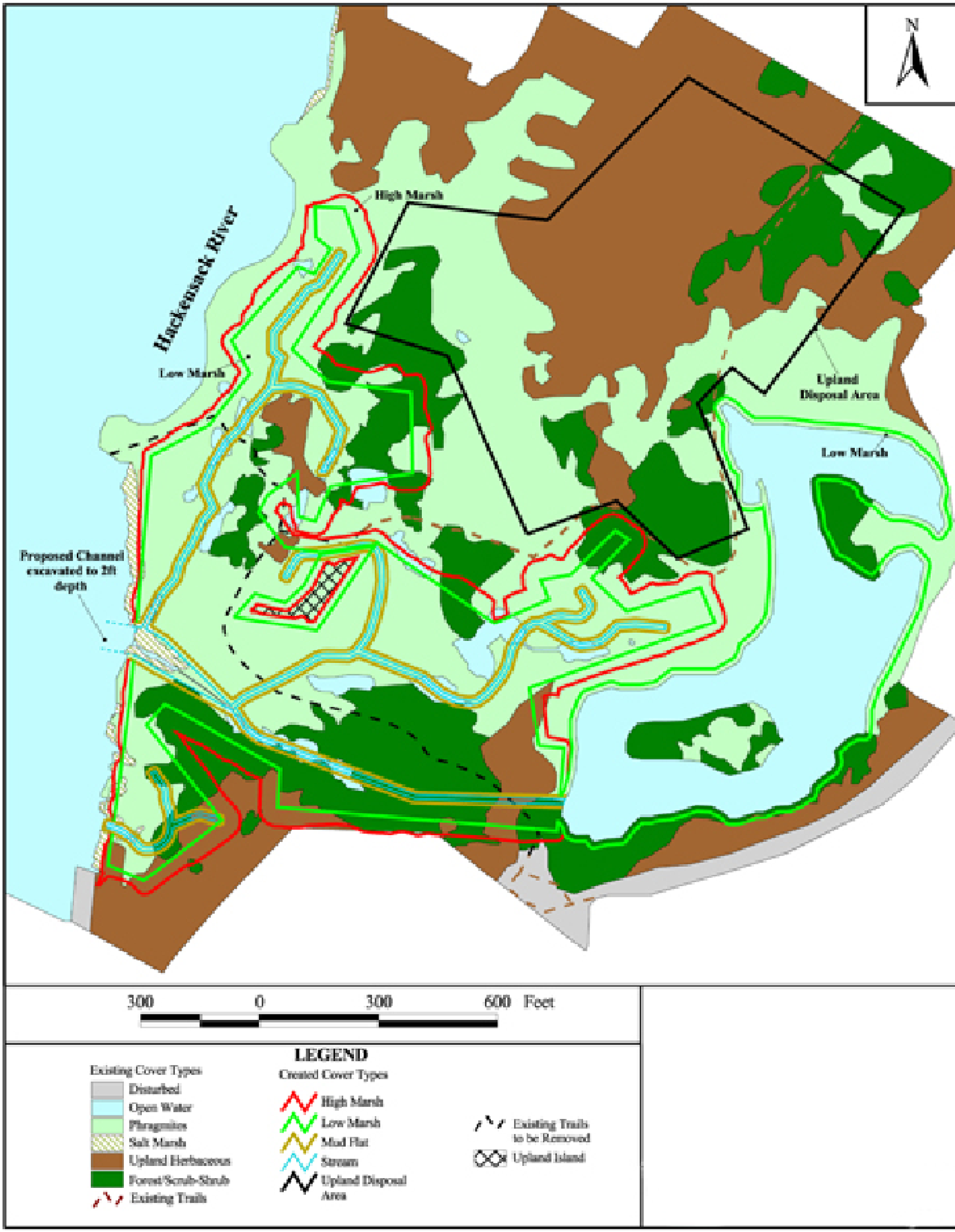
Figure 14



N.J. Department of Environmental Protection

Lincoln Park Wetland Restoration
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Jersey City, Hudson County, NEW JERSEY

Conceptual Design for Restoration Alternative 2.1

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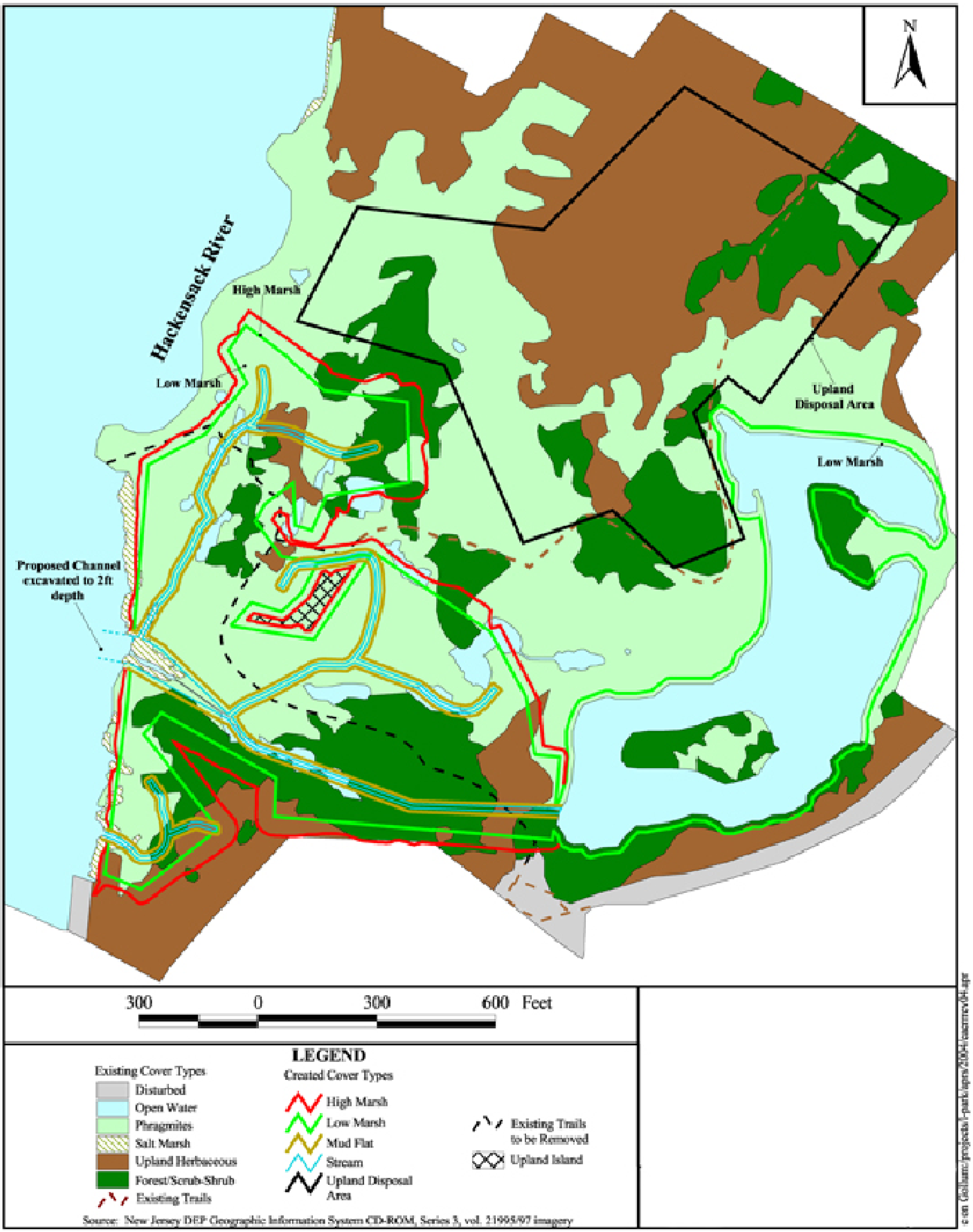
Figure 15



N.J. Department of Environmental Protection

Lincoln Park Wetland Restoration
Contract No. A-68677
Jersey City, Hudson County, NEW JERSEY

Conceptual Design for Restoration Alternative 2.2

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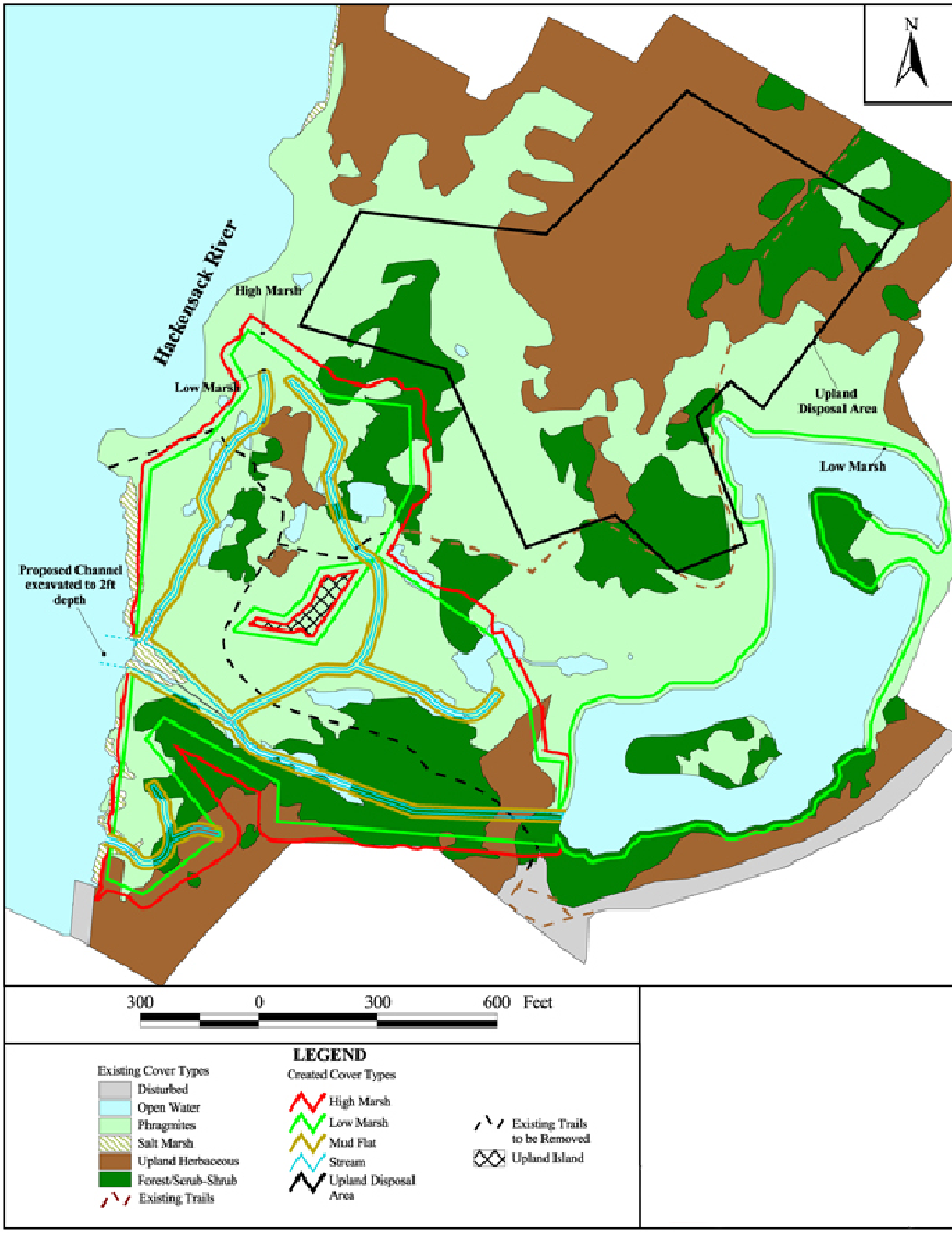
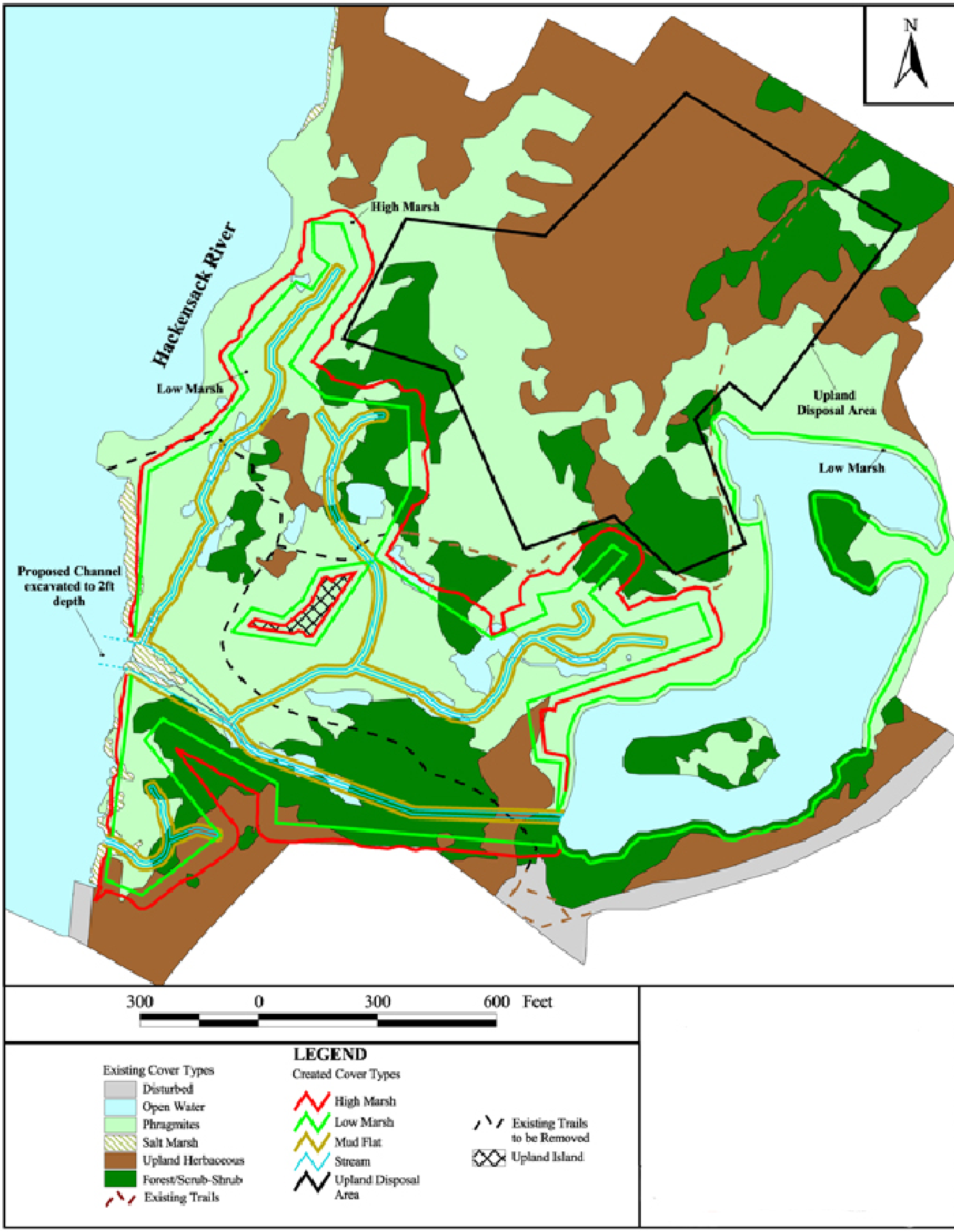
Figure 16



N.J. Department of Environmental Protection	Lincoln Park Wetland Restoration Contract No. A-68677 Jersey City, Hudson County, NEW JERSEY **Conceptual Design for Restoration Alternative 2.3**	The Louis Berger Group, Inc. 412 Mount Kemble Ave Morristown, NJ 07962	Figure 17



N.J. Department of Environmental Protection

Lincoln Park Wetland Restoration
Contract No. A-68677
Jersey City, Hudson County, NEW JERSEY

Conceptual Design for Restoration Alternative 2.4

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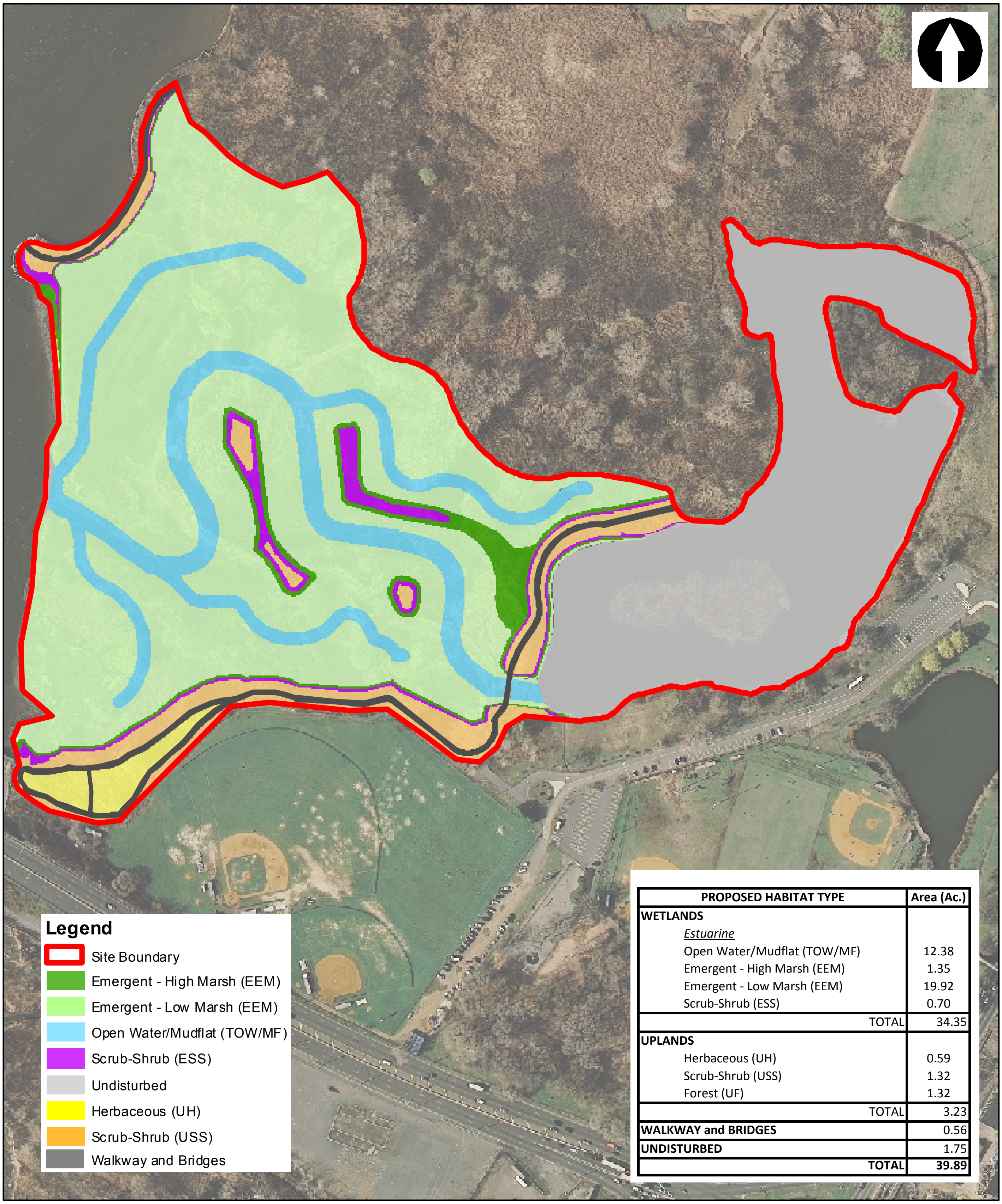
Figure 18



PROPOSED HABITAT TYPE	Area (Ac.)
WETLANDS	
Estuarine	
Open Water/Mudflat (TOW/MF)	12.38
Emergent - High Marsh (EEM)	1.35
Emergent - Low Marsh (EEM)	19.92
Scrub-Shrub (ESS)	0.70
TOTAL	34.35
UPLANDS	
Herbaceous (UH)	0.59
Scrub-Shrub (USS)	1.32
Forest (UF)	1.32
TOTAL	3.23
WALKWAY and BRIDGES	0.56
UNDISTURBED	1.75
TOTAL	**39.89**

Source: Base Map - NJ Office of Information Technology, 2007.
Habitat Types - Berger, 2009.

0 150 300 Feet

N.J. Department of Environmental Protection

Lincoln Park Wetland Restoration
Contract No. A-68677
Jersey City, Hudson County, NEW JERSEY
Alternative 2.5:
Preferred Alternative Design

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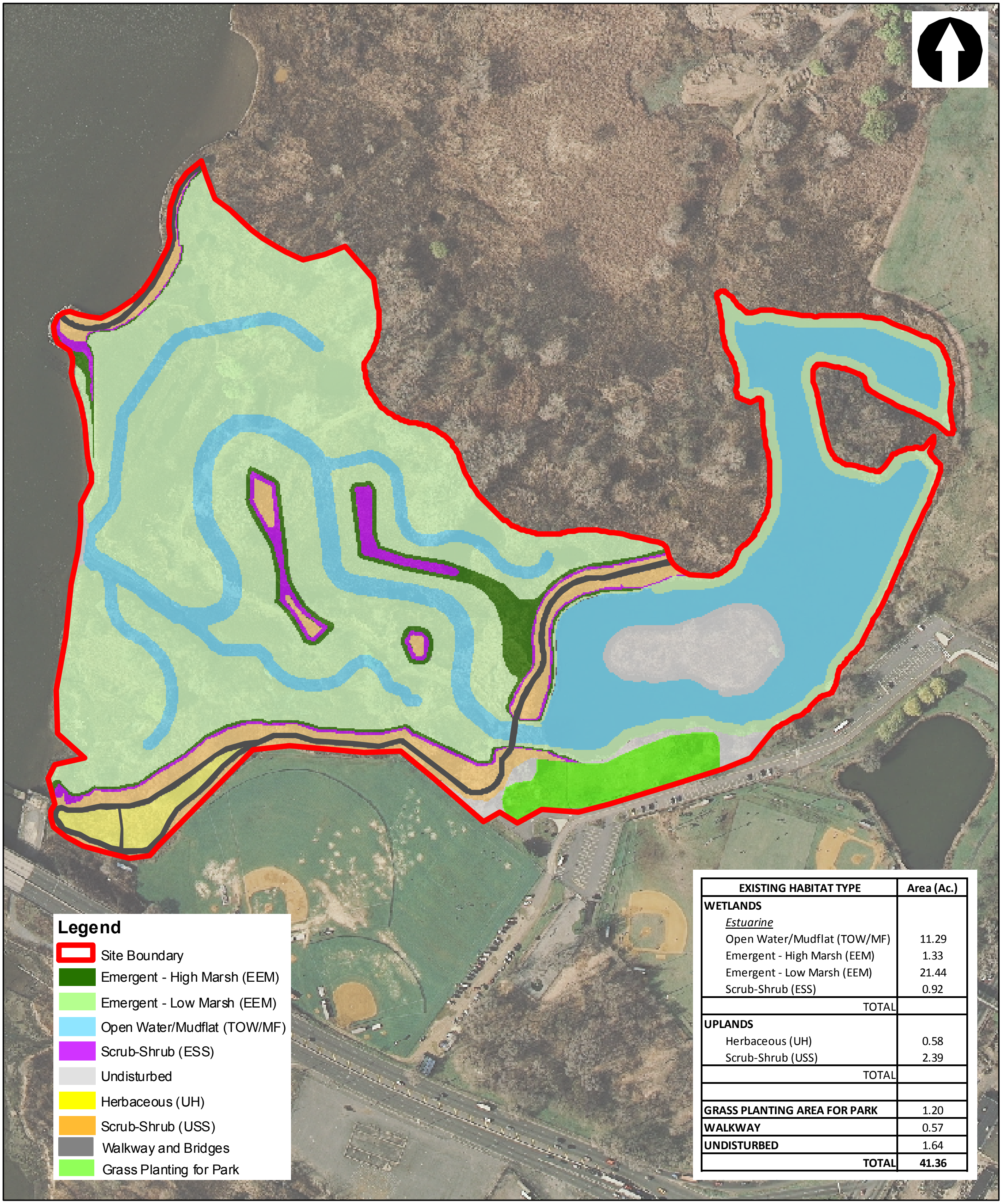
Figure 19



EXISTING HABITAT TYPE	Area (Ac.)
WETLANDS	
Estuarine	
Open Water/Mudflat (TOW/MF)	11.29
Emergent - High Marsh (EEM)	1.33
Emergent - Low Marsh (EEM)	21.44
Scrub-Shrub (ESS)	0.92
TOTAL	
UPLANDS	
Herbaceous (UH)	0.58
Scrub-Shrub (USS)	2.39
TOTAL	
GRASS PLANTING AREA FOR PARK	1.20
WALKWAY	0.57
UNDISTURBED	1.64
TOTAL	**41.36**

Source: Base Map - NJ Office of Information Technology, 2007.
Habitat Types - Berger, 2009.

N.J. Department of Environmental Protection

Lincoln Park Wetland Restoration
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Jersey City, Hudson County, NEW JERSEY

Alternative 2.5.1:
Preferred Alternative Design with Pond Option

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Figure 20