A. INTRODUCTION

The proposed development of Fresh Kills Park (see Figure 10-1) is a long-term project that would provide a variety of cultural, athletic, and educational facilities, and extensive ecological benefits through reclaimed wetlands, grasslands, and new woodlands that would offer both wildlife habitat and natural open spaces for park visitors. The proposed park development will allow for various transport modes, including proposed park roads and roads, footpaths, and bicycle and equestrian paths.

This chapter assesses the potential impacts of the proposed project with respect to terrestrial and aquatic natural resources[1] and floodplains. The purpose of this chapter is to:

- Present the regulatory programs that protect floodplains, wildlife, threatened or endangered species, aquatic resources, or other natural resources within the study area for the Fresh Kills Park plan;
- Describe existing geology and soils, groundwater, floodplain and wetland resources;
- Describe existing water and sediment quality within the study area;
- Describe existing terrestrial and aquatic biota, and threatened or endangered species and species of special concern;
- Assess future conditions for each of these natural resources features through the 2016 and 2036 analysis years;
- Assess the potential effects of the proposed project on water and sediment quality within the study area, as described in the reasonable worst-case development scenario (RWCDS) for the 2016 and 2036 analysis years;
- Assess the potential effects of the proposed project, as described in the RWCDS, on the aquatic and terrestrial biota within the study area for the 2016 and 2036 analysis years; and
- Present measures, as necessary, that mitigate and/or reduce any identified potential significant adverse effects to water quality and natural resources.

The project site is located at the Fresh Kills Landfill Complex ("Fresh Kills Landfill") on the Arthur Kill waterfront of Staten Island and extending inland along the tributary waterways of Great Fresh Kill, Main Creek, and Richmond Creek (see Figure 10-1). Much of the project site is a highly engineered complex of man-made infrastructure and artificial landscapes (see Figure 10-2). The disturbance to natural ecosystems caused by 50-plus years of municipal solid waste

[1] Natural resources are defined as "Plant and animal species and any area capable of providing habitat for plant and animal species or capable of functioning to support ecological systems and maintain the city's environmental balance." (*New York City Environmental Quality Review (CEQR) Manual*, City of New York, 2001).

landfilling has been significant. However, Fresh Kills retains many ecological features, including areas within North Park connected with the William T. Davis Wildlife Refuge and areas within South Park connected with LaTourette Park (see Figure 10-3). These natural areas include hundreds of acres of salt marsh (an estimated 360 acres of designated tidal wetlands), a significant network of tidal creeks (210 acres of open water), and upland areas with young and maturing woodlands and native and non-native grasslands. The creeks and wetlands within Fresh Kills Landfill include Fresh Kills, at the center of the project site; Richmond Creek, a tributary to the south; and Main Creek, a tributary to the north. The project site's proximity to the Staten Island Greenbelt and William T. Davis Wildlife Refuge suggests that that fauna and flora present in these natural areas would have the opportunity to frequent or colonize the Fresh Kills Park project site. These adjacent areas also create significant opportunities for open space linkages. For these reasons, the creeks and wetland habitats of Fresh Kills have been designated a Significant Coastal Fish and Wildlife Habitat by New York State Department of State ([NYSDOS] 2007).

Provided below is an assessment of the potential impacts of the proposed project with respect to natural resources. It begins with the methodologies employed in the investigation, the resulting context for the site (i.e., existing regulatory jurisdiction) and the assessment of impacts, and provides the baseline (existing) conditions, the future without the proposed project (2016 and 2036), and the future with the proposed project (2016 and 2036).

B. METHODOLOGY

This section presents the methodologies used to describe natural resources within the study area for the Fresh Kills Park plan under existing and future conditions, and to assess potential impacts to these resources from the proposed project. It follows the Natural Resources Field Survey Plan (May 2007) and subsequent Fall 2007 Addendum (September) the Natural Resources Technical Memorandum (January 22, 2007), which were developed in conjunction with City and State agencies for the purposes of supplementing the Final Scope of Work (August 2006) with respect to the natural resources investigations that were undertaken for this Generic Environmental Impact Statement (GEIS) as well as wetland delineations performed in September and December 2007.

For the purposes of this analysis, two study areas were defined: a primary study area, which is the project site and is the study area for direct impacts; and a secondary study area, which encompasses the large parcels surrounding the project site and is the area of potential secondary (or indirect) impacts. The primary study area for the terrestrial resources assessment included the habitats within the Fresh Kills Park project site (see Figure 10-3). The secondary study area included habitats located adjacent to the Fresh Kills Park project site (up to a distance of ½ mile from the primary study area boundary). Adjacent areas that comprise the secondary study area include park lands and other open space or natural areas such as (but not limited to) South Shore Golf Course, Arden Heights Woods Park, LaTourette Park, Willowbrook Park, and the existing William T. Davis Wildlife Refuge to the north of the project site. Potential impacts to threatened or endangered species were evaluated for a distance of approximately ½ mile from the Fresh Kills Park project site. The study area for water quality and aquatic resources included the overall aquatic resources within the Arthur Kill, and the water quality and aquatic resources within Fresh Kills, Richmond Creek, and Main Creek, up to and including the headwaters within the William T. Davis Wildlife Refuge.

The analysis of potential impacts on natural resources from the proposed project considered the potential effects of the park elements for the two proposed analysis years, 2016 and 2036 (see Chapter 1, "Project Description).

EXISTING CONDITIONS (METHODOLOGY)

Existing conditions for geology, soils, groundwater, floodplains, wetlands, water quality, aquatic biota, and terrestrial biota within the study area were summarized from the information sources described below.

- Investigations performed by SCS Engineers and summarized in *Preliminary Fresh Kills Landfill Conceptual Design Report, Subtask 3.2, Mapping and Assessment of Natural Areas* (April 1990).
- Investigations performed by Applied Ecological Services, Inc. (AES) and summarized in selected chapters of Field Operations' *Fresh Kills End Use Master Plan,* including 2.1.7 Soil Boring Analysis and Soils Plan, Soils and Ecological Condition of Waste Deposit Areas at Fresh Kills Landfill (AES 2007) and 2.1.8 Ecological Survey, Ecological Conditions of Natural Areas at Fresh Kills Landfill (AES 2003).
- Investigations performed by AES and summarized in the Draft Vegetative Assessment of North Park Area Including North Mound and Off-Mound (AES 2007).
- Freshwater wetlands investigation and delineation performed by Geosyntec Consultants in September 2007 for the North and East parks, and December 2007 along the West Shore Expressway service ramp corridor for the purposes of determining any potential wetland impacts from the proposed construction of the northbound service road. Delineations were performed in these areas based on the United States Army Corps of Engineers (USACE) three-parameter approach methodology.
- The Fresh Kills Park Stormwater Management Plan prepared by Geosyntec (February 2008).
- Data collected by AKRF during May and October 2007 field observations, which were conducted to characterize existing terrestrial and aquatic resources within the primary and secondary study areas. Information obtained during these recent field observations included geographic location of habitats in the primary and secondary study areas, weather conditions, wetland/upland classification, vegetative composition, herbaceous and canopy cover, plot size, number and size of trees observed, hydrology, wildlife observed, level of disturbance, unvegetated surface area, surrounding/adjacent land use, and other applicable parameters. Appendix C contains the detailed Natural Resources Field Survey Plan, which describes the methods used to perform the field observations, a map of the project site indicating the sampling locations, and data sheets prepared for each sampling location.
- Existing information identified in the literature and obtained from governmental and non-governmental agencies such as: New York City Department of Environmental Protection (NYCDEP); the 1993 New York City Department of Sanitation (DSNY) Final Surface Water and Sediment Report prepared as part of the Fresh Kills Leachate Mitigation System Project in compliance with the Consent Order (IT Corporation 1993), 1996 Fresh Kills Landfill Draft EIS (DEIS) prepared by DSNY, results of field observations performed in May 2006 as part of the Owl Hollow Environmental Assessment Statement EAS prepared by the New York City Department of Parks and Recreation (DPR) (2007), results of surface water, sediment, and benthic invertebrate sampling conducted by DSNY as part of the Fresh Kills Environmental Monitoring Plan (Shaw 2005 and 2007), New York City Audubon

Society; NY State Ornithological Association (NYSOA) annual January waterfowl count, New York State Department of Environmental Conservation (DEC) Bird Conservation Area Program, the Breeding Bird Atlas Project, and Coastal Fish and Wildlife Habitat Rating Forms, New York State Amphibian and Reptile Atlas Project, and tidal wetlands and freshwater wetlands maps; United States Environmental Protection Agency (USEPA); New York/New Jersey Harbor Estuary Program (HEP); USEPA Regional Environmental Monitoring and Assessment Program (R-EMAP); US Fish and Wildlife Service (USFWS) Waterfowl Surveys and National Wetland Inventory (NWI) maps, Federal Emergency Management Agency (FEMA); and Interstate Environmental Commission (IEC) and USACE studies conducted as part of the New York and New Jersey Harbor Navigation Project and the Hudson-Raritan Estuary Environmental Restoration Feasibility Study (Arthur Kill/Kill Van Kull Study Area).

- Responses to requests for information on rare, threatened or endangered species, or critical habitats in the vicinity of the project area were submitted to the U.S. Fish and Wildlife Service (USFWS)—New York Field Office, National Marine Fisheries Service (NMFS), and New York Natural Heritage Program (NYNHP).

CONDITIONS IN THE FUTURE WITHOUT THE PROPOSED PROJECT (METHODOLOGY)

The methodology for developing conditions in the future without the proposed project for geology and soils, groundwater, floodplains and natural resources considered the potential effects from in-water and upland activities that may occur within and outside the study area independently of the proposed project. The assessment considered ongoing and proposed projects in the vicinity of the Fresh Kills Park project site such as:

- Ongoing Fresh Kills closure construction, maintenance, and monitoring operations;
- Continued operation of the DSNY Staten Island Solid Waste Transfer Station;
- Water quality and sediment quality improvements expected to occur as a result of regional programs and the completed closure construction of Landfill Sections 6/7 and 1/9;
- Landscape enhancement or restoration activities associated with HEP, or Hudson-Raritan Estuary Ecosystem Restoration Project (HRE); and
- Proposed projects or plans expected to be completed by the two analysis years.

The assessment also considered the results of the hydrodynamic modeling study conducted for the proposed project.

ASSESSMENT OF IMPACTS FROM THE PROPOSED PROJECT METHODOLOGY

WATER AND SEDIMENT QUALITY

Potential impacts to water and sediment quality from the construction and operation of the Fresh Kills Park plan were assessed using an approach that considered the following:

- Existing water and sediment quality within the study area;
- Hydrodynamic characteristics of the surface waters within the study area;
- Results of the hydrodynamic modeling study being conducted for the proposed project;

- Temporary impacts to water quality during construction of in-water components with the potential to result in temporary increases in suspended sediment and release of contaminants during sediment disturbance such as piling installation associated with docks and overwater walkways, boat launch areas, and small boat marina; repair of existing shoreline stabilization features, debris removal, sediment removal and shoreline grading required as part of wetland enhancement/creation activities; and the discharge of sediment and stormwater during construction of upland elements; and
- Potential long-term impacts to water and sediment quality resulting from the operation of the proposed project, including potential effects associated with stormwater discharge from the Fresh Kills site and potential impacts to stormwater quality resulting from vegetation management activities (i.e., application of herbicides, pesticides, and fertilizers following DPR's Integrated Pest Management (IPM) strategy), as well as beneficial effects to surface water and sediment quality resulting from the proposed project such as wetland restoration and enhancement.

GEOLOGY AND SOILS, GROUNDWATER, FLOODPLAINS, WETLANDS, AND AQUATIC AND TERRESTRIAL BIOTA

Potential impacts to floodplains, wetlands, and aquatic and terrestrial biota from the construction and operation of the Fresh Kills Park plan were assessed using an approach that considered the following:

- Temporary impacts to water quality and aquatic organisms during construction of in-water components (i.e., piles, boat launch ramps, debris removal, repair of shoreline stabilization features, boat launches, etc.) evaluated in the water quality assessment, and possible dredging. In-water construction of these project elements has the potential to result in the following:
  - temporary increases in suspended sediment and release of contaminants during sediment disturbance—potential risks to aquatic biota from the resuspension of bottom sediments during construction and operation will be qualitatively assessed on the basis of the existing sediment conditions, using the DEC guidelines discussed previously; and
  - temporary loss of fish breeding or nursery habitat, or Essential Fish Habitat (EFH) identified by the NMFS from temporary water quality changes and impacts associated with pile driving and dredging;
- Temporary impacts to aquatic resources from the discharge of stormwater during construction of the upland components of the proposed project;
- Temporary impacts to geology and soils, groundwater, floodplains, and terrestrial natural resources associated with land clearing, grading and other upland activities associated with construction of the proposed project;
- Long-term impacts to aquatic biota due to permanent loss of habitat for benthic macroinvertebrates and fish from construction of in-water components such as piles and boat ramps;
- Long-term impacts to geology and soils, groundwater, floodplains, and terrestrial natural resources associated with permanent loss or modification of habitat associated with construction of project elements such as roads and access ramps, and recreational facilities (e.g., playing fields and indoor facilities);

- Long-term beneficial impacts to aquatic biota resulting from tidal wetland restoration and enhancement measures;
- Long-term impacts to fish and benthic macroinvertebrate habitat as a result of shading from new over water structures such as bridges, walkways, boat docks and overlooks;
- Long-term impacts to water quality and aquatic biota resulting from the operation of a ferry service, small boat marina, and increased recreational boat activity such as bottom disturbance and shoreline erosion;
- Long-term impacts to water quality and aquatic biota resulting from stormwater discharges during operation of the proposed project;
- Long-term beneficial impacts to plants and wildlife from the proposed creation/enhancement of woodland, meadow, grassland and wetland landscapes within the Fresh Kills site;
- Long-term impacts to wildlife, including the harbor herons, grassland birds, and insects, associated with:
  - increased human activity such as recreational boat traffic,
  - recreational fishing,
  - passive and active recreational users of the park elements and trails,
  - development of energy/infrastructure elements (i.e., wind turbines),
  - nighttime lighting,
  - mosquito control measures such as Open Marsh Water Management (OMWM) implemented with the high marsh landscapes created as part of the proposed project,
  - DPR's IPM strategies for turf and landscape management and for mosquito control,
  - other park management measures that may be implemented when needed such as nuisance species control; and
- Results of empirical studies conducted within or near the project area, or relevant studies performed in other geographic areas that relate to the proposed project such as in-water construction activities, stormwater discharge, operation of a ferry service or marina, recreational boating, solar or wind generation of power, and nighttime exterior lighting within parks taking into consideration guidance on exterior lighting developed by the New York City Department of Design and Construction, and the Illuminating Engineering Society of North America (IESNA).

REGULATORY CONTEXT

Activities proposed in tidal and freshwater wetlands and in-water activities, and activities within the New York State Coastal Zone require compliance with relevant federal and state laws and regulations, a summary of which is provided below.

FEDERAL LAWS AND REGULATIONS

Clean Water Act (33 USC §§ 1251 to 1387)

The objective of the Clean Water Act (CWA), also known as the Federal Water Pollution Control Act, is to enhance and maintain the chemical, physical, and biological integrity of U.S. waters. It regulates point sources of water pollution such as discharges of municipal sewage and industrial wastewater, the discharge of dredged or fill material into navigable waters and other

waters of the United States, and non-point source pollution such as runoff from streets, agricultural fields, and construction sites.

Under Section 401 of the Act, any applicant for a federal permit or license for an activity that may result in a discharge to navigable waters must provide a certificate to the relevant federal agency stating that the discharge would comply with Sections 301, 302, 303, 306, 307, and 316 (b) of the CWA. Applicants for discharges to navigable waters in New York must obtain a Water Quality Certificate from DEC.

Section 404 of the Act requires authorization from the Secretary of the Army, acting through USACE for the permanent or temporary discharge of dredged or fill material into navigable waters and other waters of the United States. The term "waters of the United States," as defined in 33 Code of Federal Regulations (CFR) 328.3, includes streams, rivers, wetlands, mudflats, and sandflats that meet the specified requirements. Activities authorized under Section 404 must also comply with Section 401 of the Act.

Rivers and Harbors Act of 1899

Section 10 of the Rivers and Harbors Act of 1899 requires authorization from the Secretary of the Army, acting through USACE, for the construction of any structure in or over any navigable waters of the United States, the excavation from or deposition of material into these waters, or the introduction of any obstruction or alteration into these waters. Any structures placed in navigable waters such as pilings, piers, or bridge abutments up to the mean high water line would be regulated pursuant to this Act.

Coastal Zone Management Act of 1972 (16 USC §§ 1451 to 1465)

The Coastal Zone Management Act of 1972 established a voluntary participation program to encourage coastal states to develop programs to manage development within the state's designated coastal areas to reduce conflicts between coastal development and protection of resources within the coastal area. Federal permits issued in New York State must be accompanied by a Coastal Zone Consistency Determination that evaluates consistency with New York State's federally approved coastal zone management program.

Magnuson-Stevens Act (16 USC §§ 1801 to 1883)

Section 305(b)(2)-(4) of the Magnuson-Stevens Act outlines the process for NMFS and the Regional Fishery Management Councils (in this case, the Mid-Atlantic Fishery Management Council) to comment on activities proposed by federal agencies that may adversely impact areas designated as EFH. EFH is defined as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (16 USC §1802(10)).

Adverse impacts, as defined in 50 CFR 600.910(A), include any impacts that reduce the quality and/or quantity of EFH. Examples include:

- Direct impacts, such as physical disruption or the release of contaminants;
- Indirect impacts, such as the loss of prey or reduction in the fecundity (number of offspring produced) of a managed species; and
- Site-specific or landscape-wide impacts that may include individual, cumulative or synergistic consequences of a Federal action.

Endangered Species Act of 1973 (16 USC §§ 1531 to 1544)

The Endangered Species Act of 1973 recognizes that endangered species of wildlife and plants are of aesthetic, ecological, educational, historical, recreational, and scientific value to the nation and its people. The Act provides for the protection of these species, and the critical habitats on which they depend for survival.

Fish and Wildlife Coordination Act (PL 85-624; 16 USC 661-667d)

The Fish and Wildlife Coordination Act entrusts the Secretary of the Interior with providing assistance to, and cooperating with, federal, state and public or private agencies and organizations, to ensure that wildlife conservation receives equal consideration with other water-resource development programs. These programs can include the control (such as a diversion), modification (such as channel deepening), or impoundment (through the construction of a dam) of a body of water.

Executive Order 11988 (Flood Plain Management)

Executive Order 11988 requires that agencies provide leadership and take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to enhance and preserve the natural and beneficial values served by floodplains.

Executive Order 11990 (Protection of Wetlands)

This Executive Order directs federal agencies to provide leadership and take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance wetland quality. New activities in wetlands, either undertaken or supported by a federal agency, are to be avoided unless there is no practicable alternative and all practical measures have been taken to minimize the potential impacts to the wetlands.

STATE LAWS AND REGULATIONS

Protection of Waters, Article 15, Title 5, New York State Environmental Conservation Law (ECL), Implementing Regulations 6 NYCRR Part 608.

DEC is responsible for administering Protection of Waters regulations to prevent undesirable activities within surface waters (rivers, streams, lakes, and ponds). The Protection of Waters permit program regulates five different categories of activities: disturbance of stream beds or banks of a protected stream or other watercourse; construction, reconstruction or repair of dams and other impoundment structures; construction, reconstruction or expansion of docking and mooring facilities; excavation or placement of fill in navigable waters and their adjacent and contiguous wetlands; and Water Quality Certification for placing fill or other activities that result in a discharge to waters of the United States in accordance with Section 401 of the CWA.

State Pollutant Discharge Elimination System (SPDES) (N.Y. Environmental Conservation Law [ECL] Article 3, Title 3; Article 15; Article 17, Titles 3, 5, 7, and 8; Article 21; Article 70, Title 1; Article 71, Title 19; Implementing Regulations 6 NYCRR Articles 2 and 3)

Title 8 of Article 17, ECL, Water Pollution Control, authorized the creation of the State Pollutant Discharge Elimination System (SPDES) to regulate discharges to the state's waters. Activities requiring a SPDES permit include: point source discharges of wastewater into surface or ground waters of the State, including the intake and discharge of water for cooling purposes; constructing or operating a disposal system (sewage treatment plant); discharge of stormwater; and construction activities that disturb one acre or more.

Waterfront Revitalization of Coastal Areas and Inland Waterways Act (Sections 910-921, Executive Law, Implementing Regulations 6 NYCRR Part 600 et seq.)

Under the Waterfront Revitalization of Coastal Areas and Inland Waterways Act, NYSDOS is responsible for administering the Coastal Management Program (CMP). The Act also authorizes the State to encourage local governments to adopt Waterfront Revitalization Programs (WRP) that incorporate the state's policies. New York City has a WRP administered by the Department of City Planning.

Tidal Wetlands Act, Article 25, ECL, Implementing Regulations 6 NYCRR Part 661.

Tidal wetlands regulations apply anywhere tidal inundation occurs on a daily, monthly, or intermittent basis. In New York State, tidal wetlands occur along the salt-water shore, bays, inlets, canals, and estuaries of Long Island, New York City and Westchester County, and the tidal waters of the Hudson River up to the salt line. DEC administers the tidal wetlands regulatory program and the mapping of the state's tidal wetlands. A permit is required for most activities that would alter wetlands or the adjacent areas (up to 300 feet inland from wetland boundary or up to 150 feet inland within New York City).

Freshwater Wetlands Act, Article 24, ECL, Implementing Regulations 6 NYCRR Part 662

The Freshwater Wetlands Act requires DEC to map freshwater wetlands protected by the Act (12.4 acres or greater in size containing wetland vegetation characteristic of freshwater wetlands as specified in the Act). Around each mapped wetland is a protected 100-foot adjacent area that serves as a buffer. In accordance with the Act, the DEC ranks wetlands in one of four classes that range from Class 1, which represents the greatest benefits and is the most restrictive, to Class IV. The permit requirements are more stringent for a Class I wetland than for a Class IV wetland. Certain activities (e.g., normal agricultural activities, fishing, hunting, hiking, swimming, camping or picnicking, routine maintenance of structures and lawns, and selective cutting of trees and harvesting fuel wood) are exempt from regulation. Activities that could have negative impact on wetlands are regulated and require a permit if conducted in a protected wetland or its adjacent area. There are no mapped State freshwater wetlands on the project site but they do exist in the surrounding area.

Floodplain Management Criteria for State Projects (6 NYCRR 502)

Under 6 NYCRR 502, all state agencies are required to ensure that the use of state lands, and the siting, construction, administration and disposition of state-owned and state-financed projects involving any change to improved or unimproved real estate, are conducted in ways that would minimize flood hazards and losses. Projects are required to consider alternative sites on which the project could be located outside the 100-year floodplain. Projects to be located within the floodplain are required to be designed and constructed to minimize flood damage, and to include adequate drainage to reduce exposure to flood hazards. All public utilities and facilities associated with a project are also required to be located and constructed to minimize or eliminate flood damage. The regulations specify that for nonresidential structures, the lowest floor should be elevated or flood-proofed to not less than one foot above the base flood level, so that below this elevation the structure, together with associated utility and sanitary facilities, is watertight, with walls substantially impermeable to the passage of water and with structural components having the capability of resisting hydrostatic and hydrodynamic loads and effects of buoyancy. No project may be undertaken unless the cumulative effect of the proposed project and existing developments would not cause material flood damage to the existing developments.

Endangered and Threatened Species of Fish and Wildlife; Species of Special Concern (ECL, Sections 11-0535[1]-[2], 11-0536[2], [4], Implementing Regulations 6 NYCRR Part 182)

These regulations prohibit the taking, import, transport, possession or selling of any endangered or threatened species of fish or wildlife, or any hide, or other part of these species, as listed in 6 NYCRR §182.6.

C. EXISTING CONDITIONS

GEOLOGY AND SOILS

The project site, located within both the Newark Basin and Atlantic Coastal Plain, is an area that has been substantially shaped by both geologic processes and human use (Isachsen et al. 2000). The underlying bedrock at the project site is complex, and consists of sedimentary material from the Ordovician (i.e., serpentinite and Manhattan Schist), Triassic (i.e., Stockton and Lockatong Formation bedrock) and Jurassic (i.e., Palisades diabase) periods (Rogers et al. 1990, DSNY 1996). The surficial geology in the project area includes silt deposited during the Cretaceous period, and glacial sand, till, and lake deposits from the Pleistocene epoch (DSNY 1996, Isachsen et al. 2000). The waterways that run through the project site were formed during glacial retreat in the Pleistocene and Holocene epochs as sea levels rose, and salt marshes subsequently formed along western Staten Island (DSNY 1996), where some of the oldest marshes in the Hudson River Estuary have been identified (Peteet et al. 2007).

Before landfill operations began, the project site was characterized by tidal and freshwater marshes, clay pits, farmlands, and upland areas (DSNY 1996, Borough of Richmond Topographical Survey Map 1911). As a result, surficial soils underneath the landfill sections, or mounds, would be classified as disturbed peat, clay, and sand deposited during the Pleistocene and Holocene epochs over older glacial and Cretaceous deposits (DSNY 1996). Soils under the landfill mounds have been compressed over time due to the weight of refuse and fill deposited on the site, which may have created a partial barrier that inhibits some direct leaching of contaminants into groundwater (DSNY 1996). Soils around the perimeter of the landfill mounds include peats and other hydric soils in tidal, freshwater, and forested wetlands in locations not directly affected by landfilling operations. Soils on Landfill Sections 3/4 and 2/8, are described as ‘silty sandy loams with some gravel or rock’ and ‘a significant amount of human-origin debris’, and are atypical of native soils (AES 2007).

Field observations conducted in May 2007 evaluated soils within specific locations identified as having the potential to be hydric. The areas evaluated a former stormwater management facility at the former Travis Landfill, north of Landfill Section 3/4 (Sampling point 52, see Appendix C); and three locations within a swale that drains to Richmond Creek between the two portions of Landfill Section 2/8 (Sampling points 32-34, see Appendix C). This swale has been identified as a possible site for wetland enhancement activities. Soil in the Travis Landfill area was disturbed, and observed to be brown in color (10YR5/3), and not categorized as hydric. Two of the three locations in the Landfill Section 2/8 swale (Sampling points 32 and 33) soils were hydric, generally black (10YR2/1) or very dark gray (10YR3/1) in color with an organic, mucky texture. Soil near sampling point 34, which was in the vicinity of an area with standing water, was yellowish-brown (10YR5/4) in color and not hydric.

GROUNDWATER

Groundwater both beneath the project site and within the secondary study area has been shown to contain various organic and inorganic contaminants. The most likely sources include leachate originating from the project site, leachate from the adjacent Brookfield Landfill, and other residential and commercial sources (ATSDR 2000). Sampling conducted within the Fresh Kills Landfill from 1991 to 1993 indicated that groundwater contaminants at Landfill Section 1/9 were present in concentrations exceeding DEC groundwater standards (DSNY 1996). Elevated levels of ammonia and other leachate indicators (i.e., total dissolved solids (TDS), total organic carbon (TOC), biological/chemical oxygen demand (BOD/COD), etc.), and volatile organic compounds (VOCs) associated with petrochemicals were present in near surface groundwater in Landfill Section 1/9 refuse and fill (DSNY 1996). In groundwater associated with lower glacial and Cretaceous deposits, saltwater intrusion and direct leachate flow into these horizons were suspected; levels of ammonia tended to be less than in shallower groundwater, possibly influenced by saltwater intrusion (DSNY 1996). Other leachate indicators (i.e., TDS, chlorine, and sulfate) and metals (i.e., iron, magnesium, manganese, and boron) were higher in groundwater found within more recent glacial deposits than in lower Cretaceous deposits (DSNY 1996). VOCs and semivolatile organic compounds (SVOCs) were low or nonexistent. At Landfill Section 6/7, similar patterns were observed in near surface groundwater, with the exception of VOCs in violation of DEC standards at one location in the southeastern area of the mound (DSNY 1996).

A leachate treatment containment, collection, and treatment system was constructed on the project site in 1997, significantly reducing the potential for leachate to affect groundwater and surface water quality within the project site. The leachate treatment plant has a treatment capacity of up to 1 million gallons of per day. As noted in Chapter 11,"Hazardous Materials," regular groundwater monitoring at the project site in 2002-2004 indicated low concentrations of VOCs and SVOCs, elevated concentrations of metals, and no polychlorinated biphenyls (PCBs) or pesticides. The results of the 2006 Fresh Kills Groundwater Quality Monitoring program found that groundwater samples collected from the shallow/refuse monitoring zone at the landfill continue to have concentrations or values of leachate indicator parameters (i.e., ammonia, color, total dissolved solids, chloride and turbidity, and concentrations of inorganic parameters boron, iron, magnesium, manganese, and sodium) above the standards (TOGS Ambient Water Quality Standards and Guidance Values). A limited number of organic parameters were detected at concentrations above the groundwater protection standards, with benzene and chorobenzene the most common. Within the intermediate depth and deep (bedrock) monitoring zones at the landfill, concentrations or values of leachate indicator parameters (i.e., bromide, chloride, total dissolved solids and turbidity, and inorganic parameters boron, iron, manganese, magnesium and sodium) consistently exceed the standards. However, geochemical evaluation of the groundwater from these monitoring zones indicate that elevated concentrations of these parameters may be a result of seawater mixing, or related to the geologic formation mineralogy. Five organic parameters in the intermediate depth-monitoring zone were detected at concentrations above groundwater standards during the 2006 monitoring period. Within the deep monitoring zone, the organic parameters toluene, 2-butanone, 2-methylphenol continued to be detected above the groundwater protection standards in each of the four landfill sections. Phenol, xylene, bis(2-ethylhexyl)phthalate and pentachlorophenol exceeded the groundwater protection standards in one or two deep wells. The results of the 2006 Groundwater Monitoring Program found that concentrations or values of leachate indicator and inorganic parameters continue to be above standard levels, as they have been since the cumulative sampling period began in 1991.

Analysis of groundwater data collected during the cumulative period (1991 through 2006) and after the installation of the leachate control systems (1998 through 2006) indicated that the majority of statistically significant trends for the parameters evaluated are decreasing concentrations, particularly with respect to leachate indicator and inorganic parameters (Shaw 2007a).

Groundwater on Staten Island has not been used for potable water since 1970. Potable water on Staten Island is provided by New York City's public water supply, which comprises a system of upstate reservoirs.

FLOODPLAIN

Figure 10-4 presents the 100-year floodplain (area with a 1 percent chance of flooding each year) and 500-year floodplain (area with a 0.2 percent chance of flooding each year) boundaries within the project site. As a result of landfilling activities which has raised the topography, much of the project site is outside the 100-year floodplain. Within the project site, the shorelines, tidal wetlands associated with William T. Davis Wildlife Refuge and Richmond Creek at the southeast corner of the project site, and much of Isle of Meadows is within the 100-year floodplain. The only portion of the project site within the 500-year floodplain is a small area of Isle of Meadows.

WETLANDS

PROJECT SITE

DEC has mapped tidal wetlands within the project site—the primary study area (see Figure 10-5). Mapped intertidal and high marsh tidal[1] wetlands occur along the shorelines of the Arthur Kill (west of Landfill Section 1/9), Main Creek and Richmond Creek (north, south, and west of Landfill Section 6/7), and Isle of Meadows; and within two large tidal wetland areas located north of Landfill Section 6/7 along Main Creek associated with the William T. Davis Wildlife Refuge, and south of Landfill Section 6/7 along Richmond Creek near the south eastern corner of the primary study area. A small area designated as high marsh, intertidal marsh and coastal shoals, bars and mudflats is located at the southwestern corner of the primary study area along the Arthur Kill. A detailed description of wetland landscapes occurring at the Fresh Kills site is provided in the Terrestrial Resources section of this Chapter.

The Arthur Kill, Great Fresh Kill, Little Fresh Kill, Richmond Creek and Main Creek within the primary study area are designated as DEC littoral zone (shallow waters six feet or less in depth at mean low water that are not included in other DEC tidal wetland categories) by DEC (see Figure 10-4). However, DEC regulations state that actual water depths determine whether or not an area is a littoral zone.

[1] 6 NYCRR Part 661 defines intertidal marsh as "the vegetated tidal wetland zone, designated IM on an inventory map, lying generally between average high and low tidal elevation. The predominant vegetation in this zone is low marsh cordgrass, *Spartina alterniflora*." 6 NYCRR Part 661 defines high marsh as "The normal uppermost tidal wetland zone, designated HM on an inventory map, usually dominated by salt meadow grass, *Spartina patens*; and spike grass, *Distichlis spicata*. This zone is periodically flooded by spring and storm tides and is often vegetated by low vigor, *Spartina alterniflora* and Seaside lavender, *Limonium carolinianum*. Upper limits of this zone often include black grass, *Juncus gerardi*; chairmaker's rush, *Scirpus* sp; marsh elder, *Iva frutescens*; and groundsel bush, *Baccharis halimifolia*.

There are no mapped and regulated DEC freshwater wetlands at the project site. However, activities in and around these wetlands would be regulated under Article 15, "Protection of Waters" on a case by case basis.

The USFWS NWI (see Figure 10-6) classifies Great Fresh Kill and Little Fresh Kill within the project site as estuarine subtidal wetlands with unconsolidated bottom (E1UBL). Subtidal estuarine wetlands are continuously submerged areas with low energy and variable salinity, influenced and often enclosed by land. Unconsolidated bottoms have at least 25 percent cover of particles smaller than 6 or 7 cm, and less than 30 percent vegetative cover. Along the Arthur Kill shoreline, the NWI indicates bands of estuarine intertidal unconsolidated shore that are regularly flooded (E2USN), with some areas of persistent irregularly flooded emergent vegetation (E2EM1P). Similar to the tidal wetland areas designated by DEC, the NWI indicates estuarine intertidal emergent wetlands lining Little Fresh Kill, Main Creek and Richmond Creek (E2EM1P) and large areas of estuarine intertidal emergent wetlands associated with the William T. Davis Wildlife Refuge on Main Creek, and at the southeast corner of the primary study area along Richmond Creek. However, additional wetlands (estuarine intertidal unconsolidated shore that are regularly flooded) were mapped in the Isle of Meadows, and along the eastern edge of Landfill Section 6/7 (estuarine intertidal emergent and unconsolidated shore (E2EM5P and E2EM1P, and E2USN)). The southern portion of this emergent estuarine wetland area corresponds to an area of DEC designated high marsh and intertidal marsh, and does appear to have a tidal connection to Richmond Creek. The DEC tidal wetlands maps, do not identify the remaining portions of this complex of open water and wetland vegetation that extends north between Landfill Section 6/7 and Richmond Avenue as tidal wetlands. The remaining portion of this open water and wetland vegetation area comprises two interconnected stormwater management basins that receive stormwater runoff from Landfill Section 6/7, and ultimately discharge to the area indicated on the NWI as estuarine emergent wetland that is located at the northeast side of Landfill Section 6/7. This area generally contains vegetation characteristic of a freshwater emergent/forested wetland and ultimately drains north to a tributary of Springville Creek through a culvert. Stormwater runoff from Richmond Avenue also drains into this area through existing storm drain pipes. With the existence of these stormwater basins the open water areas may be regulated under Article 15, "Protection of Waters," by DEC.

Freshwater wetland[1] investigations were conducted in September 2007 within North Park and East Park by Geosyntec Consultants, Inc. (Geosyntec 2007), and in December 2007 within the western portion of South Park and along the right-of-way of the West Shore Expressway (Route 440) within the vicinity of the proposed service road to be located on the south side of the expressway. That investigation used the three parameter methodology (i.e., hydrology, vegetation and soils) of the USACE Wetlands Delineation Manual (1987). Figure 10-7 depicts the approximate locations of the freshwater wetlands identified as part of the Geosyntec investigations. In addition, AES performed specific vegetative investigations throughout portions of the site for future planning and enhancement activities. The results of these investigations, in addition to data and information collected during Natural Resources Field observations, are described below.

[1] According to the DEC, "Freshwater wetlands are those areas of land and water that support a preponderance of characteristic wetlands plants that out-compete upland plants because of the presence of wetlands hydrology (such as prolonged flooding) or hydric (wet) soils. Freshwater wetlands commonly include marshes, swamps, bogs, and fens."

Stormwater basins, and freshwater wetlands identified using the USACE three-parameter methodology, are present along the eastern border of East Park paralleling Richmond Avenue. There are no DEC-regulated freshwater wetlands mapped on the project site. Although some areas of the Fresh Kills Park site may have taken on the characteristics of freshwater wetlands, theses areas were not mapped as freshwater wetlands by DEC. These areas were typically designed as part of the stormwater infrastructure system for the Fresh Kills Landfill, a necessary component for proper operation of the site. Over time, while still functioning as critical stormwater drainage for the landfill, the hydrology, soils, and flora changed, taking on some characteristics associated with freshwater wetlands. As such, the regulatory context over these areas is not clear. These wetlands have not been mapped as tidal or freshwater wetlands by the DEC, and are not associated with any classified waterbodies regulated under Article 15, Water Resources Law, of the Environmental Conservation Law. These stormwater basins and freshwater wetlands do include much of the NWI-mapped estuarine wetlands presented in Figure 10-6. To the north and south of the freshwater wetlands identified as associated with Basins A, B1 and B2, are DEC mapped tidal wetlands (Hartzel 2007). The freshwater wetlands identified in association with Basins A, B1 and B2 along the eastern border of East Park are a combination of emergent and forested wetlands. Characteristic plants associated with these wetlands include sweet gum (*Liquidambar styraciflua),* bayberry (*Morella pensylvanica),* groundselbush (*Baccharis halimifolia),* marsh-elder (*Iva frutescens*), *Phragmites,* broad leaf cat-tail (*Typha latifolia*), jewel weed (*Impatiens capensis),* and various sedges (*Carex* spp.) (AKRF 2007).

Within North Park, freshwater wetlands identified using the USACE three-parameter methodology occur along much of the northern border of the project site. These wetlands have not been mapped as tidal or freshwater wetlands by the DEC, and are not associated with any classified waterbodies regulated under Article 15, Water Resources Law, of the Environmental Conservation Law. The northeastern section of the freshwater wetlands extends toward tidal wetlands associated with Main Creek, while the southwestern section extends toward West Shore Expressway (Hartzel 2007). These wetlands consist of both emergent and forested wetlands. Plant species associated with the emergent wetland areas include *Phragmites*, spike rush (*Eleocharis spp.),* switchgrass (*Panicum spp*.), smartweeds (*Polygonum spp.*), and sedges. The forested wetlands are characterized by red maple (*Acer rubrum*), pin oak (*Quercus palustris),* sweet gum, black gum (*Nyssa sylvatica),* gray birch (*Betula populifolia),* black willow (*Salix nigra),* sassafras (*Sassafras albidum),* arrow-wood (*Viburnum dentatum),* smartweeds, and greenbrier (*Smilax rotundifolia)* (AKRF 2007).

An additional freshwater wetland reported by AES as occurring in the northeastern portion of North Park, within the former Travis Landfill, was not identified in the Geosyntec study or during the AKRF field investigations. This small wetland is reportedly vegetated with native grasses, rushes, sedges, and includes woody plants such as elderberry (*Sambucus sp.*), blackberry (*Rubus sp.*), arrow-wood, and sweet gum (AES 2007), and exists in the vicinity of other small patches of native vegetation within an area largely dominated by mugwort and common reed.

Three freshwater wetlands, identified using the USACE three-parameter methodology, occur within the western portion of South Park. As described below, two of these wetlands are stream channels bordered by grey birch, cottonwood, dogwood, northern arrowwood, red maple and elderberry. They are located south of Muldoon Avenue and parallel the southern edge of the West Shore Expressway.

- A stream channel located within the West Shore Expressway right-of-way just south of the southern edge of the existing roadway, from a point approximately 1,500 feet south of Muldoon Avenue to the culvert under Muldoon Avenue. This stream channel drains to the culvert under Muldoon Avenue. This wetland has not been mapped as tidal or freshwater wetland by the DEC, and is not associated with any classified waterbodies regulated under Article 15, Water Resources Law, of the Environmental Conservation Law.
- A stream channel located approximately 170 to 200 feet southeast of the expressway, outside of the right-of-way, running along the northern border of the future Owl Hollow Park (see Figure 10-7) from a point approximately 1,100 feet south of Muldoon Avenue to where this channel intersects with the stream channel running through forested wetland located along the eastern border of the future Owl Hollow Park. This wetland has not been mapped as tidal or freshwater wetland by the DEC, and is not associated with any classified waterbodies regulated under Article 15, Water Resources Law, of the Environmental Conservation Law.
- Stream channel and palustrine forested wetland are located along the eastern border of the future Owl Hollow Park. The stream running through the palustrine forested wetlands (described below under "Habitats and Communities") on the eastern portion of the future Owl Hollow Park originates within Arden Heights Woods, south of Arthur Kill Road, runs through the culvert under Muldoon Avenue, and continues to the northeast as a wetland/stream channel, paralleling the West Shore Expressway, running between the two mounds of Section 2/8 before discharging to Richmond Creek. The portion of the freshwater wetland between Muldoon Avenue and Richmond Creek is described as *phragmites*-dominated emergent/scrub-shrub wetlands in the section "Habitats and Communities," and is depicted in Figure 10-7 as the linear wetland paralleling the expressway. Three small tributaries drain to this same linear freshwater wetland/stream channel via culverts that flow under the West Shore Expressway. The palustrine forested wetland located at the eastern border of Owl Hollow Park has not been mapped as tidal or freshwater wetland by the DEC. However, the entire length of stream channel, from its origin within Arden Heights Woods to its confluence with Richmond Creek has been classified as SC/B by the DEC and is regulated under Article 15, Water Resources Law, of the Environmental Conservation Law.

SECONDARY STUDY AREA

Within the secondary study area, DEC tidal wetlands have been mapped in the William T. Davis Wildlife Refuge (north of the project site), in the area northwest of the project site associated with Neck Creek, and at the southeastern corner of the project site along Richmond Creek within LaTourette Park and at the edge of Brookfield Landfill. DEC freshwater wetlands have been mapped within Arden Heights Woods Park south of the project site, within LaTourette Park, within the William T. Davis Wildlife Refuge to the north of the project site, within Willowbrook Park northeast of the project site, and in association with Neck Creek to the northwest of the project site.

Similar to DEC mapped freshwater wetlands, the NWI indicates areas of freshwater wetlands—palustrine forested broad-leaved deciduous seasonally flooded/saturated (PFO1E) and palustrine scrub-shrub broad-leaved deciduous seasonally flooded/saturated (PSS1E), and palustrine emergent wetlands (PEM1E) within Arden Heights Woods Park, palustrine forested and emergent wetlands within Willowbrook Park, and palustrine forested wetlands north of the tidal wetlands of William T. Davis Wildlife Refuge.

The former Brookfield Landfill, while presently undergoing remediation due to illegal disposal of hazardous materials at the landfill, contains plant communities that could provide information for enhancement efforts at Fresh Kills (Lynch 2007).

AQUATIC RESOURCES

The surface water resources within the vicinity of the project site include the Arthur Kill, Great Fresh Kill, Little Fresh Kill, Fresh Kill, Main Creek and Richmond Creek. The Arthur Kill is part of the Newark/Raritan Bay tidal complex, which has two principal freshwater inputs (the Raritan River and the Passaic River), and two tidal inputs, Arthur Kill and Kill van Kull. The Arthur Kill is a tidal strait that connects Newark Bay to Raritan Bay (Kaluarachchi et al 2003, Pence et al 2005). It is approximately 13 miles long, between 800 and 2,800 feet-wide, and has a total surface area of approximately 4.4 square miles. A 500-foot-wide federal navigation channel, maintained at a depth of 35 feet mean low water level (MLW), runs the entire length of the Kill (USACE 1999a).

Tidal dynamics in the Arthur Kill are extremely complex, as they are driven by astronomical and meteorological tidal forces from multiple inlets, seasonally variable freshwater input, and anthropogenic effects. Long term volume and salt flux generally is directed southward toward Raritan Bay, with the peak water flux being more than 400 cubic meters per second (14,125 cubic feet per second). This flux appears to be driven by the tidal elevation gradients between New York Bay and Raritan Bay that result from the tides in these water bodies being temporally out of phase, and not by water density differences attributable to salinity gradients (Kaluarachchi et al 2003).

The Arthur Kill has been heavily impacted by anthropogenic activity, and much of the Arthur Kill's shoreline is developed with cargo shipping terminals, petroleum refineries, tank farms, electrical generating stations, chemical manufacturers, landfills, and other industrial uses. Despite the extensively developed nature of these land uses, the Arthur Kill shoreline still contains substantial acreages of tidal salt marshes. Oil spills routinely impact the Arthur Kill, including a 500,000-gallon spill in 1990, and a recent 31,000-gallon spill (Chevron 2006). Several salt marsh enhancement projects lead by DPR – Natural Resources Group and other organizations have been conducted subsequent to some of these previous spills.

Results of water quality studies (dye study and water quality study) conducted by DEC in the Fresh Kills system in 1989 (DEC 1991 and IT Corporation 1993) indicated that the Fresh Kills system reaches equilibrium within 5 tidal cycles, indicating a high degree of mixing and that the tidal exchanges with the Arthur Kill flush the system relatively quickly.

In addition to the tidal water bodies discussed above, the project site also contains constructed stormwater management ponds, basins, and swales that feed into Main Creek and Richmond Creek. Two stormwater management ponds are located in the central portion of the project site (Basins C1 and C2), near the confluence of Main Creek and Richmond Creek (see Figure 10-7), and currently receive stormwater runoff from Landfill Section 6/7. Both stormwater management ponds have vegetated riprap banks (shrubs and herbaceous plants) and stormwater inlet and outlet structures. Standing water was present at the time of the May and October 2007 field observations. Sampling for fish and benthic invertebrates within these areas was conducted during the October 2007 field investigation. The sampling results are summarized in the *Benthic Invertebrates* and *Fish* sections of this chapter.

Four other large open water areas are located along the eastern edge of the project site, between Landfill Section 6/7 and Richmond Avenue. These areas correspond to the areas misidentified as estuarine emergent wetlands by NWI (see Figure 10-6) and the freshwater wetlands identified using the USACE three-parameter approach during the Geosyntec study, as discussed in the previous section. These wetlands have not been mapped as tidal or freshwater wetlands by the DEC, and are not associated with any classified waterbodies regulated under Article 15, Water Resources Law, of the Environmental Conservation Law. They include the wetland basin with some tidal connection to Richmond Creek; two interconnected stormwater management basins (Basins B1 and B2) that receive runoff from Landfill Section 6/7; and an open water area that drains to a tributary of Springville Creek through a culvert. This upper basin does not directly receive stormwater runoff from Landfill Section 6/7, but does receive surface water from Basin B1 and stormwater runoff from Richmond Avenue. At the time of the 2007 field observations, these areas had emergent and forested wetlands along the edges but did not appear to be tidally influenced. There was no apparent connection between Basin B2 and Richmond Creek. During the October 2007 field investigation, fish and benthic invertebrate sampling was performed in the two stormwater management basins and freshwater wetlands east of Landfill Section 6/7. The results of this sampling effort are summarized in the *Benthic Invertebrates* and *Fish* sections of this chapter.

Another pond is located near the two portions of Landfill Section 2/8, south and east of Richmond Creek, within South Park. This pond did not appear to be directly associated with any active stormwater management facilities, but was connected to the tributary stream described previously under "Wetlands" as originating in Arden Heights Woods, then running through the palustrine forested wetland on the eastern edge of Owl Hollow Park, through the culvert under Muldoon Avenue, and then parallel to the West Shore Expressway before discharging to Richmond Creek. As discussed previously, this stream channel, from its origin within Arden Heights Woods to its confluence with Richmond Creek, has been classified as SC/B by the DEC and is regulated under Article 15, Water Resources Law, of the Environmental Conservation Law. Because the pond associated with the stream is less than 10 acres in size, it would likely also be regulated under Article 15, Water Resources Law. It appears to be tidally influenced at its confluence with Richmond Creek. A portion of stream located slightly northeast of this pond was sampled for fish and benthic invertebrates in October 2007. The sampling results are summarized in the *Benthic Invertebrates* and *Fish* sections of this chapter.

A tidal tributary to Main Creek is present in the northernmost portion of the project site (North Park, Section 3/4), along the edge of the former Travis Landfill. This tidal tributary is not a classified water body but is contiguous with Main Creek. Therefore, it would be regulated under Article 15, Water Resources Law.

WATER QUALITY

Although water quality has improved within other portions of the Harbor Estuary, the Arthur Kill continues to experience low dissolved oxygen (DO), typically in the summer. In addition, sampling conducted by DEC as part of the New York/New Jersey Harbor Estuary Contaminant Assessment Reduction Program (CARP) found impairments due to a number of constituents that exceed DEC guidance values or standards, potentially affecting aquatic organisms. Provided below is a detailed discussion of the existing water and sediment quality, and aquatic biota for the surface waters within the study area.

Title 6 of the NYCRR Part 703 includes surface water standards for each Use Classification of New York surface waters. The New York classified use for the Arthur Kill and the lower portion of Fresh Kills requires that the water be suitable for fish survival (Use Class SD). This classification is reserved for water bodies that cannot meet the requirements for primary and secondary human contact and fish propagation. The DEC saline surface water quality standards for Use Class SD is that DO must never be less than 3 milligrams per liter (mg/L). No standards for coliform have been established for Use Classification SD waters.

The New York Classified use for Richmond Creek, Main Creek and the upper portion of Fresh Kills requires that the water be suitable for fish propagation and survival, and for primary and secondary contact recreation (Use Class SC). Water quality standards for fecal and total coliform, DO, and pH for Use Class SC waters are as follows. (There are no New York State standards for chlorophyll *a* or water clarity.)

- Fecal coliform—Monthly geometric mean less than or equal to 2,000 colonies/100mL.
- Total coliform—Monthly median less than 2,400 colonies/100 milliliters (mL).
- DO—Never less than 5 mg/L.

The City of New York has monitored New York Harbor water quality for over 90 years through the Harbor Survey. NYCDEP evaluates surface water quality of four designated regions: Inner Harbor Area, Upper East River-Western Long Island Sound, Lower New York Bay-Raritan Bay, and Jamaica Bay (NYCDEP 2006). The Harbor Survey station closest to the project site is Station K4 (Fresh Kills). Additionally, the DSNY has conducted water and sediment quality monitoring within the Arthur Kill and Fresh Kills estuary (i.e., Little Fresh Kill, Great Fresh Kill, Fresh Kills, Richmond Creek, and Main Creek) from 1991 to the present. This sampling is currently being conducted in accordance with the Environmental Monitoring Plan (EMP) developed as part of the Post-Closure Monitoring and Maintenance Operations Manual prepared for the landfill.

Temperature and salinity influence several physical and biological processes within the Harbor, Raritan Bay, and the Arthur Kill. Temperature has an effect on the spatial and seasonal distribution of aquatic species and affects oxygen solubility, respiration, and other temperature-dependent water column and sediment biological and chemical processes. Salinity fluctuates in response to tides and freshwater discharges. Salinity and temperature largely determine water density and can affect vertical stratification of the water column. Salinity is also an important habitat variable as a number of aquatic species have a limited salinity tolerance.

Average temperatures taken in the Arthur Kill typically range from about 3°C (37.4°F) in winter months to nearly 30°C (86°F) in summer. For the period of 2002 through 2003, the maximum temperature observed at NYCDEP Harbor Survey station closest to the project site (Station K4, Fresh Kills) was 28.57°C (83.7°F) in the second half of August, 2002.

Salinity measurements taken in the Arthur Kill near the project site between 2002 and 2003 generally ranged from about 14.3 to 28.0 parts per thousand (ppt), with bottom water salinity generally slightly greater than surface water salinity. Periodic high freshwater flows in extremely wet years can occasionally create mesohaline conditions (salinity between 5 and 18 ppt) for relatively short periods.

The results of recent Harbor Surveys (NYCDEP 2001, 2002, 2003, 2004, 2005, 2006) show that the water quality of New York Harbor has improved significantly since the 1970s as a result of measures undertaken by the City. These measures include eliminating 99 percent of raw dry-

weather sewage discharges, reducing illegal discharges, increasing the capture of wet-weather related "floatables," and reducing the toxic metals loadings from industrial sources by 95 percent (NYCDEP 2002). The 1999 and 2000 IEC 305(b) reports also indicate that the year-round disinfection requirement for discharges to waters within its district (including New York Harbor) has contributed significantly to water quality improvements since the requirement went into effect in 1986 (IEC 2000, 2001).

Recent survey data from Harbor Survey Station K4, Fresh Kills, near the project site, indicate that the water quality in this part of the lower Arthur Kill conforms with NYCRR water quality standards for Use Classification SD. The following section provides a summary of the water quality conditions in the sampling region (Arthur Kill) of the Harbor Survey that includes the project site. Table 10-1 presents a summary of water quality measurements at the Fresh Kills station (K4) for 2006.

Table 10-1
2006 NYCDEP Water Quality Data for the Fresh Kills (K4) Sampling Station

Parameter	Surface Waters			Bottom Waters		
	Low	High	Mean	Low	High	Mean
Total Fecal Coliform (per 100 mL)	2	475	125	NR	NR	NR
Dissolved Oxygen (mg/L)	3.8	10.4	6.6	3.6	10.9	6.1
Secchi Transparency (ft)	2.5	6.0	4.1	NA	NA	NA
Chlorophyll a (µg/L)	1.0	31.7	7.7	NM	NM	NM

Notes: NA = Not applicable, NM = Not measured, NR = Not reported.
Sources: NYCDEP 2006 (2006 New York Harbor Water Quality Report).

The presence of coliform bacteria in surface waters indicates potential health impacts from human or animal waste, and elevated levels of coliform can result in the closing of bathing beaches and shellfish beds. The waters of the Inner Harbor Area, which includes the Arthur Kill, complied with fecal coliform standards for the water body they are located in for all sampling locations. Temporary increases in fecal coliform concentrations may occur during wet weather due to increased runoff containing fecal coliform loadings following a rain event. Overall, fecal coliform concentrations in this area have declined, significantly improving water quality from the early 1970s, when levels were well above 2,000 colonies/100 mL; however, there has been a gradual increase over the last few years (NYCDEP 2006). Levels are well below the Bathing Standard for the region, but increasing. In general, the improvement in water quality with respect to fecal coliform has allowed for the opening of Inner Harbor waters for most recreational activities (NYCDEP 2004).

DO in the water column is necessary for respiration by all aerobic forms of life, including fish and invertebrates such as crabs, clams, and zooplankton. The bacterial breakdown of high organic loads from various sources can deplete DO and persistently low DO can degrade habitat and cause a variety of sublethal or, in extreme cases, lethal effects. Consequently, DO is one of the most universal indicators of overall water quality in aquatic systems. DO concentrations in the Inner Harbor Area have increased over the past 30 years from an average that was below 3 mg/L in 1970 to approximately 5.2 mg/L in 2006 (NYCDEP 2006), above the 3.0 mg/L standard for Use Class SD waters. DO concentrations recorded during DSNY annual late summer sampling at low tide from 2001 through 2004 within the Fresh Kills, Main Creek and Richmond Creek, which are Use Class SC, have generally been at or above the 5 mg/L standard for Use Class SC waters (Shaw 2005), but were generally below the 5 mg/L standard during the 2006 annual late summer sampling (Shaw 2007b).

High levels of nutrients can lead to excessive plant growth (a sign of eutrophication) and depletion of DO. Concentrations of the plant pigment chlorophyll *a* in water can be used to estimate productivity and the abundance of phytoplankton. Chlorophyll *a* concentration greater

than 20 micrograms per liter (µg/L) are considered suggestive of eutrophic conditions. The Inner Harbor area had average 2006 summer chlorophyll *a* values below the 20µg/L level for all sampling stations (NYCDEP 2006). Although chlorophyll concentrations at the Harbor Survey Station K4 near the project site (see Table 10-3) have generally been below the level suggestive of a eutrophic system, chlorophyll concentrations may occasionally be higher that 20µg/L, such as the 31.7 µg/L concentration reported in April 2006.

Secchi transparency is a measure of the clarity of surface waters. Transparency greater than 5 feet (1.5 meters) is indicative of clear water. Decreased clarity can be caused by high suspended solid concentrations or blooms of plankton. Secchi transparencies less than 3 feet (0.9 meters) are generally indicative of poor water quality conditions. Average Secchi readings in the Inner Harbor area have remained relatively consistent since measurement of this parameter began in 1986, ranging between about 3.5 and 5.5 feet (NYCDEP 2004). In 2006, the average Secchi transparency for the Inner Harbor area was 4.6 feet (NYCDEP 2006). In 2006, secchi depths reported for the Harbor Survey station closest to the project site (see Table 10-3) ranged from 2.5 to 6 feet, suggesting that at times, transparency at this station was suggestive of poor water quality conditions.

The DEC routinely monitors potentially harmful levels of contaminants in fish and wildlife in the freshwater and marine waters of New York. The New York State Department of Health (NYSDOH) issues advisories on eating sportfish and wildlife on the basis of these testing results. The general health advisory for sportfish obtained from New York's fresh waters and the marine waters at the mouth of the Hudson River, including the Arthur Kill, is that a person should eat no more than one half pound of fish per week, or six blue crabs (*Callinectes sapidus*) per week. Specific restrictions have been issued on the consumption of certain species of fish from the Arthur Kill, Kill van Kull and Newark Bay due to concentrations of dioxin and PCBs. Fish not recommended for consumption include American eel (*Anguilla rostrata)*, gizzard shad (*Dorosoma cepedianum*), striped bass (*Morone saxatilis)* and white perch (*Morone Americana*). Fish recommended for consumption no more than one meal per month include Atlantic needlefish (*Strongylura marina*), bluefish (*Pomatomus saltatrix)*, and rainbow smelt (*Osmersus mordax*) (NYSDOH 2007).

DSNY WATER QUALITY SAMPLING

Since 1991, DSNY has been conducting water and sediment quality monitoring within the Arthur Kill and Fresh Kills estuary (i.e., Little Fresh Kill, Great Fresh Kill, Fresh Kills, Richmond Creek, and Main Creek). Sampling conducted after 1998 represents the conditions present within the water bodies in and near the landfill after the leachate control system was installed at all four landfill sections to control future percolation to local groundwater. Water and sediment samples are analyzed for chemical parameters considered indicative of leachate contamination from the Fresh Kills Landfill complex, as identified through the process described in the 1996 Fresh Kill Landfill DEIS (DSNY 1996). These parameters included general water chemistry parameters (i.e., alkalinity, ammonia, BOD, COD, color, DO, total Kjeldahl nitrogen (TKN), and turbidity), and metals (i.e., arsenic, barium, copper, lead, manganese, nickel, and zinc).

Results of sampling conducted between 1991 and 1995 indicated that during all seasons, parameters suggestive of leachate contamination were higher in Main Creek and Richmond Creek, decreasing gradually in Fresh Kills toward the Arthur Kill. This was most pronounced at low tide (DSNY 1996). Results of sampling conducted within the Arthur Kill, Fresh Kills, Main Creek and Richmond Creek after 1998 show a similar pattern for most of the leachate contaminants. However, on the basis of the results from the 2006 Environmental Monitoring Program, some of these parameters have exhibited a significant downward trend after 1998.

Surface water TKN, color, manganese, ammonia, zinc, lead, alkalinity, copper and nickel exhibit significant decreasing trends and significantly lower values or averages for the period after 1998 compared to the period prior to the completion of the leachate collection system.

Only two VOCs were detected in the samples collected in the 2004 surface water quality monitoring program within the Landfill creeks. Toluene was detected at a very low concentration in only one Main Creek sample. Acetone, though detected frequently, was highest in the freshwater portion of Main Creek. Only three to five organic parameters have been detected between 1998 and 2004 (Shaw 2005). On the basis of an evaluation of the surface water data collected through 2004, and as permitted by the Environmental Monitoring Program for Fresh Kills Landfill, the analysis of organic parameters in surface water was discontinued after 2004.

SEDIMENT QUALITY

Typical of any urban watershed, New York Harbor Estuary sediments, including the Arthur Kill and the other surface waters within the Fresh Kills Park project site, are contaminated due to a history of industrial uses in the area. Contaminants found throughout the New York Harbor Estuary included pesticides such as chlordane and DDT, metals such as mercury and copper, and various polycyclic aromatic hydrocarbons. Adams et al. (1998) found the mean sediment contaminant concentration for 50 of 59 chemicals measured to be statistically higher in the Harbor Estuary than other coastal areas on the East Coast. Within the New York Harbor Estuary, Adams et al. (1998) ranked Newark Bay as the most degraded area on the basis of sediment chemistry, toxicity, and benthic community, followed by the Upper Harbor, Jamaica Bay, Lower Harbor, Western Long Island Sound and the New York Bight Apex. Biological effects, identified based upon the benthic invertebrate community, were found to be associated with the chemical contamination. While the sediments of the New York Harbor Estuary are contaminated, the levels of most sediment contaminants (e.g., dioxin, DDT, and mercury) have decreased on average by an order of magnitude over the past 30 years (Steinberg et al. 2002). Between 1993 and 1998 the percentage of sediment sampling locations with benthic macroinvertebrate communities considered impacted, or of degraded quality, decreased throughout the New York/New Jersey Harbor Estuary. Within the Upper Harbor, the percentage of benthic communities considered impacted decreased significantly from 75 percent in 1993 to 48 percent in 1998 (Steinberg et al. 2004).

Arthur Kill sediment has been found to have very high concentrations of PCB, dioxin, and DDT (primarily DDD). Arthur Kill PCBs are richer in the heavier homologues than those from other areas. The chemicals contributing to total dioxin concentrations in the Arthur Kill suggest sources beyond those from the Newark Bay-Passaic River-Hackensack River watershed (Litten & Fowler 1999, Litten 2003). Sediment quality data reported in the USEPA National Sediment Database for the Arthur Kill near Goethals Bridge and near the Arthur Kill/Kill van Kull confluence had concentrations of polycyclic aromatic hydrocarbons (PAHs), metals (lead, mercury, zinc), PCBs, and total DDT that may affect benthic organisms (Maxus 1991, National Oceanic and Atmospheric Administration (NOAA) 1991, USEPA 1993). Results of sediment sampling conducted as part of the Environmental Monitoring Program in 2006 detected concentrations of contaminants not indicative of leachate—alpha-chlordane, gama-chlordane, DDT, DDD and DDE, and the PAHS benzo(a)anthracene, benzo(b)fluoranthene, chrysene, fluoranthene, and pyrene—above their criteria in sediment samples collected from within Fresh Kills, Main, and Richmond creeks, and from the Arthur Kill. (Shaw 2007b).

DSNY SEDIMENT MONITORING

As stated above, DSNY has conducted sediment quality monitoring within the Arthur Kill and Fresh Kills estuary (i.e., Little Fresh Kill, Great Fresh Kill, Fresh Kills, Richmond Creek, and Main Creek) since 1991 to assess the effects of leachate discharge, characterize the sediment quality, to monitor the effects of landfill operation, and as part of the Long-Term Monitoring Plan. Sediment samples were collected from subtidal areas and analyzed for the same parameters indicative of leachate contamination that were discussed previously under "Water Quality."

For sediment samples collected in 1992, TKN sediment concentrations were found to be significantly higher at the Fresh Kills and Main Creek stations than in the Arthur Kill. Barium, nickel and zinc concentrations in sediment were found to be higher in Fresh Kills, Main, and Richmond Creeks than in the Arthur Kill. Sulfide concentrations within sediments of the Fresh Kills system creeks were similar to those for Arthur Kill sediments. Sediment levels of COD, phenols, TOC, aluminum, arsenic, chromium, cobalt, copper, iron, lead, manganese, vanadium and total cyanide were similar in the Fresh Kills estuary and the Arthur Kill (DSNY 1996).

The presence of leachate in sediments may be indicated by elevated levels of alkalinity, ammonia, TKN, barium, sulfide, and zinc in samples in the vicinity of the Fresh Kills Landfill in Fresh Kills, Main Creek, and Richmond Creek. Results of sampling conducted within the Arthur Kill, Fresh Kills, Main Creek and Richmond Creek after 1998 show a similar pattern for most of the leachate contaminants. On the basis of the results from the 2006 Environmental Monitoring Program, some of these parameters are exhibiting a significant downward trend after 1998. Ammonia, alkalinity, and TKN exhibit significant decreasing trends in some locations, which were mirrored in samples collected from shallow groundwater wells (Shaw 2007b). These improvements in sediment quality may be indicative of decreasing leachate impacts on the Landfill creeks.

AQUATIC BIOTA

PHYTOPLANKTON

Phytoplankton are generally microscopic plants whose movements within the waters of the Harbor Estuary are controlled by tides and currents. Phytoplankton, submerged aquatic vegetation (SAV), and benthic macroalgae (multi-cellular algae that attach to surfaces) are the primary producers of energy in the ocean food chain. They require sunlight as their primary energy source, and their productivity, biomass, and depth distribution will be limited by light penetration. Diatoms (unicellular members of the largest group of algae in the golden algae phylum) dominate the phytoplankton community in the Harbor Estuary in late winter to early spring, when they are succeeded by smaller forms (Malone 1977, Lively et al. 1983). Brosnan and O'Shea (1995) identified 29 taxa in a 1993 survey of the New York Harbor. Common phytoplankton species that occur in the Harbor Estuary are as presented below.

- Diatoms (Bacillariophyta)—*Asterionella japonica, Chaetoceros debilis, Eucampia zoodiacus, Nitzchia bilobata, Rhizosolenia delicatula, Schroderella delicatula, Skeletonema costatum, Thalassionema nitzchoides, Thalassiosira decipiens, and Thalassiosira nordenskioldii.*
- Dinoflagellates (a group of microscopic algae characterized by two flagella, whip-like projections) (Pyrrophyta)—*Peridinium globulum, Peridinium trochoideum, Prorocentrum micans, and Prococentrum refieldii*.
- Green algae (Chlorophyta)—*Chlorella* sp., and *Nannochloris atomus*.
- Blue-Green algae (Cyanophyta)—*Agmenellum* sp., and *Anacystis* sp. (Brosnan and O'Shea 1995, Cosper undated).

ZOOPLANKTON

Zooplankton are another integral component of the aquatic food web—they are primary grazers on phytoplankton and detrital (organic debris formed by decomposition of plants and animals) material, and are themselves consumed by fish such as bay anchovy (*Anchoa mitchilli)* and early life stages of commercially and recreationally important fish species such as striped bass and white perch. Zooplankton include life stages of other organisms such as fish eggs and larvae and decapod (group of crustacean invertebrates with 5 pairs of legs, e.g., shrimp, lobster and crab) larvae that spend only part of their life cycle as plankton. In the Harbor Estuary, copepods (microscopic crustaceans) are the dominant mesozooplankton (retained on nets with mesh openings greater than 200 µm) group throughout the year (Stepien et al. 1981). The most dominant species include the copepods *Acartia tonsa, Acartia hudsonica, Eurytemora affinis,* and *Temora longicornis,* with each species being prevalent in certain seasons (Stepien et al. 1981, Lonsdale and Cosper 1994, Perlmutter 1971, Hazen and Sawyer 1983). Copepods, rotifers, and barnacle larva (Cirripedia) are common microzooplankton (smallest zooplankton) (USACE & U.S. Department of Transportation (USDOT) 1984). Common larger macrozooplankton (retained on nets with mesh openings of 505 µm) are mysid shrimp (*Neomysis americana*), cumaceans, and amphipods (USACE & USDOT 1984).

BENTHIC INVERTEBRATES

Benthic macroinvertebrates live within or on sediment and associated structures, and in estuarine systems, and include molluscs, crustaceans, marine worms, and amphipods. Benthic communities are regulated by both substrate type and the quality of surface water and sediment, as tolerance to pollution varies among species. Both diversity and abundance of species tolerant or susceptible to pollution are used as relative indices of benthic community health. Benthic macroinvertebrates support higher level consumers such as fish and birds, and thus play an important role in estuarine food webs in terms of nutrient cycling (Steinberg et al. 2004). Species identified in the NY-NJ Harbor include cnidarians (i.e., anemones), annelids (i.e., oligochaete and polychaete worms), mollusks (i.e., bivalves such as clams and mussels), and arthropods (i.e., shrimps, crabs, isopods) (EA 1988, EA Engineering Science & Technology 1990, NJDEP 1984, Princeton Aqua Science 1985a & 1985b, LMS 1980 & 1984).

Table 10-2 is a list of estuarine benthic macroinvertebrates identified within the project site (DSNY 1996, Shaw 2005 and 2007). Baseline benthic community studies were conducted within the project site in 1991-1994, and post-corrective benthic community studies have been conducted from 1998 to 2006 (DSNY 1996, Shaw 2005 and 2007). Pollution-tolerant suspension and deposit feeding worms dominate the benthic community in the tidal creeks located within the project site (Richmond Creek, Main Creek and Fresh Kills) and indicate stressed conditions, although more pollution sensitive amphipods and mollusks (*Macoma balthica*) were noted in 2004 and 2006. Shaw (2007) noted that burrowing anemones of the family Edwardsiidae were more abundant in the 2006 samples than in previous years, and that these organisms may be considered to be indicative of improved habitat quality. Additionally, the 2006 sampling efforts collected a single Eastern oyster (*Crassotrea virginica*) in Main Creek. This is the first instance of a living individual of this species being collected during the 13 years of benthic macroinvertebrate monitoring at Fresh Kills. Some species differences may be due to sampling effort and classification of benthos. For instance, saltmarsh snails (*Melampus spp.)* and shrimp were noted on the 1991 species list, but not in 2004, although they most certainly were present; conversely, cnidarians and insects were noted in 2004 and not in 1991. Benthic macroinvertebrate communities in estuarine systems were not assessed as part of the 2007 AKRF field observations. However, benthic macroinvertebrates present in stormwater basins

and other open water areas, and creeks with uncertain connections to estuarine systems, were sampled during the fall AKRF survey, and are discussed at the end of this section.

Table 10-2
Estuarine Benthic Invertebrate Community for Project Site, 1991, 2004, and 2006

Scientific Name	Common Name	Tidal Zone	Year observed
PHYLUM CNIDARIA			
Class: Actiniaria			
Anemones		Subtidal	2004
Family: Edwardsiidae		Intertidal and Subtidal	2006
Edwardsia elegans		Intertidal	2006
Family: Haliplanellidae			
Haliplanella lineata		Subtidal	2006
PHYLUM NEMERTINA			
Class: Nemertea			
Proboscis worms Nemertean worms		Subtidal	1991
Celebratulus sp.		Subtidal	2004
Carinoma tremaphoros		Subtidal	2006
Family: Lineidae		Intertidal and Subtidal	2006
PHYLUM ASCHELMINTHES			
Class: Nematoda			
Aschelminthian worms Roundworms		All	1991
PHYLUM MOLLUSCA			
Class: Bivalvia			
Macoma balthica		Intertidal and Subtidal	2006
Crassostrea virginica		Subtidal	2006
Class: Gastropoda			
Hydrobia minuta	Swamp hydrobia	High & low marsh	1991
Melampus bidentatus	Saltmarsh snail	High & low marsh	1991 2006
Nassarius obsoletus	Mud snail	Intertidal	2006
Nassarius trivittatus	New England dog whelk	Subtidal	2006
Melampus bidentatus	Marsh snail	Intertidal	2006
Class: Pelecypoda			
Modiolus demissus	Ribbed mussel	Intertidal	1991
Tellina agilis	Dwarf tellin	Intertidal	1991
Macoma balthica	Baltic macoma clam	Subtidal	Both
PHYLUM ANNELIDA			
Class: Polychaeta			
Mobile Polychaetes			
Family Phyllodocidae		Intertidal and Subtidal	2006
Eteone heteropoda	Paddle worms	Intertidal and Subtidal	1991, 2004, and 2006
*Nereis succinea**	Clam worm	All	1991 and 2006
Nereis virens	Clam worm	All	1991
Nereis accuminata	Clam worm	All	2004
Notomastus latericeus	Clam worm	All	2004
Scolecolepides viridis	Clam worm	All	2004 and 2006
Sedentary Polychaetes			
Orbiniidae	Orbiniid worms	Intertidal and Subtidal	1991
*Streblospio benedicti**	Mud worm	Intertidal and Subtidal	1991, 2004, and 2006
*Polydora ligni**	Mud worm	Intertidal and Subtidal	1991, 2004, and 2006
Hypaniola grayi	Ampharetid worm	Intertidal and Subtidal	Both
Amphicteis floridus	Ampharetid worm	Intertidal and Subtidal	2006
Scolopolos fragilis		Intertidal and Subtidal	2004 and 2006
Family Capitellidae			
Heteromastus filiformis	Capitellid worm	Intertidal and Subtidal	2006
Capitella capitata	Gallery worm	Intertidal and Subtidal	2006
Class: Oligochaeta *			
Family: Tubificidae		Intertidal and Subtidal	1991, 2004, and 2006
Family: Enchytraeidae		Intertidal and Subtidal	1991, 2004, and 2006

Table 10-2 (cont'd)
Estuarine Benthic Invertebrate Community for Project Site, 1991, 2004, and 2006

Scientific Name	Common Name	Tidal Zone	Year observed
PHYLUM SIPUNCULA			
Family: Sipunculidae		Intertidal and Subtidal	2004
PHYLUM ARTHROPODA			
Class: Crustacea			
Order: Insecta			
Tabanidae			2004
Chironomus sp.			2004
Order: Cumacea		Intertidal and Subtidal	2006
Leucon americanus	Cumacean shrimp		1991
Order: Isopoda		Subtidal	2006
Cyathura polita	Slender isopod	High/low intertidal	1991, 2004, and 2006
Edotea triloba		Subtidal	2006
Order: Amphipoda			
Gammarus mucronatus	Scud	Intertidal	1991
Gammarus spp.	Scud	Intertidal	Both
Order: Decapoda			
*Palaemonetes pugio**	Shore shrimp	Subtidal	1991
Rhithropanopeus harrisii	White-fingered mud crab	Intertidal and Subtidal	1991, 2004, and 2006
Uca pugnax	Mud fiddler crab	Intertidal	1991
Crangon septemspinosa	Sevenspine bay shrimp	Subtidal	2006
Subclass Cirripedia (barnacles)			
Balanus eburneus	Acorn barnacle	Subtidal	2006

Note: *** =** pollution tolerant species
Source: DSNY (1996), Shaw (2005 and 2007).

The benthic community structure within the landfill creeks and the Arthur Kill has shown variability among sampling locations and the various years of the monitoring program and consistent upward or downward trends are not evident. However, some statistically significant improvement in benthic community descriptors have been identified. On the basis of the results from the 2006 Environmental Monitoring Program, some of these parameters are exhibiting a significant downward trend after 1998.

In 1991, the project site supported a species-poor estuarine community (i.e., low species diversity and richness) dominated by pollution-tolerant suspension and deposit-feeding detritivores, considered to be typical of benthic communities in other areas of the Arthur Kill and its tributaries. Sediment and the associated benthic community within the general Arthur Kill region has been adversely impacted by activities (i.e., discharges) from the surrounding highly urbanized area, to a greater degree than the surrounding waters (e.g., Raritan Bay). Benthic invertebrate samples were collected from the subtidal and low intertidal zones at stations in Richmond Creek, Main Creek, and Marshes Creek (a reference area in the Rahway River). Species distributions in the three creeks were similar. *Streblospio benedicti* was the most abundant polychaete worm, within the subtidal zone of all three creeks. Low intertidal zones were dominated by either *S. benedicti* or oligochaete worms. *Eteone heteropoda*, a polychaete worm within low intertidal or subtidal zones, was not as abundant as *S. benedicti*. In the upper tidal zone, oligochaetes were generally the most abundant benthic organism. Intertidal zone also contained low densities of molluscs (i.e., snails and bivalves), amphipods (*Gammarus* spp), and very low densities of the pollution-sensitive isopod (*Cyathura polita*).

Monitoring conducted in 2004 indicated similar benthic macroinvertebrate community structure in Main and Richmond creeks that were dominated by polychaete and oligochaete worms (Shaw 2005, Table 10-4). While some changes in species diversity were observed, statistically

significant trends in population shifts did not seem to indicate a wide improvement in environmental conditions within the project site.

There is some indication that benthic invertebrate distributions are changing as sediment quality improves (Adams et al. 1998). In 1993 and 1998, the EPA conducted the Regional Environmental Monitoring and Assessment Program (R-EMAP) in the NY-NJ Harbor area to examine benthic community structure and sediment contamination. In 1993, substantial proportion of sampling sites near the Arthur Kill (Newark and Raritan Bays) were considered degraded, although improvements in both sediment quality and benthic species diversity were observed (Adams and Benyi 2003). Interestingly, the percent of pollution-tolerant species significantly declined, but pollution-sensitive species did not show an increasing trend (Adams and Benyi 2003).

Freshwater benthic invertebrate sampling was performed in five areas within the project site during the fall 2007 AKRF field investigation (2 October 2007) to document the presence of macroinvertebrates in these water bodies. A dip net and small shovel were used to collect sediment, and a series of sieves (mesh sizes of 9.52, 4.70, 0.25 and 0.119 millimeter (mm)) were used to sort macroinvertebrates from the sediment. All organisms were then identified in the field to the lowest taxonomic level possible with the aid of a 10X field hand lens. The sample locations and results are described below:

- Stormwater management basin (Basin C1) just east of the confluence between Main Creek and Richmond Creek (see Appendix C, Figure 1, "Natural Resources Survey Data Collection Points," Data Collection Point 18)—Basin sediment consisted of fine brown silt. Three worm species (Subclass Oligochaeta) and one nematode (Phylum Nematoda) were collected.
- Pond near West Shore Expressway, west of Landfill Section 2/8 (South Park) (see Appendix C, Figure 1, "Natural Resources Survey Data Collection Points," Data Collection Points 35 and 36a)—Pond sediment consisted of a two to three inch layer of fine brown silt over deep, black muck. Invertebrates collected included two worm species (Subclass Oligochaeta), one copepod (Subclass Copepoda), and one mosquito larva (Family Culicidae).
- Stormwater management basin B2, east of Landfill Section 6/7 (East Park) (see Appendix C, Figure 1, "Natural Resources Survey Data Collection Points," Data Collection Point 1)—Basin sediment consisted of coarse sand with gravel and silt. Invertebrates collected included two worm species (Subclass Oligochaeta) and two unidentified insect larvae (Order Diptera). Small freshwater snails (Class Gastropoda) were observed on riprap within this basin.
- Stormwater management basin B1, east of Landfill Section 6/7 (East Park) (see Appendix C, Figure 1, "Natural Resources Survey Data Collection Points," Data Collection Point 3)—Basin sediment consisted of coarse sand with gravel and silt. Two oligochaete worms, two unidentified insect larvae (Order Diptera), and one unidentified insect larva (Class Insecta) were collected.
- Freshwater open water/palustrine forested wetland north of basin B1 (see Appendix C, Figure 1, "Natural Resources Survey Data Collection Points," Data Collection Point 6)—Basin sediment consisted of deep, fine, brown silt. Invertebrates collected in this area included two worm species (Subclass Oligochaeta), one leech (Class Hirudinea), and two unidentified insect larvae (Order Diptera).

FISH

The Arthur Kill is located at the confluence of several major river and estuarine systems, all of which discharge to the New York Bight of the Atlantic Ocean. This convergence has resulted in a mix of habitats in the Arthur Kill that can support marine fish, estuarine fish, anadromous fish (fish that

migrate up rivers from the sea to breed in freshwater), and catadromous fish (fish that live in freshwater but migrate to marine waters to breed). Some species may use it only on a seasonal basis as a migratory route between the Hudson River and Raritan Bay. Table 10-3 lists fish species with the potential to occur within the Arthur Kill and adjacent waters. Examples of resident species include naked goby (*Gobiosoma bosc)*, winter flounder (*Pseudopleuronectes americanus)*, and estuarine species such as mummichog (*Fundulus heteroclitus)*, Atlantic silverside (*Menidia menidia)*, striped killifish (*Fundulus majalis)*, and grubby sculpin (*Myxocephalus aeneus*) (USFWS 1997).

Results of sampling conducted in the Arthur Kill, Kill Van Kull, and Newark Bay in the mid-1990s (USCG 1995, and LMS 1996) indicate seasonal and spatial patterns for the most abundant fish species. Fish found to be abundant in the shoal areas included bay anchovy, striped bass, winter flounder, windowpane flounder (*Scopthalmus aquosus)*, Atlantic silverside (*Menidia menidia)*, summer flounder (*Paralichthys dentatus)*, northern pipefish (*Syngnathus fuscus)*, white perch, Atlantic herring (*Clupea harengus)*, and Atlantic tomcod (*Microgadus tomcod)*. Fish that were abundant in the channels included grubby (*Myoxocephalus aenaeus)*, scup (*Stenotomus chrysops)*, spot (*Leiostomus xanthurus)*, cunner (*Tautogolabrus adspersus)*, alewife (*Alosa pseudoharengus)*, gizzard shad, bay anchovy, rainbow smelt, Atlantic tomcod, spotted hake (*Urophycis regia)*, white perch, striped bass, weakfish (*Cynoscion regalis)*, summer flounder, and winter flounder. Fish found to be abundant in the deep-water areas included some of the same species found to be abundant in the shoal areas, as well as other species abundant only in the channel areas. Fish were much more abundant from April to October in the shoal areas, but was more consistent in the channel areas. Striped and common killifish/mummichog are also found in abundance in the shoal areas. These species, along with bay anchovy, Atlantic silverside and white perch are important forage species for larger predator fish. Duffy-Anderson et al. (2003) conducted fish sampling in the Arthur Kill on alternate weeks from August to November 1995 to characterize juvenile fish assemblages around man-made structures. Young-of-the-year comprised the majority of the individuals collected. Silver perch and naked goby were the most abundant species collected. Many of the dominant fishes were typically more abundant in structured habitats (wrecks or pile fields) than in the open water sites, and only silver perch was collected in greater numbers in open water.

Fish sampling was performed in six open water areas within the project site during the fall 2007 AKRF field investigation (2 October 2007) to document the presence of fish in these water bodies. One standard round minnow trap was used at each sampling site. Each trap was baited (one cup of dry cat food), set at a depth of 1 to 5 feet, and collected after approximately four hours. Individual fish collected in the traps were identified in the field and returned to the water body. The sample locations and trapping results are described below:

- Stormwater management basin (Basin C1), east of the confluence between Main Creek and Richmond Creek (see Appendix C, Figure 1, "Natural Resources Survey Data Collection Points," Data Collection Point 18)—A baited minnow trap was placed approximately 3 feet below the surface. Fifty-four mummichogs (*Fundulus heteroclitus*, Family Cypronodontidae), ranging in length between 1 to 3+ inches, were collected.
- Stormwater management basin (Basin C2), east of the confluence between Main Creek and Richmond Creek, and east of Basin C1 (see Appendix C, Figure 1, "Natural Resources Survey Data Collection Points," Data Collection Point 17)—A baited minnow trap placed at a depth of approximately 3 to 5 feet. Ninety-two mummichogs, ranging in length between 1 to 3+ inches, were collected.

Table 10-3
Fish Species With the Potential to Occur in the Arthur Kill

Common Name	Scientific Name
Alewife	*Alosa pseudoharengus*
American eel	*Anguilla rostrata*
American sand lance	*Ammodytes americanus*
American shad	*Alosa sapidissima*
Atlantic Croaker	*Micropogonias undulates*
Atlantic herring	*Clupea harengus*
Atlantic menhaden	*Brevoortia tyrannus*
Atlantic silverside	*Menidia menidia*
Atlantic tomcod	*Microgadus tomcod*
Bay anchovy	*Anchoa mitchilli*
Black sea bass	*Centropristis striata*
Blueback herring	*Alosa aestivalis*
Bluefish	*Pomatomus saltatrix*
Butterfish	*Peprilus triacanthus*
Crevalle jack	*Caranx hippos*
Cunner	*Tautogolabrus adspersus*
Feather blenny	*Hypsoblennius hentz*
Fourbeard rockling	*Enchelyopys cimbrius*
Grubby	*Myoxocephalus aenaeus*
Hickory shad	*Alosa mediocris*
Hogchoker	*Trinectes maculates*
Inland silverside	*Menidia beryllina*
Inshore lizardfish	*Synodus foetens*
Little skate	*Raja erinacea*
Mummichog	*Fundulus heteroclitus*
Naked Goby	*Gobiosoma bosc*
Northern kingfish	*Menticirrhus saxitilis*
Northern pipefish	*Syngnathus fuscus*
Northern puffer	*Sphoeroides maculates*
Northern searobin	*Prionotus carolinus*
Northern stargazer	*Astroscopus guttatus*
Orangespotted filefish	*Cantherhines pullus*
Oyster toadfish	*Opsanus tau*
Pollock	*Pollachius virens*
Rainbow smelt	*Osmersus mordax*
Red hake	*Urophycis chuss*
Rock gunnel	*Pholis gunnellus*
Scawled cowfish	*Lactophrys quadricornis*
Scup	*Stenotomus chrysops*
Sea horse	*Hippocampus erectus*
Seaboard goby	*Gobiosoma ginsburgi*
Silver hake	*Merluccius bilinearis*
Silver Perch	*Bairdiella chrysoura*
Smallmouth flounder	*Etropus microstomus*
Spanish mackerel	*Scomberomorus maculates*
Speckled worm eel	*Myrophis punctatus*
Spot	*Leiostomus xanthurus*
Spotfin butterflyfish	*Chaetodon ocellatus*
Spotted Hake	*Urophycis regia*
Striped bass	*Morone saxatilis*
Striped burrfish	*Chilomycterus schoepfi*
Striped cusk-eel	*Ophidion marginatum*
Striped killifish	*Fundulus majalis*
Striped mullet	*Mugil cephalus*
Striped searobin	*Prionotus evolans*
Summer flounder	*Paralichthys dentatus*
Tautog	*Tautoga onitis*
Weakfish	*Cynoscion regalis*
White mullet	*Mugil curema*
White perch	*Morone Americana*
Windowpane	*Scopthalmus aquosus*
Winter flounder	*Pseudopleuronectes americanus*

Sources: DSNY (1996), Able and Fahay (1998), Duffy-Anderson et al. (2003), USCG (1995), and LMS (1996).

- Channel receiving drainage from pond sampled for benthic macroinvertebrates, west of Landfill Section 2/8 (South Park) and east of the West Shore Expressway (see Appendix C, Figure 1, "Natural Resources Survey Data Collection Points," Data Collection Point 36a)—A baited minnow trap was placed in the channel at a depth of 1.5 feet. Eighty-two mummichogs, ranging in length between 1 and 3+ inches were collected.
- Stormwater management basin B2, east of Landfill Section 6/7 (East Park) (see Appendix C, Figure 1, "Natural Resources Survey Data Collection Points," Data Collection Point 1), Stormwater management basin B1, east of Landfill Section 6/7 (East Park) (see Appendix C, Figure 1, "Natural Resources Survey Data Collection Points," Data Collection Point 3), and freshwater open water/palustrine forested wetland north of basin B1 (see Appendix C, Figure 1, "Natural Resources Survey Data Collection Points," Data Collection Point 6)—At basins B2 and B1, baited minnow traps were placed at depths of 3 feet and 2 feet, respectively. Due to the relatively dry conditions at the period of the sampling, the baited trap was set at a depth of about 6 inches within the freshwater open water/palustrine forested wetland north of basin B1. No fish were captured in traps at these three sampling locations, although movement at the surface indicated the presence of fish in these water bodies. Carp (Family Cyprinidae) were noted at the surface of the open water portion of the freshwater wetland north of Basin B1, and sunfish (Family Centrarchidae) and catfish (Family Ictaluridae) were observed previously in basins B1 and B2, and the freshwater open water/palustrine forested wetland north of basin B1.

Project Site—Main and Richmond Creeks

DSNY conducted a survey of the fish community within Main and Richmond Creeks in May 1995 to supplement the available data regarding fish species in the vicinity of the Fresh Kills Landfill. The fish communities in Main and Richmond Creeks appeared to be typical of communities found in small, estuarine waters. The community composition in these creeks was consistent with results from previous studies and other available information on fish communities in the Arthur Kill. Fish species collected included American eel, blueback herring (*Alosa aestivalis)*, Atlantic menhaden (*Brevoortia tyrannus)*, bay anchovy, mummichog, three-spine stickleback (*Gasterostreus aculeatus*), Atlantic silversides, hogchoker (*Trinectes maculates)*, striped bass, and white perch (DSNY 1996).

Essential Fish Habitat

The site is located on the Arthur Kill within a portion of the Raritan Bay River Estuary Essential Fish Habitat (EFH) that is situated in NOAA/NMFS 10' x 10' square with coordinates (North) 40°40.0' N, (East) 74°10.0' W, (South) 40°30.0' N, (West) 74°20.0' W, and which includes estuarine Raritan Bay waters within a portion of Newark Bay and the Arthur Kill. The area of the Arthur Kill containing the Fresh Kills Park project site has been identified as EFH for 16 species of fish. Table 10-4 lists the species and life stages of fish identified as having EFH in the Arthur Kill.

HABITATS AND COMMUNITIES

The following sections describe the existing habitats and communities in the primary study area (i.e., the "project site") and secondary study area (i.e., select locations in the vicinity of the project site; see Figure 10-3). Information provided below is based on previous documents regarding the project site, and 2007 field observations by AKRF Inc. Appendix C contains the Natural Resources Field Survey Plan, the reference map identifying the data collection locations, and field data sheets.

Table 10-4
Essential Fish Habitat Designated Species for the Arthur Kill

Species	Eggs	Larvae	Juveniles	Adults
Red hake (*Urophycis chuss*)		X	X	X
Winter flounder (*Pseudopleuronectes americanus*)	X	X	X	X/S
Windowpane (*Scopthalmus aquosus*)	X	X	X	X/S
Atlantic herring (*Clupea harengus*)		X	X	X
Bluefish (*Pomatomus saltatrix*)			X	X
Atlantic butterfish (*Peprilus triacanthus*)		X	X	X
Atlantic mackerel (*Scomber scombrus*)			X	X
Summer flounder (*Paralicthys dentatus*)		X	X	X
Scup (*Stenotomus chrysops*)	X	X	X	X
Black sea bass (*Centropristus striata*)			X	X
King mackerel (*Scomberomorus cavalla*)	X	X	X	X
Spanish mackerel (*Scomberomorus maculatus*)	X	X	X	X
Cobia (*Rachycentron canadum*)	X	X	X	X
Clearnose skate (*Raja eglanteria*)			X	X
Little skate (*Leucoraja erinacea*)			X	X
Winter skate (*Leucoraja ocellata*)			X	X

Note: "S" indicates habitat for spawning adults.
Source: National Marine Fisheries Service. "Summary of Essential Fish Habitat (EFH) Designation" posted on the internet at http://www.nero.noaa.gov/hcd/ny3.html.

Figure 10-7 presents the general land cover classifications identified for the project site. In addition, Figures 10-8 through 10-44 provide photographs of some of the key images over the site in the vicinity of the proposed East Park, North Park, South Park, West Park, central area, and secondary study area locations.

GENERAL CONDITIONS

The impact of past and present human activities on the landscape in both the project site and secondary study area is readily apparent. Within the project site, the presence of 50-year-old Municipal Solid Waste Landfilling sites with a substantial infrastructure, service roads, a waste transfer station, and other facilities are clear indications of the extent of human use of the site. However, Fresh Kills is also one of the largest contiguous upland areas in New York City where access is restricted, human activities are relatively limited, and where the landscape is incrementally shifting towards the development (both natural and assisted) of complex habitat assemblages. Presently, the vast project site contains numerous upland habitats, including 10- to 50-year-old woodlands and expanses of both native and non-native grasslands. A number of these habitats are considered rare or critical within the city and state, and represent valuable sites for flora and fauna in their present condition.

Additionally, limited nighttime lighting is present within the project site, making the project site one of the darkest sites in the New York City area. Nighttime lighting within the project area is limited to the West Shore Expressway, public streets (such as Arthur Kill Road and Richmond Avenue) that surround the project site, and roadway lights along paved roads, bridges and facility areas within former Fresh Kills Landfill. The majority of existing secondary roads, such as those surrounding or traversing landfill sections, are presently unlit; this likely supports numerous wildlife activities (i.e., breeding, foraging) that would not occur in natural areas of the city that are directly or indirectly illuminated.

PLANT COMMUNITIES

Plant communities present within the project site and secondary study area are described using terms introduced by SCS Engineers (1990) and adopted by AES (2003) in their subsequent plant

community surveys. Categories differ from habitat classifications described in Edinger et al. (2000), but are used in this report for the sake of continuity with previous plant surveys.

The 1996 DEIS describes the project site's upland communities areas as "a highly disturbed upland plant community dominated by grasses" and categorized as early- and late-successional old field communities and early deciduous forest, with associated tidal wetland habitat classifications following Cowardin et al. (1979). Table 10-5 lists plant species identified in the 1996 DEIS as present within the project site (specifically Landfill Sections 1/9 and 6/7) and in tidal wetlands during field observations, and whether they were observed during the 2007 field observations. Figure 10-7 illustrates the current distribution of land cover categories within the project site.

Project Site

Spartina-dominated Marsh

The project site contains approximately 160 acres of relatively undisturbed *Spartina*-dominated salt marsh (SCS Engineers 1990, AES 2003, AKRF 2007). These areas generally are located in the Main Creek area of the site north of Landfill Section 6/7, and along Richmond Creek south of Landfill Section 6/7. One of these tidal estuaries (Richmond Creek) has been identified by the HEP as a priority enhancement site (HEP 2007). These marshes are predominantly low marsh vegetated with *Spartina alterniflora*, with smaller areas of high marsh vegetation (i.e., *Spartina patens*, *Distichlis spicata).* Groundselbush (*Baccharis halimifolia*) is present throughout the area's salt marsh communities.

Mixed Marsh

Much of the shoreline habitats in the project site are vegetated with patches of *Spartina alterniflora* and *Phragmites australis*. Areas of *Spartina alterniflora,* approximately 5 -25 feet in width, exist along the shoreline, generally at the mid and mean high tide elevation levels. Stands of *Phragmites* are associated with *Spartina* fragments or alone, and tend to be located along wetland edges, and transitional areas between wetland and upland areas. Groundselbush is also present within these mixed marsh areas, but less frequently than *Spartina* and *Phragmites*.

There is evidence that the marsh community species composition has changed in some areas of the project site over time, possibly due to changes in site activity associated with the closure of the landfill. For instance, a 32-acre scraped shoreline community vegetated with *S. alterniflora, S. patens, D. spicata,* and *Phragmites* was described along Landfill Sections 1/9 and 3/4 in 1990 (SCS Engineers 1990). These areas are now predominantly vegetated with *Spartina alterniflora* immediately along the shoreline, with small stands of *Phragmites* and groundselbush (AES 2003, AKRF 2007).

Phragmites-Dominated Emergent/Scrub-Shrub Wetlands

Historically, many areas within the project site were vegetated with scrub-shrub and emergent species including blunt spikerush (*Eleocharis obtusa),* sensitive fern (*Onoclea sensibilis)* and other common emergent species (SCS Engineers 1990). However, *Phragmites*-dominated emergent and scrub-shrub wetlands are common communities in wetland areas, in both tidal areas and areas isolated from any tidal exchange. As observed in marshlands throughout the region, *Phragmites* is becoming increasingly dominant in emergent/scrub-shrub wetlands in many areas of the project site (SCS 1990, AES 2003, AKRF 2007). It occurs in the ponded area at the southeast edge of Landfill Section 6/7, and the stormwater management basin to the north, in depressions at the base of some of the mounds, adjacent to roadways (i.e., West Shore Expressway), within the drainage between the two portions of Landfill Section 2/8 that is a tributary to Richmond Creek, and on the eastern side of Isle of Meadows.

Table 10-5
Plant Species Known to Occur Within the Project Site

Common Name	Scientific Name	Observed in 2007
Grasses/Sedges/Rushes		
Bentgrass	*Agrostis sp.*	
Broom sedge	*Andropogon virginicus*	
Japanese Broom	*Bromus japonicus*	
Sedge	*Carex spp.*	X
Tussock sedge	*Carex stricta*	X*
Blunt broom sedge	*Carex tribuloides*	
Umbrella sedge	*Cyperus strigosus*	X
Crabgrass	*Digitaria filiformis*	
Saltgrass	*Distichlis spicata*	X
Barnyard grass	*Echinochloa crus-galli*	X
Blunt spike rush	*Eleocharis obtusa*	X
Spike rush	*Eleocharis sp.*	X
Fescue	*Festuca sp.*	X
Squirrel-tail grass	*Hordeum jubatum*	X*
Canadian rush	*Juncus canadensis*	
Soft rush	*Juncus effusus*	X
Path rush	*Juncus tenuis*	X*
Panic grass	*Panicum spp.*	X
Philadelphia panic grass	*Panicum philadelphicum*	
Switchgrass	*Panicum virgatum*	X
Reed canary grass	*Phalaris arundinacea*	X
Common reed	*Phragmites australis*	X
Sturdy bulrush	*Schoenoplectus robustus*	
Woolgrass	*Scirpus cyperinus*	X
Foxtail grass	*Setaria sp.*	
Green foxtail	*Setaria viridis*	
Saltwater cordgrass	*Spartina altemiflora*	X
Salt reed grass	*Spartina cynosuroides*	
Salt-meadow grass	*Spartina patens*	X
Broad-leaved cattail	*Typha latifolia*	X
Forbs		
Yarrow	*Achillea millefolium*	X
Purple false foxglove	*Agalinis purpurea*	X
White snakeroot	*Ageratina altissima*	X*
Scented thoroughwort	*Ageratina aromatica*	
Marsh water-hemp	*Amaranthus cannabinus*	
Common ragweed	*Ambrosia artemisiifolia*	X
Indianhemp	*Apocynum cannabinum*	
Biennial wormwood	*Artemisia biennis*	
Common mugwort	*Artemisia vulgaris*	X
Common milkweed	*Asclepias syriaca*	X
Marsh orache	*Atriplex patula*	
Bearded beggarticks	*Bidens aristosa*	
False nettle	*Boehmeria cylindrica*	X*
Patridge pea	*Chamaecrista nictitans*	X
Lambs quarters	*Chenopodium album*	
Mexican tea	*Chenopodium ambrosioides*	
Common chicory	*Cichorium intybus*	X*
Canada thistle	*Cirsium arvense*	
Bull thistle	*Cirsium vulgare*	X

Table 10-5 (cont'd)
Plant Species Known to Occur Within the Project Site

Common Name	Scientific Name	Observed in 2007
Forbs (cont'd)		
Asiatic dayflower	*Commelina communis*	X
Horseweed	*Conyza canadensis*	
Whorled coreopsis	*Coreopsis verticillata*	X*
Fiveangled dodder	*Cuscuta pentagona*	
Queen Anne's Lace	*Daucus carota*	
Hay-scented fern	*Dennstaedtia punctilobula*	
White thoroughwort	*Eupatorium album*	X*
Hyssop-leaf thoroughwort	*Eupatorium hyssopifolium*	X*
Common boneset	*Eupatorium perfoliatum*	X*
Late-flowering thoroughwort	*Eupatorium serotinum*	
Slender goldenrod	*Euthamia tenuifolia*	X*
Wild sunflower	*Helianthus annuus*	
Jewel weed	*Impatiens capensis*	X*
White morning glory	*Ipomoea lacunosa*	X*
Marsh elder	*Iva frutescens*	
Bugleweed	*Lycopus sp.*	X
White sweet clover	*Melilotus alba*	X
Evening primrose	*Oenothera biennis*	
Sensitive fern	*Onoclea sensibilis*	X
Cinnamon fern	*Osmunda cinnamomea*	X
Pokeweed	*Phytolacca americana*	X
Common plantain	*Plantago major*	X*
Lady's thumb	*Polygonum cespitosum*	X*
Japanese knotweed	*Polygonum cuspidatum*	X
Nodding knotweed	*Polygonum lapathifolium*	
Dotted smartweed	*Polygonum punctatum*	
Pennsylvania knotweed	*Polygonum pensylvanicum*	
Climbing false buckwheat	*Polygonum scandens*	
Knotweed	*Polygonum spp.*	X
Sweet everlasting	*Pseudognaphalium obtusifolium*	
Curly dock	*Rumex crispus*	X
Climbing nightshade	*Solanum dulcamara*	
Common nightshade	*Solanum ptycanthum*	X*
Canada goldenrod	*Solidago canadensis*	X
Grass-leaved goldenrod	*Solidago graminifolia*	X
Sweet goldenrod	*Solidago odora*	
Wrinkled goldenrod	*Solidago nigosa rugosa*	X
Goldenrods	*Solidago sp.*	X
Small white aster	*Symphyotrichum lateriflorum*	X*
Heath aster	*Symphyotrichum pilosus*	X
Marsh aster	*Symphyotrichum subulatus*	X
Skunk cabbage	*Symplocarpus foetidus*	X
Dandelion	*Taraxacum sp.*	
Lesser hop clover	*Trifolium campestre*	X*
Red clover	*Trifolium pratense*	X
Common mullein	*Verbascum thapsus*	
Swamp vervain	*Verbena hastata*	
White vervain	*Verbena urticifolia*	
Tall ironweed	*Vernonia gigantea*	
Cocklebur	*Xanthium strumarium*	

Table 10-5 (cont'd)
Plant Species Known to Occur Within the Project Site

Common Name	Scientific Name	Observed in 2007
Woody Plants		
Red maple	*Acer rubrum*	X
Silver maple	*Acer saccharinum*	X
Tree-of-heaven	*Ailanthus altissima*	X
Mimosa tree	*Albizia julibrissin*	
Hazel alder	*Alnus serrulata*	
Serviceberry	*Amelanchier sp.*	X
Groundselbush	*Baccharis halimifolia*	X
Gray birch	*Betula populifolia*	X
Gray dogwood	*Cornus .racemosa*	X*
Silky dogwood	*Cornus amomum*	
Persimmon	*Diospyros sp.*	X
White ash	*Fraxinus americana*	X
Green ash	*Fraxinus pennsylvanica*	X
Witch hazel	*Hamamelis virginiana*	X
Eastern red cedar	*Juniperus virginiana*	X*
Spicebush	*Lindera benzoin*	X
Sweet gum	*Liquidambar styraciflua*	X
Tulip tree	*Liriodendron tulipifera*	X
Crabapple	*Malus spp.*	X*
Bayberry	*Morella pensylvanica*	
White mulberry	*Morus alba*	X
Black tupelo	*Nyssa sylvatica*	X
Princess tree	*Paulownia tomentosa*	X*
Chokeberry	*Photinia sp.*	X*
Black chokeberry	*Photinia melanocarpa*	
White pine	*Pinus strobus*	X
Cottonwood	*Populus deltoides*	X
Large-toothed aspen	*Populus grandidentata*	X
Sour cherry	*Prunus cerasus*	
Black cherry	*Prunus serotina*	X
White oak	*Quercus alba*	X
Swamp white oak	*Quercus bicolor*	X
Scarlet oak	*Quercus coccinea*	X*
Pin oak	*Quercus palustris*	X
Willow oak	*Quercus phellos*	X*
Red oak	*Quercus rubra*	X
Winged sumac	*Rhus copallinum*	X
Smooth sumac	*Rhus glabra*	
Staghorn sumac	*Rhus typhina*	X
Black locust	*Robinia pseudoacacia*	X
Multiflora rose	*Rosa multiflora*	X
Blackberry	*Rubus sp.*	X
Blackberry	*Rubus allegheniensis*	X
Pussy willow	*Salix discolor*	
Black willow	*Salix canadensis*	X
Common elderberry	*Sambucus nigra*	X
Sassafras	*Sassafras albidum*	X
Eastern hemlock	*Tsuga canadensis*	X
American elm	*Ulmus americana*	X
Blueberry	*Vaccinium sp.*	X

Table 10-5 (cont'd)
Plant Species Known to Occur Within the Project Site

Common Name	Scientific Name	Observed in 2007
Woody Plants (cont'd)		
Highbush blueberry	*Vaccinium corymbosum*	X*
Black highbush blueberry	*Vaccinium fuscatum*	X*
Arrow-wood	*Viburnum dentatum*	X
Vines		
Porcelainberry	*Ampelopsis brevipedunculata*	X*
Oriental Bittersweet	*Celastrua orbiculatus*	X
Common bindweed	*Convolvulus arvensis*	
Bush honeysuckle	*Lonicera sp.*	X*
Japanese honeysuckle	*Lonicera japonica*	X
Virginia creeper	*Parthenocissus quinquefolia*	X
Greenbrier	*Smilax rotundifolia*	X
Poison ivy	*Toxicodendron radicans*	X
Fox Grape	*Vitis labrusca*	X*

Notes: The species above were noted in 1996 at Landfill Sections 1/9 and 6/7 at the project site, and verified in 2007 by AKRF.
Sources: DSNY 1996, AKRF field observations, May and October 2007.
X—plant species observed during the May 2007 field investigation
X*—plant species observed during the October 2007 field investigation

Palustrine Forested Wetlands

Palustrine forested wetlands are present within the southern portion of the project site—south and east of the West Shore Expressway, across from Arden Heights Woods, and south of Landfill Section 2/8. Here, red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), pin oak (*Quercus palustris*), and green ash (*Fraxinus pennsylvanica*) are the dominant tree species (SCS Engineers 1990). These communities are relatively undisturbed and of similar composition to those described in earlier studies. Spicebush (*Lindera benzoin*) and arrow-wood (*Viburnum dentatum*) are the dominant understory shrub species. Jewelweed (*Impatiens capensis*) is the common herbaceous species. *Phragmites* occurs along the outer edges of these forested communities. Poison ivy (*Toxicodendron radicans*) and Virginia creeper (*Parthenocissus quinquefolia*) occur within the interior and along the upland-wetland edges. Japanese knotweed (*Polygonum cuspidatum),* an invasive species, also occurs within these communities.

Mixed Palustrine Forested and Emergent Wetlands

As described previously under "Wetlands," a mixture of palustrine forested and emergent wetlands exists along the northwestern border of the North Park section of the project site and in the basins east of Landfill Section 6/7. Within the freshwater wetlands of North Park, the northeastern section of the observed wetland system extends toward tidal wetlands associated with Main Creek, while the southwestern section extends toward West Shore Expressway (Hartzel 2007). As previously described, plant species associated with the emergent wetland areas include *Phragmites*, spike rush, switchgrass, smartweeds, and sedges. The forested wetlands are characterized by red maple, pin oak, sweet gum, black gum, gray birch, black willow, sassafras, arrowwood, smartweeds, and greenbrier (AKRF 2007).

AES further described wetlands along the northwestern border of North Park and other areas centrally located within the North Park section of the site. These areas are described as being vegetated with native grasses, rushes, sedges, and include woody plants such as elderberry (*Sambucus sp.*), blackberry (*Rubus sp.*), arrow-wood, and sweet gum (AES 2007).

Phragmites/Mugwort-dominated Field with Woody Vegetation

The project site has approximately 150 acres of areas vegetated predominantly with *Phragmites* and mugwort (SCS Engineers 1990, AES 2003). During 2007 AKRF field observations, *Phragmites* and mugwort (*Artemisia vulgaris)* were the most abundant species at former landfill areas in the northern (i.e. Travis Landfill area, northern portion of North Park) and southern (i.e., Arden Avenue Landfill (future Owl Hollow Park) and West Shore Expressway Landfill located east of the West Shore Expressway and south of Landfill Section 2/8) portions of the project site. These areas are typically composed of early successional native species and introduced species that colonize urban vacant land. Subdominant species observed throughout these areas included tree-of-heaven *(Ailanthus altissima)*, black cherry (*Prunus serotina*), black locust (*Robinia pseudoacacia*), Japanese knotweed, ragweed (*Ambrosia* spp.), and goldenrod (*Solidago* spp.).

Maturing Woodland

The majority of maturing woodland communities are located at older landfills within the project site. The maturing woodland located at the southwest corner of the project site (south of Landfill Section 1/9 and the West Shore Expressway), is an upland, late-successional forest predominantly vegetated with pin oak (*Quercus palustris*), gray birch (*Betula populifolia*), sassafras, and bigtooth aspen (*Populus grandidentata*) (SCS Engineers 1990, AES 2003), and also greenbriar (*Smilax rotundifolia*), black locust, and several introduced species (i.e., tree-of-heaven, multiflora rose (*Rosa multiflora*), and Japanese knotweed).

Two areas formerly identified as young woodlands in 1990 are now better characterized as maturing woodlands with some wetland-tolerant species. The first of these woodland areas is located south of Richmond Creek and southeast of Landfill Section 2/8. Previously described as a predominantly upland, late-successional forest with both upland and freshwater wetland-tolerant species (SCS 1990, AES 2003), the canopy of this maturing woodland is composed of maturing red maple, gray birch sassafras, pin oak, and black tupelo (*Nyssa sylvatica*), with an understory of black cherry, poison ivy, and cinnamon fern (*Osmunda cinnamomea*) (SCS Engineers 1990). Additional species observed in 2007 included black locust, tree of heaven, and eastern cottonwood, and Japanese knotweed and Virginia creeper in the understory.

The second maturing woodland is located southwest of Landfill Section 2/8. In 1990, this woodland was described as a young woodland with a sparse canopy (SCS Engineers 1990). It was later described as a late-successional area supporting a similar species complement as the other reclassified young woodland described above (AES 2003). This woodland is currently vegetated with species tolerant of wet conditions, including red maple, sweet-gum, pin oak, northern arrowwood, and poison ivy. However, portions of the woodland also have a mix of wetland and upland species. These woodlands also contain silver maple (*Acer saccharinum),* spicebush, black cherry, sassafras, tree-of-heaven, and Virginia creeper. Wetland hydrology (i.e., standing water) was present at the time of the May 2007 field observations.

A maturing woodland community not previously mapped was observed in the southeastern portion of the East Park area (southeast of Landfill Section 6/7) of the site. This woodland was observed to be densely vegetated with a mixture of upland and wetland tolerant species including sweetgum, grey birch, arrowwood, blackberry, poison ivy, and Japanese honeysuckle.

During the fall 2007 field observations, an additional maturing woodland community was observed in the South Park area, southeast of West Shore Expressway. This area was bordered by a *Phragmites*-dominated drainage feature to the north and west (immediately adjacent to West Shore Expressway) and an existing drainage channel to the south and east. Species

observed in this community included red maple, grey birch, sassafras, black locust, tree-of-heaven, *Phragmites*, and poison ivy.

Maturing woodlands also occur on the berms developed and planted along Arthur Kill Road and Richmond Avenue to visually screen the landfill from neighboring areas. These linear woodlands support species such as red oak (*Quercus rubra*), tulip poplar (*Liriodendron tulipifera*), black cherry, with an understory of multiflora rose, poison ivy, and Virginia creeper, and less-frequently observed *Phragmites*, grape (*Vitis* sp.), blueberry (*Vaccinium* sp.), black locust, and groundselbush (2007 AKRF).

Grass/Forb Dominated

The Landfill Sections 1/9, 2/8, 3/4, and 6/7 (see Figure 10-7) are dominant features within the project site. These mounds are vegetated by *Phragmites*, mugwort, cover crop areas, cool season grasses, and native grasses (AES 2003, AKRF 2007). Common species include switchgrass (*Panicum* spp.), fescue (*Festuca* spp.), asters (*Symphyotrichum* spp.), hopclover, and Kentucky blue grass (*Poa pratensis*). *Phragmites* observed within grass/forb dominated areas was found on mounds, but not as a dominant species. Grass/Forb dominated communities also were observed in non-mound areas, including a portion of Isle of Meadows, and supported several upland and wetland grass and forb species, including *Panicum* spp. grasses, mugwort, common ragweed (*Ambrosia artemisiifolia*) in dry areas, and broad-leaved cattail (*Typha latifolia*) and several species of sedges and rushes in the wet areas (AKRF 2007).

Young tree species, including black locust, cottonwood, tree-of-heaven, and white mulberry (*Morus alba*), are present in the grass/forb dominated areas and adjacent swales, suggesting some forest succession and seed dispersal on the site, as well as planting activity over the past 20 years.

Secondary Study Area

The secondary study area is composed of city-owned parklands, natural areas, and undeveloped land with varied levels of human use, including Willowbrook Park, the north section of the William T. Davis Wildlife Refuge, a marsh and upland area west of Route 440 between Neck Creek Marsh and Little Fresh Kill, LaTourette Park, Arden Heights Woods Park, South Shore Golf Course. As virtually all plant communities listed above are represented in the non-contiguous sites that comprise the secondary study area, each property will be discussed individually.

Willowbrook Park

This DPR property is a 164-acre park located east and south of the intersection of Richmond Avenue and Victory Boulevard, and northeast of Landfill Section 6/7. It has both active recreational uses and unpaved hiking trails through natural woodland areas. Plant communities within the park include:

- Mature woodlands containing tulip tree, red and white oak (*Quercus alba)*, black cherry, tree-of-heaven, black locust, American elm (*Ulmus americana)*, and Japanese knotweed;
- Palustrine forested wetlands (as indicated in Figures 10-5 and 10-6) containing red maple, sweet-gum, arrow-wood, spicebush, and jewelweed;
- Active, regularly maintained grass recreational fields; and
- Open water (pond)

South Shore Golf Course Park

The South Shore Golf Course Park includes an 18-hole golf course in addition to undeveloped young and mature upland forest sections. A portion of the woodland has species tolerant of wet conditions and is mapped as palustrine forested wetlands by the NWI. Sweet-gum, red maple,

sassafras, tulip poplar, poison ivy, and Virginia creeper are present within the woodlands. The remainder of this property consists of the golf course and other managed facilities.

Arden Heights Woods Park

The 185-acre Arden Heights Woods Park is located south of West Shore Expressway and Landfill Section 1/9. The park is listed as a NY-NJ HEP priority restoration site, and an adjoining woodland area to the east listed as a priority acquisition site (HEP 2007). Most of the park is a palustrine forested wetland, and is the largest of this wetland type classified by DEC within the New York metropolitan area. It contains several kettle ponds that are connected by streams and mature forested uplands. The main stream passes under Arthur Kill Road and continues into the project site at a location south of Muldoon Avenue. DEC has identified the freshwater wetlands within Arden Heights Woods as freshwater wetland AR-5 freshwater wetland, and classified these wetlands as a Class I wetland system. The majority of wetlands within AR-5 are described as palustrine, broad-leaved deciduous forested wetlands with seasonal flooding. DPR has identified 14 plant communities within the park, closed forest, swamp forest, emergent wetland, denuded forest understory, and shrub swamp, with closed forest as the most prevalent coverage. The varied topography of the area allows for freshwater marshes, ponds, streams, grassy fields, as well as uplands dominated by oak and hickory (*Carya spp*.).

Most of the Arden Heights Woods Park appears to be relatively undisturbed with few invasive plant species. However, Japanese knotweed does occur along the periphery at the southern and southwestern edges of the park. Vegetation in upland portions of the park include mixed species of oak, beech (*Fagus sp.*), red maple and sweetgum, with poison ivy and Virginia creeper comprising the understory. Other species known to occur in the upland woods include eastern hemlock (*Tsuga canadensis*), black cherry, persimmon (*Diospyros sp.*), and eastern white pine (*Pinus strobus*) (DPR 2007). Red maple, sweetgum, pin oak, highbush blueberry (*Vaccinium corymbosum*), spicebush, jewelweed, and poison ivy occur in the forested wetlands within the park.

LaTourette Park

LaTourette Park is a large, 540-acre open space area located east of Landfill Section 6/7 and Richmond Parkway. Communities within the park include:

- *Spartina*-dominated marsh containing saltmarsh cordgrass, salt hay, groundsel bush, and common reed bordering Richmond Creek, which traverses the park;
- Palustrine forested wetlands containing red maple, sweetgum, black willow, ash (*Fraxinus* sp.), arrow-wood, highbush blueberry, jewelweed, and skunk cabbage *(Symplocarpus foetidus)*;
- Young and mature forested uplands containing various oak species, tulip tree, tree-of-heaven, black cherry, and witch hazel (*Hamamelis virginiana*);
- Grass/forb dominated areas containing goldenrod, aster, and mixed grasses; and
- Active, managed recreational fields, a golf course, and park facilities.

William T. Davis Wildlife Refuge

A large proportion of the 340-acre William T. Davis Wildlife Refuge, located north of Fresh Kills Landfill Sections 3/4 and 6/7, is divided by the northern border of the project site. Therefore, the refuge exists in both the project site and the secondary study area. The refuge is the first and oldest wildlife refuge in New York City, and was the home to the first Audubon Center of New York City (Staten Island Greenbelt 2007). Plant communities on-site include:

- *Spartina*-dominated marsh containing saltmarsh cordgrass, salt hay, groundsel bush, and common reed, consistent with other tidal communities observed at the project site and surrounding areas;
- Palustrine forested wetlands containing red maple, sweetgum, arrow-wood, and spicebush; and
- Mainly mature forested uplands containing red maple, tulip tree, red and white oak, and Virginia creeper. In some areas, introduced species such as Japanese knotweed and tree-of-heaven are beginning to become established.

A detailed site assessment of William T. Davis Refuge was conducted in 2005 by the Staten Island Museum, DPR -NRG, and other organizations (Johnson and Matarazzo 2006). The study was funded by the NYC Environmental Fund (NYCEF) to inform upcoming initiatives proposed for the refuge, including habitat management, trail creation, development of interpretive signage, and environmental education programs. In addition to coastal Spartina marshes and freshwater marshlands, high-quality swamp forest was noted as a dominant habitat, with canopy (i.e., sweetgum, American elm, red maple and white ash) and understory (i.e., arrow-wood, spicebush, elderberry and swamp dogwood) similar to swamp forests in other secondary study areas and within the project area. Approximately 57 plant species were noted as new to the refuge since plant surveys conducted in the 1950's, with 31% of these being invasive species (i.e., garlic mustard, Norway maple, multiflora rose, black locust, etc.). Few common mammal, reptile and amphibian species were observed at the refuge; however, the northern diamondback terrapin A New York state game species and watch list species on NYNHP's 2007 Rare Animal Status List) was observed. Numerous bird species (including waterfowl, shorebirds, wading birds, and songbirds) were observed in the relatively diverse habitats of the refuge, including breeding willet, great horned owl and yellow-billed cuckoo. Additional site work at the refuge, including an environmental education program for the NYC High School for Environmental Studies, is planned for 2008 (Lisa Garrison, NYCEF, 8 January 2008).

Arthur Kill Coastal Area - Neck Creek Marsh to Victory Boulevard

Two undeveloped parcels of land, zoned as 'industrial' and totaling approximately 110 acres, are located north of the project site along the Arthur Kill. These parcels are listed as an HEP priority acquisition sites (HEP 2007), and described as valuable to regional wildlife and plant communities in Trust for Public Land's "An Islanded Nature" (2001). The northern parcel contains Neck Creek Marsh and associated uplands, is bisected by Route 440 and located west of the Travis neighborhood. The southern parcel contains a variety of undeveloped land west of Route 440, south of Victory Boulevard and north of Little Fresh Creek. These parcels contain the following communities:

- *Spartina*-dominated and mixed marsh containing saltmarsh cordgrass, salt hay, groundsel bush, and common reed, consistent with other tidal communities observed at the project site and surrounding areas;
- *Phragmites*-dominated emergent/scrub-shrub wetlands surrounding freshwater ponds;
- Palustrine forested wetlands containing red maple, sweetgum, arrow-wood, and spicebush;
- Young and mature forested uplands containing red maple, tulip tree, red and white oak, and Virginia creeper. In some areas, introduced species such as Japanese knotweed and tree-of-heaven are beginning to establish a foothold; and
- Various paved and unpaved roads.

WILDLIFE

The various ecological communities, terrestrial and aquatic, present at the project site and surrounding areas provides suitable habitat for a variety wildlife species including a diverse number of birds, in addition to various species of mammals, reptiles, and fish. The following section presents an overview of the species observed during 2007 AKRF field observations (Appendix C), wildlife observed during other surveys and investigations of the project site; publicly documented records of wildlife use of the project site and secondary study area; other species known to occur on Staten Island; and species with the potential to use the project site and secondary study area on the basis of existing habitats observed during the field studies. Wildlife known to occur within the secondary study area would have the potential to occur within the project site should similar habitat be present.

Project Site

Birds

As described above, the project site has a diverse range of habitats and ecological communities including tidal wetlands and tidal waters, freshwater emergent and forested wetlands, freshwater ponds and streams, upland forests, and a variety of fields and open meadow habitats available for use by birds as foraging, nesting, breeding, and roosting habitat. Additionally, the Arthur Kill provides important foraging areas for many waterbirds (i.e., ducks, wading birds, shorebirds). Until 2001, several species of wading birds (i.e., herons, egrets, ibis), gulls, and waterfowl nested within the project site on Isle of Meadows. The project site also provides important foraging habitat for migratory songbirds and raptors, and nesting habitat for several grassland and marsh-obligate species (USFWS 1997). The Arthur Kill and its tributaries are known to be important to both resident and migrating birds (Kane et. al 1991). Migrating songbirds using areas around the project site as stopover sites may prefer larger woodland areas on and adjacent to the project site, rather than edge and scrub habitats, as observed by Kerlinger (1996). *Phragmites* marshes such as those found within and adjacent to the project site are also known to provide habitat for a number of resident bird species, including rails and other rare breeding species (Kane 2001).

Landfilling activity on the project site officially ceased in March 2001. With the exceptions of ongoing maintenance of landfill infrastructure (i.e., methane and leachate collection systems), periodic mowing, and a variety of activities on Landfill Section 1/9 in 2001-2004, the project site provides large areas of grasslands, marshes, and forests that are relatively free of human activities. Freshwater wetlands, including the two stormwater management ponds east of Landfill Section 6/7 (described previously) and the wetland area to the north that they ultimately drain to, other open water areas west of Landfill Section 6/7, and smaller ponds throughout the project site, also provide foraging habitat for birds. The diversity of habitats, proximity to a major estuary, and the relative low level of human use on the project site contribute to its value as bird habitat.

Table 10-6 provides a list of birds observed within the project site from 2000-2007. A total of 211 species have been reported within the project site during various bird surveys permitted by DSNY, including National Audubon Society's Christmas Bird Count (NAS 2007), DEC's Breeding Bird Atlas, NYSOA's January Waterfowl Count, and several university field studies (NAS Christmas Bird Count data 2000-2007, Atlas 2000, NYSOA 2000-2006, A. Bernick, 2007 pers. comm.).

Table 10-7 lists breeding birds known to occur at the project site between 2000-2007 (DEC 2007, Bernick 2007 pers comm.). The 61 species nesting within the project site include those that nest in tidal wetlands (i.e., American black duck [*Anas rubripes*], clapper rail [*Rallus longirostrus*], marsh wren [*Cistothorus palustris*]), scrub-shrub areas (i.e., song sparrow [*Melospiza melodia*]), upland

grasslands (i.e., savannah sparrow, indigo bunting [*Passerina cyanea*]), and woodlands (i.e., red-tailed hawk [*Buteo jamaicensis*], downy woodpecker [*Picoides pubescens*]).

Table 10-6

Bird Species With the Potential to Occur at the Project Site and Secondary Study Area

Common Name	Scientific Name	Present in 2007
Snow Goose	*Chen caerulescens*	
Canada Goose	*Branta canadensis*	X
Altlantic Brant	*Branta bernicla*	X
Tundra Swan	*Cygnus colombianus*	
Mute Swan	*Cygnus olor*	X
Wood Duck	*Aix sponsa*	X
Gadwall	*Anas strepera*	X
American Wigeon	*Anas americana*	
American Black Duck	*Anas rubripes*	X
Mallard	*Anas platyrhynchos*	X
Blue winged Teal	*Anas discors*	X
Northern Shoveler	*Anas clypeata*	X
Northern Pintail	*Anas acuta*	X
Green winged Teal	*Anas crecca*	X
Canvasback	*Aythya valisineria*	
Ring necked Duck	*Aythya collaris*	
Greater Scaup	*Aythya marila*	
Lesser Scaup	*Aythya affinis*	X
Long-tailed Duck	*Clangua hyemalis*	
Bufflehead	*Bucephala albeola*	
Common Goldeneye	*Bucephala clangula*	
Hooded Merganser	*Lophodytes cucullatus*	
Red-breasted Merganser	*Merganser serrator*	X
Ruddy Duck	*Oxyura jamaicensis*	
Northern Shelduck	*Tadorna ferruginea*	
Ring necked Pheasant	*Phasianus colchicus*	X
Red throated Loon	*Gavia stellata*	
Common Loon	*Gavia immer*	
Pied billed Grebe	*Podilymbus podiceps*	
Horned Grebe	*Podiceps auritus*	
Double-crested Cormorant	*Phalacrocorax auritus*	X
Great Cormorant	*Phalacrocorax carbo*	
American Bittern	*Botaurus lentiginosus*	X
Great Blue Heron	*Ardea herodias*	X
Great Egret	*Ardea alba*	X
Snowy Egret	*Egretta thula*	
Little Blue Heron	*Egretta caerulea*	
Tricolored Heron	*Egretta tricolor*	
Cattle Egret	*Bubulcus ibis*	
Green Heron	*Butorides virescens*	
Black-crowned Night-heron	*Nycticorax nycticorax*	X
Yellow-crowned Night-Heron	*Nyctanassa violacea*	X
Glossy Ibis	*Plegadis falcinellus*	X
Turkey vulture	*Cathartes aura*	X
Osprey	*Pandion haliaetus*	X
Bald Eagle	*Haliaeetus leucocephalus*	
Northern Harrier	*Circus cyaneus*	X
Sharp-shinned Hawk	*Accipiter striatus*	
Cooper's Hawk	*Accipiter cooperii*	
Red-shouldered Hawk	*Buteo lineatus*	
Broad-winged Hawk	*Buteo platypterus*	
Red-tailed Hawk	*Buteo jamaicensis*	X
American Kestrel	*Falco sparverius*	X

Table 10-6 (cont'd)

Bird Species With the Potential to Occur at the Project Site and Secondary Study Area

Common Name	Scientific Name	Present in 2007
Merlin	*Falco columbarius*	X
Peregrine Falcon	*Falco peregrinus*	
Clapper Rail	*Rallus longirostrus*	
Virginia Rail	*Rallus limicola*	
Sora	*Porzana caroline*	
Common Moorhen	*Gallinula chloropus*	
American Coot	*Fulica americana*	
American Woodcock	*Scolopax minor*	X
Black bellied Plover	*Pluvialis squatarola*	
Semipalmated Plover	*Charadrius semipalmatus*	
Killdeer	*Charadrius vociferous*	X
Greater Yellowlegs	*Tringa melanoleuca*	X
Lesser Yellowlegs	*Tringa flavipes*	X
Solitary Sandpiper	*Tringa solitaria*	
Willet	*Catoptrophorus semipalmatus*	
Spotted Sandpiper	*Actitus macularia*	
Whimbrel	*Numenius phaeopus*	
Ruddy Turnstone	*Arenaria interpres*	
Red Knot	*Calidris canutus*	
Sanderling	*Calidris alba*	
Semipalmated Sandpiper	*Calidris pusilla*	X
Least Sandpiper	*Calidris minutilla*	X
Hudsonian godwit	*Limosa haemastica*	X
Wilson's phalarope	*Phalaropus tricolor*	X
Laughing Gull	*Larus atricilla*	X
Bonaparte's Gull	*Larus philadelphia*	
Ring-billed Gull	*Larus delawarensis*	X
Herring Gull	*Larus argentatus*	X
Iceland Gull	*Larus glaucoides*	
Lesser Black-backed Gull	*Larus fuscus*	
Glaucous Gull	*Larus hyperboreus*	
Great Black-backed Gull	*Larus marinus*	X
Common Tern	*Sterna hirundo*	
Forster's Tern	*Sterna foresteri*	
Black Skimmer	*Rynchops niger*	X
Rock Pigeon	*Columba livia*	X
Mourning Dove	*Zenaida macroura*	X
Black billed Cuckoo	*Coccyzus erythropthalmus*	
Yellow-billed Cuckoo	*Coccyzus americanus*	X
Barn Owl	*Tyto alba*	
Eastern Screech Owl	*Megascops asio*	
Great Horned Owl	*Bubo virginianus*	
Snowy Owl	*Bubo scaniacus*	
Short eared Owl	*Asio flammeus*	
Common Nighthawk	*Chordeiles minor*	
Chimney Swift	*Chaetura pelagica*	
Ruby throated Hummingbird	*Archilochus colubris*	
Belted Kingfisher	*Ceryle alcyon*	X
Red-bellied Woodpecker	*Melanerpes carolinus*	X
Yellow-bellied Sapsucker	*Sphyrapicus varius*	
Downy Woodpecker	*Picoides pubescens*	X
Hairy Woodpecker	*Picoides villosus*	X
Northern Flicker	*Colaptes auratus*	X
Eastern Wood-Pewee	*Contopus virens*	
Yellow-bellied Flycatcher	*Empidonax flaviventris*	
Willow Flycatcher	*Empidonax traillii*	

Table 10-6 (cont'd)

Bird Species With the Potential to Occur at the Project Site and Secondary Study Area

Common Name	Scientific Name	Present in 2007
Eastern Phoebe	*Sayornis phoebe*	
Great Crested Flycatcher	*Myiarchus crinitus*	
Ash-throated Flycatcher	*Myiarchus cinerascens*	
Eastern Kingbird	*Tyrannus tyrannus*	
Northern Shrike	*Lanius excubitor*	
White eyed Vireo	*Vireo griseus*	
Blue headed Vireo	*Vireo solitarius*	
Warbling Vireo	*Vireo gilvus*	
Red-eyed Vireo	*Vireo olivaceus*	
Blue Jay	*Cyanocitta cristata*	X
American Crow	*Corvus brachyrhynchos*	X
Fish Crow	*Corvus ossifragus*	
Common Raven	*Corvus corax*	
Horned Lark	*Eremophila alpestris*	
Purple Martin	*Progne subis*	
Tree Swallow	*Tachycineta bicolor*	
Northern Rough winged Swallow	*Stelgidopteryx serripennis*	
Bank Swallow	*Riparia riparia*	
Barn Swallow	*Hirundo rustica*	
Black capped Chickadee	*Poecile artricapillus*	X
Tufted Titmouse	*Baeolophus bicolor*	X
Red breasted Nuthatch	*Sitta canadensis*	
White-breasted Nuthatch	*Sitta carolinensis*	
Brown Creeper	*Certhia americana*	
Carolina Wren	*Thryothorus ludovicianus*	X
House Wren	*Troglodytes aedon*	X
Winter Wren	*Troglodytes trogloytes*	
Marsh Wren	*Cistothorus palustris*	X
Golden-crowned Kinglet	*Regulus satrapa*	
Ruby-crowned Kinglet	*Regulus calendula*	
Blue-gray Gnatcatcher	*Polioptila caerulea*	
Eastern Bluebird	*Sialia sialis*	
Veery	*Catharus fuscenscens*	
Gray-cheeked Thrush	*Catharus minimus*	
Swainson's Thrush	*Catharus ustulatus*	X
Hermit Thrush	*Catharus guttatus*	X
Wood Thrush	*Hylocichla mustelina*	X
American Robin	*Turdus migratorius*	X
Gray Catbird	*Dumetella carolinesis*	X
Northern Mockingbird	*Mimus polyglottos*	X
Brown Thrasher	*Toxostoma rufum*	X
European Starling	*Sturnus vulgaris*	X
American Pipit	*Anthus rubescens*	
Cedar Waxwing	*Bombycilla cedrorum*	X
Blue winged Warbler	*Vermivora pinus*	
Orange-crowned Warbler	*Vermivora celata*	
Nashville Warbler	*Vermivora ruficapilla*	
Northern Parula	*Parula americana*	X
Yellow Warbler	*Dendroica petechia*	X
Chestnut sided Warbler	*Dendroica pensylvanica*	
Magnolia Warbler	*Dendroica magnolia*	
Black-throated Blue Warbler	*Dendroica caerulescens*	X
Yellow-rumped Warbler	*Dendroica coronata*	X
Black-throated Green Warbler	*Dendroica virens*	
Blackburnian Warbler	*Dendroica fusca*	
Pine Warbler	*Dendroica pinus*	

Table 10-6 (cont'd)

Bird Species With the Potential to Occur at the Project Site and Secondary Study Area

Common Name	Scientific Name	Present in 2007
Prairie Warbler	*Dendroica discolor*	X
Palm Warbler	*Dendroica palmarum*	X
Bay-breasted Warbler	*Dendroica castanea*	
Blackpoll Warbler	*Dendroica striata*	
Black-and-White Warbler	*Mniotilla varia*	
American Redstart	*Setophaga ruticilla*	
Ovenbird	*Seiurus aurocapilla*	
Northern Waterthrush	*Seiurus noveboracensis*	
Louisiana Waterthrush	*Seiurus motacilla*	
MacGillivray's Warbler	*Oporornis tolmiei*	
Common Yellowthroat	*Geothlypis trichas*	X
Hooded Warbler	*Wilsonia citrine*	
Wilson's Warbler	*Wilsonia citrine*	
Canada Warbler	*Wilsonia canadensis*	
Scarlet Tanager	*Piranga olivacea*	
Eastern Towhee	*Pipilo erythrophthalmus*	X
American Tree Sparrow	*Spizella arborea*	
Chipping Sparrow	*Spizella passerine*	
Field Sparrow	*Spizella pusilla*	
Savannah Sparrow	*Passerculus sanwichensis*	X
Saltmarsh Sharp-tailed Sparrow	*Ammodramus caudacutus*	
Seaside Sparrow	*Ammodramus maritimus*	
Fox Sparrow	*Passerella iliaca*	
Song Sparrow	*Melospiza melodia*	X
Lincoln's Sparrow	*Melospiza lincilnii*	
Swamp Sparrow	*Melospiza georgiana*	X
White-throated Sparrow	*Zonotrichia albicollis*	X
White-crowned Sparrow	*Zonotrichia leucophrys*	
Dark-eyed Junco	*Junco hyemalis*	
Snow Bunting	*Plectrophenax nivalis*	
Northern Cardinal	*Cardinalis cardinalis*	X
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	
Indigo Bunting	*Passerina cyanea*	
Dickcissel	*Spiza americana*	
Bobolink	*Dolichonyx oryzivorus*	
Red-winged Blackbird	*Agelaius phoeniceus*	X
Eastern Meadowlark	*Sturnella magna*	
Common Grackle	*Quiscalus quiscula*	X
Boat-tailed Grackle	*Quiscalus major*	
Brown-headed Cowbird	*Molothrus ater*	X
Orchard Oriole	*Icterus spurious*	
Baltimore Oriole	*Icterus galbula*	X
Purple Finch	*Carpodacus purpureus*	
House Finch	*Carpodacus mexicanus*	X
Red Crossbill	*Loxia curvirostra*	
Pine Siskin	*Carduelis pinus*	
American Goldfinch	*Carduelis tristis*	X
House Sparrow	*Passer domesticus*	X

Notes: This list represents all resident, migrant, and wintering bird species observed within the project site from 1996-2006. Birds observed during 2007 AKRF field observations are also noted.
Sources: DSNY 1996, NYSARC 2000-2006, NAS 2007, AKRF May and October 2007 Field survey, Bernick 2007, DEC 2007.

Table 10-7
Breeding Birds at the Project Site and Secondary Study Area 2000-2007

Common Name	Scientific Name	Observed in 2007	Habitat
Canada Goose	*Branta canadensis*	X	Lakes, ponds, bays, marshes, fields
Gadwall	*Anas strepera*	X	Lakes, ponds, marshes
American Black Duck	*Anas rubripes*	X	Marshes, lakes, bays, fields
Mallard	*Anas platyrhynchos*	X	Marshes, wooded swamps, grainfields, ponds, rivers, lakes, bays
Ring necked Pheasant	*Phasianus colchicus*	X	Farms, fields, marsh edges, brush
Pied billed Grebe	*Podilymbus podiceps*		Ponds, lakes, marshes, salt bays
Least Bittern	*Ixobrychus exilis*		Marshes, reedy lakes
Great Egret*	*Ardea alba*	X	Marshes, ponds, shores, mud flats
Snowy Egret*	*Egretta thula*		Marshes, swamps, ponds, shores, tidal flats
Little Blue Heron*	*Egretta caerulea*		Marshes, swamps, rice fields, ponds, shores
Cattle Egret*	*Bubulcus ibis*		Farms, marshes, highway edges, near cattle
Green Heron	*Butorides virescens*		Lakes, ponds, marshes, swamps, streamsides
Black-crowned Night-heron*	*Nycticorax nycticorax*	X	Marshes, shores
Yellow-crowned Night-Heron	*Nyctanassa violacea*	X	Cypress swamps, mangroves, bayous, marshes, streams
Glossy Ibis*	*Plegadis falcinellus*		Marshes, rice fields, swamps
Osprey	*Pandion haliaetus*	X	Rivers, lakes, coasts
Northern Harrier	*Circus cyaneus*	X	Marshes, fields, etc.
Red-tailed Hawk	*Buteo jamaicensis*	X	Open country, woodlands, prairie groves, mountains, plains
Peregrine Falcon	*Falco peregrinus*		Open country, some cities
Clapper Rail	*Rallus longirostrus*		Salt marshes, rarely brackish, locally mangroves
Virginia Rail	*Rallus limicola*		Mainly fresh and brackish marshes; salt marshes
Sora	*Porzana caroline*		Fresh marshes, wet meadows, salt marshes
Common Moorhen	*Gallinula chloropus*		Fresh marshes, reedy ponds
American Coot	*Fulica americana*		Ponds, lakes, marshes
American Woodcock	*Scolopax minor*	X	Grasslands
Killdeer	*Charadrius vociferous*	X	Fields, airports, lawns, river banks, shores
Willet	*Catoptrophorus semipalmatus*		Marshes, wet meadows, mud flats, beaches
Spotted Sandpiper	*Actitus macularia*		Pebbly lakeshores, ponds, streamsides, seashores
Herring Gull	*Larus argentatus*	X	Various estuarine and freshwater habitats, terrestrial
Rock Pigeon	*Columba livia*	X	Sustains self in wild about cities, farms, cliffs, bridges
Mourning Dove	*Zenaida macroura*	X	Farms, towns, open woods, scrub, roadsides, grasslands
Black billed Cuckoo	*Coccyzus erythropthalmus*		Wood edges, groves, thickets
Yellow-billed Cuckoo	*Coccyzus americanus*	X	Wood edges, groves, thickets
Barn Owl	*Tyto alba*		Woodlands, groves, farms, barns, towns, cliffs
Eastern Screech Owl	*Megascops asio*		Woodlands, farm groves, shade tress
Great Horned Owl	*Bubo virginianus*		Forests, woodlands, thickets, streamsides, open country
Chimney Swift	*Chaetura pelagica*		Open sky, cities, towns, nests in chimneys
Ruby throated Hummingbird	*Archilochus colubris*		Flowers, gardens, wood edges
Belted Kingfisher	*Ceryle alcyon*	X	Streams, lakes, bays, coasts, banks
Red-bellied Woodpecker	*Melanerpes carolinus*	X	Woodlands, groves, orchards, towns
Downy Woodpecker	*Picoides pubescens*	X	Forests, woodlots, willows, river groves, orchards, shade trees
Hairy Woodpecker	*Picoides villosus*	X	Mature forest
Northern Flicker	*Colaptes auratus*	X	Open forests, woodlots, groves, farms, towns, semi-open country
Willow Flycatcher	*Empidonax traillii*		Bushes, willows, thickets
Great Crested Flycatcher	*Myiarchus crinitus*		Woodlands, groves
Eastern Kingbird	*Tyrannus tyrannus*		Wood edges, river groves, farms, shelterbelts, orchards, roadsides, fencerows, wires
White eyed Vireo	*Vireo griseus*		Wood edges, brush, brambles, undergrowth
Warbling Vireo	*Vireo gilvus*		Deciduous and mixed woods, aspen groves, poplars, shade trees

Table 10-7 (cont'd)
Breeding Birds at the Project Site and Secondary Study Area 2000-2007

Common Name	Scientific Name	Observed in 2007	Habitat
Blue Jay	*Cyanocitta cristata*	X	Oak and pine woods, suburban gardens, groves, towns
American Crow	*Corvus brachyrhynchos*		Woodlands, farmland, agricultural fields, river groves, shores
Fish Crow	*Corvus ossifragus*		Similar to American Crow, more confined to tide water and lower valleys of large rivers
Tree Swallow	*Tachycineta bicolor*		Marshes, meadows, streams, lakes, wires
Northern Rough winged Swallow	*Stelgidopteryx serripennis*		Near streams, lakes, river banks
Barn Swallow	*Hirundo rustica*		Open lands, farms, fields, marshes, lakes, wires
Black capped Chickadee	*Poecile artricapillus*	X	Mixed and deciduous woods; willow thickets, groves, shade trees
Tufted Titmouse	*Baeolophus bicolor*	X	Woodlands, shade trees, groves; feeders
White-breasted Nuthatch	*Sitta carolinensis*		Forests, woodlots, groves, river woods, shade trees, visits feeders
Carolina Wren	*Thryothorus ludovicianus*	X	Tangles, brushy undergrowth, suburban gardens, towns
House Wren	*Troglodytes aedon*	X	Open woods, thickets, towns, gardens
Marsh Wren	*Cistothorus palustris*	X	Marshes
Wood Thrush	*Hylocichla mustelina*	X	Deciduous woodlands
American Robin	*Turdus migratorius*	X	Cities, towns, farmlands, lawns, shade trees, forests
Gray Catbird	*Dumetella carolinesis*	X	Undergrowth, brush, thorn scrub,
Northern Mockingbird	*Mimus polyglottos*	X	Towns, farms, roadsides, thickets
Brown Thrasher	*Toxostoma rufum*	X	Thickets, brush, shrubbery, thorn scrub
European Starling	*Sturnus vulgaris*	X	Cities, parks, farms, open groves, fields, open country
Cedar Waxwing	*Bombycilla cedrorum*	X	Open woodlands, fruiting trees, orchards
Yellow Warbler	*Dendroica petechia*	X	Bushes, swamp, edges, streams, gardens
Common Yellowthroat	*Geothlypis trichas*	X	Swamps, marshes, wet thickets
Eastern Towhee	*Pipilo erythrophthalmus*	X	Open woods, undergrowth, brushy edges
Field Sparrow	*Spizella pusilla*		Bushy pastures, scrub
Savannah Sparrow	*Passerculus sanwichensis*	X	Open fields, meadows, salt marshes, prairies, dunes, shores
Saltmarsh Sharp-tailed Sparrow	*Ammodramus caudacutus*		Marshes, muskeg; coastal marshes
Song Sparrow	*Melospiza melodia*	X	Thickets, brush, marshes, roadside, gardens
Swamp Sparrow	*Melospiza georgiana*	X	Fresh marshes with tussocks, bushes or cattails
Northern Cardinal	*Cardinalis cardinalis*	X	Woodland edges, thickets, suburban gardens, towns
Indigo Bunting	*Passerina cyanea*		Brushy pastures, bushy wood edges
Red-winged Blackbird	*Agelaius phoeniceus*	X	Breeds in marshes, brushy swamps, hayfields; forages in cultivated land
Eastern Meadowlark	*Sturnella magna*		Fields, meadows, prairies
Common Grackle	*Quiscalus quiscula*	X	Croplands, towns, groves, streamsides
Boat-tailed Grackle	*Quiscalus major*		Resident near salt water along coasts; marshes
Brown-headed Cowbird	*Molothrus ater*	X	Farms, fields, barnyards, roadsides, wood edges, river groves
Orchard Oriole	*Icterus spurious*		Wood edges, orchards, shade trees
Baltimore Oriole	*Icterus galbula*	X	Open woods, elms, shade trees
House Finch	*Carpodacus mexicanus*	X	Cities, suburbs, farms
American Goldfinch	*Carduelis tristis*	X	Thistles and weeds, dandelions, open woods, edges, open roads
House Sparrow	*Passer domesticus*	X	Cities, farms

Notes: Common names in **bold** represent birds that were confirmed as nesting within project site atlas blocks. All other common names were reported as breeding within the secondary study area. Both the project site and secondary study area are represented by Atlas 2000 blocks 5648a, 5649a, 5649b, 5649c, and 5649d. Species observed within the project site in 2007 are noted.

* = Wading birds last nested on Isle of Meadows in 2001.

Source: DEC 2007, Habitat information from Peterson 1980.

The 2007 AKRF field observations confirmed the presence of 84 bird species (Table 10-8). Of these, 49 bird species observed have nested within the project site or secondary study area in previous years (DEC 2007, Table 10-9). Ducks and waterfowl, foraging colonial waterbirds and other wetland-obligate species, migrating and resident shorebirds, raptors, and numerous resident and migrating passerines (e.g., blackbirds, warblers, and sparrows) were observed within the project site.

Table 10-8
Mammals Documented at the Project Site and Secondary Study Area 1991-2007

Common Name	Scientific Name	Observed in 2007	Habitat*
Likely to be present			
Eastern cottontail	*Sylvilagus floridanus*	X	Bottomlands, swamps, lake borders, coastal waterways.
Muskrat	*Ondatra zibethica*	X	Fresh, brackish, or saltwater marshes, ponds, lakes, rivers, canals.
Domestic cat	*Felis silvestris*	X	Residential areas.
House mouse	*Mus musculus*	X	Buildings; areas with good ground cover, including cultivated fields. Uncommon in undisturbed or natural habitats.
Meadow vole	*Microtus pennsylvanicus*	X	Lush grassy fields; also marshes, swamps, woodland glades, mountaintops.
Virginia opossum	*Dipelphis virginiana*	X	Open woods, bushy wastelands, farmlands.
Raccoon	*Procyon lotor*	X	Various, but most common along wooded streams.
Gray squirrel	*Sciuris carolinensis*	X	Hardwood or mixed forests with not trees, especially oak-hickory forests.
Norway rat	*Rattus norvegicus*	X	Farms, cities, many types of human dwellings; in summer: often cultivated fields.
White footed mouse	*Peromyscus leucopus*	X	Wooded and bushy areas.
Eastern chipmunk	*Tamias striatus*		Open woodland; forest edges; brushy areas; bushes and stone walls in cemeteries and around houses.
Little brown bat	*Myotis lucifugus*		In summer, form nursery colonies in buildings. In winter, hibernates in caves and mines in the East.
Red bat	*Lasiurus borealis*		Typical migrant through coastal areas
Hoary bat	*Lasiurus cinereus*		Typical migrant through coastal areas
Silver-haired bat	*Lasionycteris noctivagans*		Typical migrant through coastal areas
Short-tailed shrew	*Blarina brevicauda*		Woods and wet areas in warmer and drier parts of range.
Eastern mole	*Scalopus aquaticus*		Open fields, waste areas, lawns, gardens, and sometimes woods, in well-drained loose soil.
Feral dog	*Canis lupus familiaris*	X	
Uncommon for Staten Island but reported within the secondary study area since 2002			
White-tailed Deer	*Odocoileus virginianus*	X	Woodlands, fields, suburbs.
Red fox	*Vulpes vulpes*		Varied; mixed cultivated and wooded area, brushlands.
Striped skunk	*Mephitis mephitis*		Woodlands, grassy plains, suburbs.

Notes: Habitat information from Whitaker 1993.
Sources: SCS Engineers 1991, DSNY 1996, AKRF May and October 2007 Field observations.

Mammals

The diverse array of terrestrial habitats within the primary and secondary study areas are suitable for numerous species of mammals commonly observed in the region (Table 10-10). Freshwater wetlands, including the open water and vegetated wetland habitats east of Landfill Section 6/7 formed by the two stormwater management basins and adjacent wetland areas, other open water areas west of Landfill Section 6/7, and smaller ponds throughout the project site, also provide foraging and nesting habitat for muskrats (*Ondatra zibethica),* raccoons (*Procyon lotor),* and other mammals. Of the 21 species likely to be present based on the 1996 DEIS and habitat considerations, eight mammal species were observed during 2007 field observations. Species observed included muskrat, eastern cottontail (*Sylvilagus floridanus),* house cat (*Felis silvestris),* house mouse (*Mus musculus),* and meadow vole (*Microtus pennsylvanicus).* White-tailed deer (*Odocoileus virginianus)* and raccoon tracks were also observed.

Table 10-9
Reptiles and Amphibians Within the Project Site or Secondary Study Area

Common Name	Scientific Name	Observed in 2007
Expected within the project site or secondary study area		
American toad	*Bufo americanus*	
Bullfrog	*Rana catesbiana*	
Fowler's toad	*Bufo fowleri*	
Green frog	*Rana clamitans*	X
Southern leopard frog	*Rana sphenocephala*	
Spring peeper	*Hyla crucifer*	X
Red-backed salamander	*Plethodon cinereus*	
Eastern painted turtle	*Chrysemys picta*	X
Snapping turtle	*Chelydra serpentina*	X
Eastern garter snake	*Thamnophis sirtalis*	
Eastern milk snake	*Lampropeltis triangulum*	
Northern black racer	*Coluber constrictor*	
Northern brown snake	*Storeria dekayi*	
Northern water snake	*Nerodia sipedon*	
Uncommon but documented at the project site or secondary study area since 1995		
Northern diamondback terrapin	*Malaclemys terrapin*	
Eastern box turtle	*Terrapene carolina*	
Pickerel frog	*Rana palustris*	
Eastern mud turtle	*Kinosternon subrubrum*	
Northern ringnecked snake	*Diadophis p. edwardsi*	
Rare for Staten Island and unlikely to occur in project site or secondary study area		
Wood frog	*Rana sylvatica*	
Spotted turtle	*Clemmys guttata*	
Four-toed salamander	*Hemidactylium scutarum*	
Northern dusky salamander	*Desmognathus fuscus*	
Northern two-lined salamander	*Eurycea bislineata*	
Northern red salamander	*Pseudotriton rubber*	
Red-spotted newt	*Notophthalmus viridescens*	
Northern fence lizard	*Sceloporus u. hyacinthinus*	

Sources: DSNY 1996, DEC Herp Atlas 2007, AKRF 2007 May and October Field observations.

While some of the mammals species noted in the 1996 species list are uncommon on Staten Island (i.e., red fox [*Vulpes vulpes*], skunk [*Mephitis mephitis*]), they have been increasingly reported within the vicinity of the project site in recent years (DPR 2007, SIIAS 2007 pers. comm.). Another example is white-tailed deer, which have had increasing populations on the Staten Island mainland and Arthur Kill islands over the past decade (DPR 2007). They were confirmed breeding on Isle of Meadows and Prall's Island in 2006, and presumably breed in mainland of Staten Island as well (Bernick 2006). Some mammals, particularly red (*Lasiurus borealis)*, hoary *(L. cinereus)*, and silver-haired bats (*Lasionycteris noctivagans)*, would only likely be found in the area during seasonal migrations through the Staten Island area. On the basis of the habitats observed within the project site and surrounding areas, ermine (*Mustela erminea*) and long-tailed weasel (*M. frenata*), previously listed as a potentially occurring species (DSNY 1996), are not likely to be found in the area.

Table 10-10
Insect Orders Likely Present within the Project Site and Secondary Study Area

Order	Example(s)	Average Size (Length)	North American species
Anoplura	Sucking lice	0.25”	62
Coleoptera	Beetles	(lg. tropical s p.)	30,000
Collembola	Springtails (wingless)	0.06”-0.25”	315
Dermaptera	Earwigs (some sp. wingless)	0.75”-1.4”	20
Diptera	Flies, mosquitoes	0.1”-0.7”	17,130
Diplura	Two-pronged bristletail (wingless, blind)	<0.25”	25
Hemiptera	True bugs	0.3”-0.8”	4,500
Homoptera	Aphids, leaf hoppers, cicadas	0.25”-1.5”	6,700
Hymenoptera	Bees, wasps, ants	0.5”-1.0”	17,300
Isoptera	Termites (winged and wingless)	0.2”-1.0”	41
Lepidoptera	Butterflies, moths	0.4”-10.6” (wingspan)	11,000
Mallophaga	Chewing lice, bird lice	0.05-0.12”	318
Mecoptera	Scorpionflies, earwigflies	0.6”-1.0”	85
Microcoryphia	Jumping bristletails (wingless)	0.6”	25
Megaloptera	Antlions, lacewings, dobsonflies	0.4”-2.75”	338
Odonata	Dragonflies, damselflies	0.75”-5.0”	450
Orthoptera	Roaches, grasshoppers, crickets, mantids	1.5”	1,000
Protura	Minute white insect (wingless, eyeless)	0.06”	20
Plecoptera	Stone flies	1.0”-3.0”	400
Psocoptera	Book lice, bark lice	0.04”-0.12”	150
Siphonaptera	Fleas (wingless)	<0.25”	250
Strepsiptera	Minute, beetle-like (only males have wings)	0.13”	60
Thysanoptera	Thrips (winged and wingless)	0.5 mm-0.13”	606
Thysanura	Bristletails, silverfish (wingless)	0.5”	40

Sources: Milne, 1980; Swan et al., 1972.

Reptiles and Amphibians

Table 10-9 lists of reptiles and amphibian with the potential to occur within the project site or secondary study area, on the basis of reptiles and amphibians noted in the 1996 DEIS, existing habitats, and species distribution noted in the DEC’s Herp Atlas. Fourteen species of reptiles and amphibians, commonly occurring within similar habitats on Staten Island, have the potential to be present at the project site (i.e., spring peeper [*Hyla crucifer*], bullfrog [*Rana catesbiana*], green frog [*R. clamitans*], garter snake [*Thamnophis sirtalis*], Dekay’s snake [*Storeria dekayi*], snapping turtle [*Chelydra serpentine*], red-eared slider [*Trachemys scripta elegans*]). An additional 13 species listed in the 1996 DEIS may be present within the secondary study area, and could possibly occur in older palustrine forested wetlands (i.e., box turtle [*Terrapene Carolina*], various frogs) and tidal wetlands (i.e., northern diamondback terrapin [*Malaclemys terrapin*]) within the project site.

During the 2007 AKRF field observations, four species of reptiles and amphibians were observed or heard on the project site. These species include snapping turtle, eastern painted turtle, green frog, and spring peeper. Painted turtles were observed in the stormwater management basins and adjacent wetland areas east of Landfill Section 6/7, adjacent to Richmond Avenue. Snapping turtles were observed in all basins and ponds east of Landfill Section 6/7, in the ponds southwest of Landfill Section 2/8, and the stormwater basin C1 located at the confluence of Richmond and Main creeks. Open water areas, and emergent and forested wetlands on the project site provide the main on-site foraging and breeding areas for some

amphibians (i.e., frogs and toads) and reptiles (i.e., turtles), although water quality will be the most important factor in determining what species exist within these water bodies. Green frogs and spring peepers were observed dispersing through forested wetlands and present in ponded ruts along unpaved roads in many areas of the property.

Insects

Detailed surveys to document insect presence and use at the Fresh Kills Landfill were not performed as part of the 2007 AKRF field observations. The most commonly observed species noted during the October 2007 field survey included various butterflies (red admiral [*Vanessa atalanta*], monarch butterfly [*Danaus plexippus*]) and dragonflies (green darner [*Anax junius*]). Existing habitats observed within the project site would be expected to support a diverse insect community.

The presence and complexity of insect communities is regulated by various factors: 1) by specific plants, as many insects are co-adapted to specific plant genera or species; 2) by habitat complexity; and 3) by microhabitat, specifically subtle differences in biotic and abiotic conditions (Gullen and Cranston 2005). Within the project site's grassland and woodland habitats, substantial insect communities are likely to exist. Changes in the project site's insect communities relating to large-scale habitat shifts (i.e., landfill capping, followed by growth of native and introduced grass and forb species) is likely to drive further changes in insect diversity and density.

A general profile of insect diversity can be established for the project site based on existing conditions. Table 10-10 is a list of insect taxa expected to be present within the project site based on present conditions and previous observations of insects within the project site (SCS Engineers 1990, DSNY 1996).

Information on charismatic insect species such as lepidopterans (i.e., butterflies, moths and skippers) and odonates (i.e., dragonflies and damselflies) exists for the New York City area, including Staten Island (Hennessey 1990). Over 100 species of butterflies commonly occur in the New York City area, including various species of swallowtails, whites, sulphurs, gossamer-wings, nymphalids, satyrs, and skippers. Over 50 species of damselflies and dragonflies have been documented within New York City, including broad-winged and true damselflies, spreadwings, petaltails, darners, Aeshna "mosaic" darners, clubtails, spiketails, cruisers, emeralds, basketails, and skimmers. Many of these species could be expected to inhabit communities present at the project site, including fields, wooded areas, streams, ponds, brackish waters, and coastal habitats.

One insect species, the Asian Longhorned Beetle (*Anoplophora glabripennis*), could have important impacts on any landscape enhancement occurring in within the project site. In March and April 2007, researchers from the United States Department of Agriculture's Animal and Plant Health Inspection Service (USDA-APHIS) detected Asian Longhorned Beetles (ALBs) on Prall's Island and Old Place Marsh in the Arthur Kill (DPR 2007), north of the project site. The ALB is a native of China, and was first detected in New York City in 1998. Since this time, there has been a substantial eradication effort conducted in New York by USDA, DEC, and NYC Parks. ALBs are known to use a variety of tree species as sites for egg-laying and development, including maples and birches (USDA 2007), which occur within the project site. Approximately 3,000 ALB host trees were cut on Prall's Island and 10,000 host trees within the vicinity of Old Place Marsh. Current management plans call for a ½ mile cut of all host tree species when an infested tree is located, and an additional area surrounding that is designated for chemical treatment (imidacloprid) and monitoring (USDA 2007).

Secondary Study Area

The following sections describe wildlife occurrence in properties within the secondary study area, based on available habitat, 2007 AKRF field observations, and existing information.

Birds

Birds recorded within the project site are likely to be present in the secondary study area. These include species that are particularly common throughout New York City in residential or vacant lot habitats, such as ring-necked pheasant (*Phasianus colchicus)*, mourning dove (*Zenaida macroura)*, gray catbird (*Dumetella carolinesis)*, American robin (*Turdus migratorius)*, song sparrow, and house sparrow (Table 10-8). Migrant songbirds (i.e., warblers, tanagers) would likely find more suitable cover and food resources during migration in mature woodland areas within the secondary study area (i.e., Willowbrook Park, LaTourette Park, Arden Heights Woods) than within many habitats at the project site. Certain habitat-specific species, such as marsh-obligate breeding birds like marsh wrens and salt marsh sharp-tailed sparrows (*Ammodramus caudacutus*), would most likely be found in appropriate habitats within the secondary study area. The William T. Davis Wildlife Refuge and Arthur Kill parcels northwest of the project site would provide adequate breeding habitat for this species.

According to the DPR, more than 117 bird species have been recorded at the William T. Davis Wildlife Refuge, including sharp-tailed sparrow and wood duck (*Aix sponsa*) (DPR 2007). Bird species recorded at the Refuge would be expected to occur within the project site if suitable habitat was observed there during the 2007 field observations. In addition, common owls and hawks also are likely to be present in this area, including barn owl (*Tyto alba*), great horned (*Bubo virginianus*), short-eared owl (*Asio flammeus*), and red-tailed hawk (*Buteo jamaicensis*), red-shouldered hawk (*Buteo lineatus*), and rough-legged hawk (*Buteo lagopus*).

Wildlife known to occur in Arden Heights Woods, and expected to occur in all other mature wooded secondary study area sites, and possibly portions of the project site, include: red-tailed hawk, American kestrel, screech owl (*Otus asio*), saw whet owl (*Aegolius acadicus*), great horned owl (*Bubo virginianus*), barn owl (*Tyto alba*), barred owl (*Strix varia*), indigo bunting, veery, brown thrasher, robin, blue jay, mocking bird, catbird, blue-winged warblers, mallards, Canada geese, little green heron, American egret, kingfisher, oriole, vireo, cardinal, song sparrow, common crow, and grackle, bank swallow (*Riparia riparia*), and northern rough-winged swallow (*Stelgidopteryx serripennis*). Migrant species known to use the site include hermit thrush (*Catharus guttatus*). Birds known to breed in the woods include brown thrasher, eastern kingbird, Baltimore oriole, red-bellied woodpecker, Eastern towhee, red-winged blackbird, wood duck (*Aix sponsa*), and wood thrush.

DPR's Natural Resources Group (NRG) conducted breeding bird surveys as part of the New York City Department of City Planning's Northwest Staten Island Corridor Project. NRG conducted breeding bird surveys on a parcel north of Little Fresh Kill and south of Victory Boulevard in 2003 and 2004, and in 2002 and 2007 on a parcel west of the West Shore Expressway, bounded by Neck Creek to the north and Victory Boulevard to the south. These sites represent important buffer zones to Fresh Kills Park, with valuable habitat for breeding songbirds and foraging wading birds, particularly in the event of a recolonization of the former wading bird nesting colony at Isle of Meadows.

Mammals

Mammals expected to occur in all sites within the secondary study area include ubiquitous urban mammals, such as raccoon, Virginia opossum (*Dipelphis virginiana)*, and gray squirrel (*Sciuris*

carolinensis). Some of the mammals species noted in the 1996 species list are uncommon on Staten Island (i.e., red fox, skunk). Other species were not noted in the 1996 list (i.e., white-tailed deer), but have been increasingly reported within the vicinity of the secondary study area in recent years (DPR 2007, SIIAS 2007 pers. comm.).

Reptiles and Amphibians

Species with the potential to occur in palustrine forested wetlands within the secondary study area include common species for Staten Island (i.e., spring peeper, bullfrog, green frog, garter snake, Dekay's snake, snapping turtle, red-eared slider). Based on habitat complexity and quality, several amphibians (i.e., woodland salamander, Fowler's toad [*Bufo fowleri*]) and reptiles (i.e., box turtle) are likely to be found within the secondary study area alone (i.e., Willowbrook Park, LaTourette Park, Arden Heights Woods). The northern diamondback terrapin (a New York State Game Species and NYNHP Watch List Species) was noted in a trap within Main Creek, which traverses the project site and William T. Davis Wildlife Refuge (DSNY 1996). This species forages in estuarine systems and nests on bare sand and rocky areas (R. Burke, 2007, pers. comm.).

Insects

Insect species that are found within the secondary study area are potentially more numerous in terms of species diversity and density than for the project site, as the available habitats tend to be more complex. The species expected to occur would include those listed in Table 10-12. In contrast, landfilling activities at the project site followed by the growth of native and invasive flora likely continues to change the project site's insect community. No insect species were noted in the May 2007 observations within the secondary study areas.

THREATENED OR ENDANGERED SPECIES

Information requests for rare, threatened or endangered species within one half mile of the project site were submitted to USFWS (NY office), NMFS, and DEC's NYNHP. With the exception of an occasional transient occurrence of shortnose sturgeon (*Acipenser brevirostrum*), no federally listed or proposed threatened or endangered species under federal jurisdiction are known to occur at the proposed project site, or in its vicinity (USFWS 2007). NMFS (2007a) stated that while the federally endangered shortnose sturgeon and several species of threatened and endangered sea turtles are known to occur in New York waters, they are not typically known to occur in the Arthur Kill, and no further coordination with respect to these species is anticipated for the project site. NMFS indicated that EFH has been identified within the project site for one or more species (NMFS 2007b). A discussion of EFH identified within the project site is presented in the Aquatic Resources section of this chapter.

The NYNHP database (Seoane 2007) indicated the following threatened, endangered, or protected species, significant ecological communities, and colonial waterbird nesting area as being recently recorded on or in the vicinity of the project site. Table 10-11 lists threatened or endangered species contained in historical records (i.e., species not documented since 1979) and the date of the last reported observation. None of these species have been reported within the vicinity of the project site since the early 1900s and none were observed during the May 2007 field observations.

Seven species of New York State "protected birds" (i.e., birds defined in New York's ECL 11-0103 as wild birds), two species of vascular plants, and two ecological communities were reported by the NYNHP as occurring on or in the vicinity of the project site, and their recent status at or near the project site is discussed below. An additional two bird species (black-crowned night-heron and northern harrier) and one reptile (northern diamondback terrapin) have been added to this discussion as they have been reported to occur at or near the project site since 1995.

Table 10-11
Historical Records of New York State Threatened/Endangered Species In The Vicinity Of The Project Site

Species	Last Reported Occurrence
Northern cricket frog (*Acris crepitans*), E	Unknown
Cattail sedge (*Carex typhina*), T	1902
Dwarf hawthorn (*Crataegus uniflora*), E	1907
Log fern (*Dryopteris celsa*), E	1907
American strawberry-bush (*Eunonymus americanus*), E	1901
American ipecac (*Euphorbia ipecacuanhae*), E	1882
Scirpus-like rush (*Juncus scirpoides*), E	1901
Bead pinweed (*Lechea pulchella* var. *moniliformis*), E	1901
Orange fringed orchid (*Platanthera ciliaris*), E	1905
Rose-pink (*Sabatia angularis*), E	1908
Primrose-leaf violet (*Viola primulifolia*), T	1902

Notes: E—New York State Endangered; T—New York State Threatened.
Source: Seoane (2007).

Colonial Waterbird Nesting Area and Relevant Species

The six species of wading birds (i.e., herons, egrets, and ibis) noted in correspondence with DEC (Seoane 2007), and a seventh not mentioned (i.e., black-crowned night-heron), comprise the species known to nest on Isle of Meadows, a wading bird and gull nesting colony within the project site. Along with nearby nesting islands at Prall's Island (in the Arthur Kill) and Shooter's Island (in the Kill Van Kull), these islands formed the largest heronry in New York State and accounted for 25 percent of the wading birds that breed in coastal New Jersey, New York, and Connecticut (USFWS 1997). Wading bird species reported to nest within the area, described as the 'Harbor Herons Region' in the Trust for Public Land's 'An Islanded Nature' (2000), include black-crowned night heron (*Nycticorax nycticorax*), snowy egret (*Egretta thula*), great egret (*Ardea alba*), cattle egret (*Bulbulcus ibis*), glossy ibis (*Plagidis facinellus*), and yellow-crowned night heron (*Nyctanassa violacea*) (USACE 2004). From 1992-1998, an average of 612 pairs of wading birds nested each year on Isle of Meadows. A sharp population decline occurred in the late 1990's, and the last consistent nesting of wading birds in the area was on Isle of Meadows in 2001. Suggested causes for the declines include regular inputs of organic and inorganic contaminants driving negative neurological and reproductive effects (Parsons 2004), changes in habitat suitability (USACE 2004), and mammalian predation and disturbance (Kerlinger 2004).

Suitable nesting habitat for wading birds remains on Isle of Meadows and Shooter's Island (Bernick 2007), and these islands continue to be recognized as potential nesting areas. Waterbird breeding colonies are known to shift locations unpredictably, so wading birds may be reasonably expected to recolonize in future years. Colonial waterbird species that nested within the project site included:

- Great egret (*Ardea alba*): Between 1985 and 2001, great egrets nested at one wading bird breeding colony within the project site (Isle of Meadows) and two nearby colonies (Prall's and Shooter's islands), as well as elsewhere in NYC (Parsons 1994, Kerlinger 2002). Recent surveys indicate that great egrets have not nested on any of these breeding colonies since 2001, although they do nest on islands elsewhere in NY/NJ Harbor (Bernick 2007). Great egrets forage primarily on estuarine and freshwater fish and some terrestrial vertebrates, and are routinely observed foraging in all areas of the project site and throughout the secondary

study area from April to October, and rarely as winter residents (DPR 2007, Maccarone and Brzorad 2002). Great egrets were observed during 2007 AKRF field observations.

- Cattle egret (*Bubulcus ibis*): Cattle egrets, in contrast to other wading birds nesting in the NY/NJ Harbor area, feed predominantly in terrestrial habitats on small vertebrates and invertebrates. Between 1985 and 2001, cattle egrets nested at one wading bird breeding colony within the project site (Isle of Meadows) and two nearby colonies (Prall's and Shooter's islands), as well as elsewhere in NYC (Parsons 1994, Kerlinger 2002). Recent surveys indicate that cattle egrets have not nested on any of these breeding colonies since 2001, and have essentially ceased breeding activity in NY/NJ Harbor (Bernick 2007). In recent years, they have rarely been observed within the project site (DPR 2007) and have not been noted in any site within the secondary study area. Cattle egrets were not observed during 2007 AKRF field observations.
- Little blue heron (*Egretta caerulea*): Between 1985 and 2001, little blue herons nested in small numbers at one wading bird breeding colony within the project site (Isle of Meadows) and two nearby colonies (Prall's and Shooter's islands), as well as elsewhere in NYC (Parsons 1994, Kerlinger 2002). Recent surveys indicate that little blue herons have not nested on any of these breeding colonies since 2001, although they do nest on islands elsewhere in NY/NJ Harbor (Bernick 2007). Little blue herons forage primarily on estuarine fish and invertebrates, and are occasionally observed foraging in coastal areas within the project site and secondary study area from April to October (DPR 2007, Maccarone and Brzorad 2002). Little blue heron were not observed during 2007 AKRF field observations.
- Snowy egret (*Egretta thula*): Between 1985 and 2001, snowy egrets nested at one wading bird breeding colony within the project site (Isle of Meadows) and two nearby colonies (Prall's and Shooter's islands), as well as elsewhere in NY City (Parsons 1994, Kerlinger 2002). Recent surveys indicate that snowy egrets have not nested on any of these breeding colonies since 2001, although they do nest on islands elsewhere in NY/NJ Harbor (Bernick 2007). Snowy egrets forage primarily on estuarine fish and invertebrates, and are routinely observed foraging in estuarine areas of the project site and secondary study area from April to October (DPR 2007, Maccarone and Brzorad 2002). Snowy egrets were not observed during 2007 AKRF field observations.
- Yellow-crowned night-heron (*Nyctanassa violacea*): Between 1985 and 2001, yellow-crowned night-herons nested at one wading bird breeding colony within the project site (Isle of Meadows) and two nearby colonies (Prall's and Shooter's islands), as well as elsewhere in New York City (Parsons 1994, Kerlinger 2002). Recent surveys indicate that this species has not nested on Isle of Meadows since 2001 (Bernick 2007). They have been reported since 2001 as nesting in mainland areas in northwestern Staten Island (E. Johnson, SIIAS, 2007, pers. comm.), and attempting to nest at nearby Prall's Island (DPR data). They nest on islands and mainland areas elsewhere in NY/NJ Harbor (Bernick 2007). Yellow-crowned night heron were not observed nesting during 2007 AKRF field observations.
- Glossy ibis (*Plegadis falcinellus*): Between 1985 and 2001, glossy ibis nested at one wading bird breeding colony within the project site (Isle of Meadows) and two nearby colonies (Prall's and Shooter's islands), as well as elsewhere in New York City(Parsons 1994, Kerlinger 2002). Recent surveys indicate that glossy ibis have not nested on any of these breeding colonies since 2001, although they do nest on islands elsewhere in NY/NJ Harbor (Bernick 2007). Glossy forage primarily in muddy areas, probing for invertebrates, and are routinely observed foraging in estuarine areas of the project site and secondary study area

from April to October (DPR 2007, Maccarone and Brzorad 2002). Glossy ibis were not observed during 2007 AKRF field observations.

- Black-crowned night-heron (*Nycticorax nycticorax*): Although not listed by the NYNHP in their response, between 1985 and 2001, black-crowned night-herons nested at the wading bird breeding colony within the project site (Isle of Meadows) and two nearby colonies (Prall's and Shooter's islands), as well as elsewhere in NYC (Parsons 1994, Kerlinger 2002). Recent surveys indicate that black-crowned night-heron have not nested on any of these breeding colonies since 2001, although they do nest on islands elsewhere in NY/NJ Harbor (Bernick 2007). Black-crowned night-heron forage on a wide variety of estuarine, freshwater, and terrestrial prey, and are routinely observed foraging in all areas of the project site and throughout the secondary study area from March-October, and often overwinter in several of the sites (DPR 2007, Maccarone and Brzorad 2002, Bernick 2007). Black-crowned night-heron were observed during 2007 AKRF field observations.

An additional "protected bird" species on the NYNHP list not associated with colonial waterbirds:

- Barn owl (*Tyto alba*): At least two barn owl nest sites have been reported in the project site and within the secondary study area in recent years (DEC 2007). Barn owls were not observed during 2007 AKRF field observations.

One bird species absent from the NYNHP response letter, northern harrier, has been known to occur in the vicinity of the project site and should be mentioned in the discussion of bird species of conservation interest.

- Northern harrier (*Circus cyaneus*), New York State Threatened. The northern harrier breeds and forages in upland and marsh grassland and low scrub habitats. These habitat types are prevalent in both the project site and secondary study area, and this species is frequently seen in both locations throughout the year. Between 2000-2006, individuals of this species were known to nest in properties to the north of the secondary study area site at Neck Creek marsh. This is one of the few recent nesting records for the NYC area (Sierra Club 2006, DEC 2007).

One reptile species absent from the NYNHP response letter, northern diamondback terrapin, has been known to occur in the vicinity of the project site and should be mentioned in the discussion of species of conservation interest.

- Northern diamondback terrapin (*Malaclemys terrapin*), New York State Games Species and NYNHP Watch List Species. An adult was caught and released during a fish study conducted in June 1995, and observed in Main Creek at the William T. Davis Refuge during that year. A limited harvest of northern diamondback terrapin is allowed in New York State via DEC permit.

Two threatened or endangered plant species reported to occur on or in the vicinity of the project site are presented below.

- Glaucous sedge (*Carex glaucodea*), New York State Endangered. Glaucous sedge has been reported as occurring within the vicinity of the project site, outside the primary and secondary study areas. This species occurs in wet to dry-mesic deciduous forests and old fields, on the edges of seasonal swamps, and in seasonally wet depressions in more open environments (Seoane 2007). Plants can often be found in roads and deer or human paths through forests. Glaucous sedge was not observed during 2007 AKRF field observations.

- Persimmon (*Diospyros virginiana*), New York State Threatened. Persimmon has been reported as occurring within the vicinity of the project site, within the secondary study area (Seoane 2007). This tree species typically prefers moist well-drained soils but also can often found in somewhat dry to mesic rocky or sandy woods, thickets, fields, and roadsides (Brooklyn Botanic Garden 2007). Persimmon was not observed during 2007 AKRF field observations.

Two significant ecological communities were also reported to occur within the secondary study area, outside the project site (Seoane 2007). Significant ecological communities are identified by DEC on the basis of significance criteria and are considered to have high ecological and conservation value. They are either an occurrence of a community type that is rare in the state, or represent a high quality example of a more common community type.

- Red maple-sweetgum swamp—This ecological community exists within the secondary study area (i.e., Arden Avenue Woods). It is described as a moderate-sized community with a low abundance of exotic species, located within a small but intake forested landscape that is surrounded by development (Seoane 2007). This community was observed during field investigations, and is described in greater detail above in the plant communities descriptions.
- Oak-tulip tree forest—This ecological community has been reported as occurring at two locations within the secondary study area (Willowbrook Park and LaTourette Park). It is described as a very large forest containing a significant component of mature forest with large trees and few exotics, although other portions of the forest are disturbed with exotic species. Within the forest are small, open patches of degraded serpentine barrens, small vernal pools, and small patches of red maple-sweetgum swamp, coastal oak-beech forest, ponds and intermittent streams (Seoane 2007). This community was observed during field investigations, and is described in greater detail above.

SIGNIFICANT COASTAL FISH AND WILDLIFE HABITAT

In 1992, NYSDOS identified Fresh Kills as a Significant Coastal Fish and Wildlife habitat (see Figures 10-45 and 10-46a through 10-46d), in spite of the severe degradation of the site by human activities (i.e., landfilling, dredging, oil spills). The designation was based on certain factors evaluated for the site such as ecosystem rarity, species vulnerability, human use, population level, and replaceability. Fresh Kills is the largest tidal wetland ecosystem in the Manhattan Hills ecological region, and at one time was one of the largest coastal wetland areas in New York State. The wetlands and other natural communities associated with Fresh Kills are among the most valuable fish and wildlife habitats occurring on Staten Island. Herons, waterfowl, shorebirds, raptors, and passerines may occur in Fresh Kills (especially during spring and fall migrations). Additionally, the tidal creeks and freshwater inflows within this habitat system provide potential spawning and nursery habitats for a variety of anadromous, estuarine, and resident freshwater fishes (NYSDOS 1992).

D. THE FUTURE WITHOUT THE PROPOSED PROJECT: 2016 AND 2036

The following sections describe the future without the proposed project within the project site and secondary study area in the 2016 and 2036 analysis years.

2016: THE FUTURE WITHOUT THE PROPOSED PROJECT

PROJECT SITE

Absent the proposed project, it is anticipated that by 2016 analysis year, the final Fresh Kills closure construction activities (i.e., final grading and capping) currently underway for Landfill Sections 6/7 and 1/9 would be completed. Chapter 1, "Project Description," provides a detailed description of the post-closure monitoring and maintenance activities being implemented by DSNY. Post-closure monitoring and maintenance activities, performed in accordance with the Fresh Kills Landfill Post-Closure Monitoring and Maintenance Operations Manual, would be expected to continue through the 2016 and 2036 analysis years. These activities would be expected to include the following:

- Monitoring and maintenance of the final cover and drainage systems.
- Monitoring and maintenance of leachate collection system and treatment plant.
- Monitoring and maintenance of stormwater management system.
- Maintenance of groundwater monitoring wells, and landfill gas migration monitoring wells and methane sensors.
- Monitoring and maintenance of landfill gas emission control, odor control and processing systems.
- Maintenance of on-site access roads and bridges.
- Environmental monitoring—quarterly groundwater monitoring, annual surface water monitoring, biennial sediment and benthic macroinvertebrate monitoring, and quarterly landfill gas migration monitoring.
- Vegetation management (i.e., occasional mowing and herbicide application).

In general, implementation of the post-closure monitoring and maintenance activities in the 2016 and 2036 future condition without the proposed project would not be expected to result in significant changes to terrestrial or aquatic natural resources within the project site. In addition, long-term monitoring and maintenance of the landfill covers (including periodic mowing) would be expected to limit any changes in habitat cover on the landfill sections. The natural resources within the project site would be expected to be similar to those present under the existing condition, with some changes occurring naturally due to successional changes in the plant community. *Phragmites* communities would have the potential to expand onto portions of the *Spartina*-dominated saltmarsh within the project site where tidal flow may be altered or restricted (Bart et al. 2006). Upland and wetland woodlands on the site would continue to mature, and where contiguous to other woodlands (e.g., at the southern portion of the project site south of Landfill Section 2/8, just north of Arden Heights Woods), may support wildlife characteristic of forest interior habitat. Palustrine emergent and scrub-shrub wetlands would continue to mature and may gain additional woody plant species. Invasive plant species would continue to colonize some portions of the project site not colonized by native species. The tidal creeks and wetlands, freshwater wetlands and open water areas, woodlands and fields would continue to provide habitat for fish and wildlife currently described as using the habitats present within the project site.

In addition to the aforementioned landfill post-closure and monitoring activities, there are proposed and ongoing regional projects associated with the New York/New Jersey Harbor Estuary Program (HEP), the Hudson-Raritan Estuary Ecosystem Restoration Project (HRE), and New York City projects identified in PlaNYC that have the potential to result in improvements

to water quality and aquatic habitat of the Arthur Kill and the Fresh Kills estuary as well as terrestrial habitat within the project site. These projects are described below. Improvements that result from these projects would occur without the proposed project, and are expected to continue through the 2016 and 2036 analysis years.

As described in Chapter 2, "Land Use, Zoning and Public Policy," there are New York City Department of Transportation (NYCDOT) and New York State Department of Transportation (NYSDOT) transportation projects proposed within or at the boundary for the project site that have the potential to affect natural resources. These projects are also described in the following sections. In general, the area affected by these projects is small and the construction and operation of these transportation projects would not result in significant adverse impacts to terrestrial or aquatic resources within or adjacent to the project site.

New York/New Jersey Harbor Estuary Program (HEP) Projects

The HEP Final Comprehensive Conservation and Management Plan (CCMP) included a number of goals to improve water quality and aquatic resources throughout the Harbor Estuary. To meet these goals, the CCMP outlines objectives for the management of toxic contamination, dredged material, pathogenic contamination, floatable debris, nutrients and organic enrichment, and rainfall-induced discharges. The HEP Habitat Workgroup developed watershed-based priorities for acquisition, protection, and restoration of sites within the Harbor Estuary for the preservation and enhancement of tidal wetlands that will provide improved habitat for fish and macroinvertebrates as well as the birds, mammals, and reptiles that depend on these habitats Feasibility studies were initiated in 2001 to assess some of these potential habitat restoration sites. Within the project site, Richmond Creek has been identified as a HEP restoration site. The project identified for Richmond Creek is the installation of an anadromous fish passage ladder to open up additional areas of the creek to anadromous fish.

The Hudson-Raritan Estuary Ecosystem Restoration Project (HRE)

HRE is a cooperative project being led by the USACE that was funded by a House of Representatives Resolution on 15 April 1999. The Port Authority of New York and New Jersey (PANYNJ) is a co-sponsor of this project. Other cooperating agencies include USEPA, USFWS, NOAA, National Resource Conservation Service, New Jersey Department of Environmental Protection (NJDEP), New Jersey Department of Transportation (Office of Maritime Resources), DEC, NYSDOS, NYCDEP, New York City Parks and Recreation, and New Jersey Meadowlands Commission. The focus of the study is to identify the actions needed to restore the Hudson-Raritan Estuary and develop a plan for their implementation. The study area for the program includes all the waters of the New York and New Jersey Harbor and the tidally influenced portions of all rivers and streams that empty into the Harbor and ecologically influence the Harbor. The program has drafted a plan that presents an ecosystem approach to restoration of the estuary, guidance for selecting specific projects, setting measurable objectives, called target ecosystem characteristics (TEC), and tracking program performance (Bain et al. 2007).

The Hudson-Raritan Estuary Ecosystem Restoration Project Environmental Restoration Feasibility Study prepared for Arthur Kill/Kill Van Kull, identified 30 potential restoration sites within the Arthur Kill/Kill Van Kull study area, two of which are within the project site: Fresh Kills landfill (restoration/enhancement of shoreline/coastal fringe habitat (bird habitat)) and Richmond Creek (restoration of fishery habitats (anadromous fish migration, artificial reefs))(USACE 2004). Implementation of these restoration projects in the 2016 and 2036 analysis years would benefit wildlife resources within and adjacent to project site.

New York City Projects

- PlaNYC—PlaNYC identifies initiatives to be implemented with respect to land, air, water, energy, and transportation to achieve the sustainability goals for the city (http://www.planyc.com). Air Quality Initiative 12 sets a goal for reforesting 2,000 acres of parkland within the City not currently occupied by ballfields by the year 2017, as one of the natural solutions proposed for improving air quality. This reforestation effort is to begin in 2009 and to be completed by 2017. One of the designated locations is Fresh Kills Park—the mapped parkland adjacent to Richmond and Main Creeks within the project site. It is anticipated that some planting of trees would occur within Fresh Kills Park as part of this initiative in the future without the proposed project. Planting of trees within the project site would benefit wildlife.
- Arthur Kill Road Improvement Project—NYCDOT is evaluating potential roadway improvements to Arthur Kill Road between Bentley Street (Tottenville) and Clarke Avenue (Richmondtown). A portion of this improvement project bounds the southern portion of the project site. Potential impacts to natural resources within the project site resulting from this project would be expected to be minimal.
- Victory Boulevard and Travis Avenue Improvement Project—NYCDOT will widen Victory Boulevard north and south of Travis Avenue, at the northern edge of the project site, and provide intersection improvements and sidewalks. Construction is expected to be completed in 2008. The construction and operation of this project would not result in adverse impacts to natural resources within or adjacent to the project site.

State Projects

West Shore Expressway Access Improvement Project

Chapter 2, "Land Use, Zoning and Public Policy," describes the alternatives evaluated by NYSDOT to improve access within six study areas, three of which include portions of the project site: Arthur Kill Road Study Area, Arden Avenue Study Area, and Victory Boulevard Study Area. The alternative selected as providing safety, access and operational improvement while minimizing environmental impacts (Alternative 4) includes the following activities with the potential to affect natural resources within the study area:

- Construction of a new ramp to northbound service road between Arthur Kill Road and Arden Avenue—This element would result in the loss of upland habitat and potential impacts to a small area within the ramp alignment.

Korean War Veterans Parkway Ramp Terminus Project

As described in Chapter 2, "Land Use, Zoning and Public Policy," NYSDOT is evaluating alternatives to improve vehicular circulation at the northern terminus of the Korean War Veterans Parkway, where it connects with the local street network (i.e., Arthur Kill Road and Richmond Avenue). Alternatives proposed include constructing ramps from the Parkway to Richmond Avenue, or constructing new at-grade connections between the Parkway at Richmond Avenue, and the Parkway at Arthur Kill Road. Also under consideration were pavement and bridge improvements. This project has the potential to result in loss of terrestrial and/or wetlands habitat at the southeast portion of the project site. These losses would not be expected to result in significant adverse impacts to terrestrial or aquatic biota within or adjacent to the project site, and would be assessed through the regulatory review process for the project. However, at this time, NYSDOT has no plans to move forward with the proposed improvements.

SECONDARY STUDY AREA

Similar to the project site, there are proposed and ongoing regional projects associated with the HEP, New York City projects identified in PlaNYC, the construction of Owl Hollow Park, and the remediation of the Brookfield Avenue landfill, that have the potential to result in improvements to water quality and aquatic habitat of the Fresh Kills estuary as well as terrestrial habitat within the secondary study area. These projects are described below. Improvements that result from these projects would occur without the proposed project, and are expected to continue through the 2016 and 2036 analysis years.

Other projects proposed for the secondary natural resources study area that have the potential to affect terrestrial and aquatic resources include the operation of the DSNY Waste Transfer Station at the northwest corner of the project site, and private residential or commercial development projects. These projects are also described in the following sections. In general, the construction and operation of these projects would not be expected to result in significant adverse impacts to terrestrial or aquatic resources within or in the vicinity of the project site.

DSNY Solid Waste Transfer Station

Located immediately northwest of the project site, north of Little Fresh Kill and west of the West Shore Expressway, this recently completed DSNY facility is a truck-to-rail transfer station that will process household waste generated on Staten Island for export by rail. Environmental review of the construction and operation of this facility was completed in 2000 as part of the Final Environmental Impact Statement for the city-wide Comprehensive Solid Waste Management Plan Draft Modification on June 1, 2000. The operation of this facility in the future without the proposed project will not result in adverse impacts to natural resources within or in the vicinity of the project site.

DEP Remediation of the Brookfield Avenue Landfill

The Brookfield Avenue Landfill, located at the southeast corner of the project site (see Figure 10-3), received municipal solid waste from 1966 until 1980. Between 1974 and 1979, industrial hazardous wastes (i.e., waste oil, sludges, metal plating wastes, lacquers and solvents) were reported to have been illegally dumped at the site. The Preliminary Design for Remedial Action prepared for the implementation of the Record of Decision (ROD) incorporates measures that are protective of public health and the environment and consistent with conversion of the landfill to a public park. These measures—landfill cap, landfill gas collection and treatment system, 3-foot wide subsurface barrier wall extending approximately 40 feet into the ground around the periphery of the two landfill mounds within Brookfield Avenue Landfill, leachate collection and pretreatment system, and stormwater management system—will contain contaminants within the landfill and facilitate treatment of leachate and landfill gas. See Chapter 2, "Land Use, Zoning and Public Policy," for a more detailed description of the remedial program.

No hazardous materials will be removed from the site and only uncontaminated soils and topsoil will be brought to the site for the construction of the cap. Construction of the remediation system is anticipated to take between 3 to 3.5 years, and is expected to be compled by the 2016 analysis year.

Construction of the remediation system will result in the loss of the successional old field/shrubland habitat that currently covers much of the landfill and the loss of the landfill as wildlife habitat for the four-year period anticipated for remediation to be completed. This loss of habitat may result in the loss of some wildlife individuals that are unable to find suitable available habitat nearby. However, the loss of these individuals would not be expected to result in significant adverse impacts to populations of these species in the New York metropolitan

region. Erosion and sediment control measures implemented during vegetation clearing, construction of subsurface barrier, and construction of other elements of the remediation system will minimize potential impacts to Richmond Creek and the tidal wetlands bordering the base of the landfill. By eliminating a source of contaminants, remediation of the Brookfield Avenue landfill will benefit water and sediment quality and aquatic resources of Richmond Creek and the tidal wetlands along the creek, including the portion within the Fresh Kills Park project site.

New York/New Jersey Harbor Estuary Program (HEP) Projects

Within the secondary natural resources study area, Arden Heights Woods located at the southern border of the project site (see Figure 10-3) has been identified as a HEP restoration site. Restoration activities would include protecting and restoring the habitat at the perimeter of the park and implementing measures to reduce non-point source impacts. These measures would improve habitat quality and benefit wildlife within and adjacent to Arden Heights Woods.

New York City Projects

- In the 2016 and 2036 analysis years, Owl Hollow Park (see Figure 1-39) is expected to be completed and operational. This 21-acre park will comprise four synthetic turf soccer fields (two of which will be lighted), a paved perimeter path around the athletic fields with benches, tables, nature trail, comfort station, playground, natural area, as well as the seven existing landfill gas monitoring wells and one groundwater monitoring well. The Owl Hollow Park project has undergone a separate environmental review. Construction and operation of this recreational facility will not result in significant adverse impacts to natural resources.
- PlaNYC—Water Quality Initiative 5 is to expand the bluebelt program to other areas of Staten Island, beginning in 2009, and expand the Bluebelt program to other areas of the city, where possible by 2015. The Main Creek Watershed is not currently within the Blue Belt. Expanding the Bluebelt program to the Main Creek Watershed, and to portions of the Richmond Creek watershed not currently included within the Bluebelt system would have the potential to improve water quality and aquatic habitat in the secondary study area and also within the project site

Private Development Projects

- Residential development projects—Privately sponsored residential developments in the vicinity of the secondary natural resources study area include: Wainwright Avenue Residential Development (16 dwelling units) located at the southeast corner of the project site, across from the Brookfield Landfill; Presentation Convent Residential Development (76 dwelling units) located adjacent to the southeastern border of Arden Heights Woods, and Victory Estates (100 dwelling units) located just north of the project site, within the portion of the secondary natural resources study area forming the northern portion of the Neck Creek watershed and adjacent to NWI designated estuarine emergent wetlands. The Presentation Convent Residential Development and Victory Estates Development would result in the loss of plant communities that currently provide wildlife habitat. While the loss of wildlife habitat within these two sites would have the potential to affect wildlife individuals, the loss of habitat would be small and the developments would not result in significant adverse impacts to wildlife populations within the metropolitan region. However, both projects are located adjacent to wetlands and have the potential to affect these habitats due to non-point source pollutant discharges.
- Commercial development projects—The L.A. Fitness health club (to be developed within an existing one-story building), and Holiday Inn Express plus two other possible hotels (two-acres of manufacturing land) would be located northwest of project site, within an area east of the West Shore Expressway and south of Victory Boulevard. These projects would not be

expected to result in adverse impacts to natural resources. Pratt Industries is expected to expand the facilities at the existing Visy Paper plant on Victory Boulevard, in the Travis neighborhood, northwest of the project site. As part of this expansion, the New York City Economic Development Corporation (EDC) will assist in the construction of a spur from the Travis branch of the Staten Island Railroad to Visy's facilities. Potential impacts to tidal wetlands resulting from the construction of the new facility and rail spur would be assessed through a separate regulatory review process.

2036: THE FUTURE WITHOUT THE PROPOSED PROJECT

PROJECT SITE

Within the project site, post-closure and maintenance activities would be expected to continue in the 2036 future without the proposed project. Natural resources within the project site would be similar to the 2016 future without the proposed project, with additional changes in some plant communities due to maturation of the plant community and natural succession. Enhancement activities conducted as part of HEP or HRE described for the 2016 analysis year would continue to benefit aquatic resources within the Fresh Kills estuary system. No new projects would occur on the project site in the 2036 future without the proposed project.

SECONDARY STUDY AREA

Natural resources within the secondary study area in the 2036 future without the proposed project is assumed to be a continuation of the conditions discussed above for the 2016 analysis year.

E. THE FUTURE WITH THE PROPOSED PROJECT: 2016 AND 2036

As presented in Chapter 1, "Project Description," the proposed project would create a large new open space with significant cultural, recreational and environmental amenities while at the same time protecting and enhancing aquatic and terrestrial habitats. Proposed new park roads and access points would improve local open space connectivity with existing adjoining parks (William T. Davis Wildlife Refuge to the north and LaTourette Park in the Staten Island Greenbelt to the east). The objectives of the landscaping plan at Fresh Kills Park is to protect the existing natural resources within the project site, while building upon those resources that would benefit local and regional ecology and park users, and convert the four landfill sections into erologically productive landscapes and recreational fields for active and passive pursuits. The park elements identified as part of the RWCS and evaluated in this GEIS will ultimately be designed around existing natural resources and habitats identified for enhancement, with the development of the park and ecological improvements phased in as the park is developed.

With respect to natural area restoration, the major objectives of the park are:

- Enhancement and expansion of the existing freshwater wetlands, including the potential enhancement at the existing stormwater basins;
- Enhancement and expansion of the existing tidal wetlands through removal of invasive species such as *Phragmites* and enhancement of the native intertidal and high marsh plant communities;
- Development of native grassland and meadow habitats on the landfill sections; and
- Expansion of woodlands to provide a buffer for the site perimeter and provide an ecological connection with woodlands adjacent to the project site.

The analysis below provides a general discussion of potential project impacts to natural resources associated with the construction of upland and in-water elements of Fresh Kills Park, and operation of certain project elements such as overwater structures, roads, nighttime lighting, commercial wind turbines, and measures that would be implemented during the development of the park to minimize these impacts, followed by a detailed discussion of the potential impacts for each of the 2016 and 2036 project elements.

CONSTRUCTION

LAND DISTURBING ACTIVITIES

Construction of the proposed projects would result in the following land disturbance activities that could impact natural resources:

- Land clearing—removal of existing vegetation or other existing cover material;
- Temporary stockpiling of fill to be used as final cover material;
- Grading and construction of surface drainage systems; and
- Installation of infrastructure and roads.

These activities have the potential to impact terrestrial and aquatic resources through:

- Discharge of stormwater to tidal and freshwater wetlands present within the project site;
- Deposition of fugitive dust resulting from grading activities into terrestrial and aquatic habitats;
- Physical damage to vegetation to be retained (i.e., above ground portion of the plants and the below ground portion of the tree protection zone for trees identified for retention);
- Modification or loss of habitat due to physical removal of plant community or grading and loss of individual wildlife due to collision with or as a result of operation of construction equipment (i.e., direct impacts);
- Loss of habitat due to avoidance of noise, vehicle traffic, or other human activity (i.e., indirect impacts); and
- Potential impacts to existing landfill environmental control systems (i.e., leachate and landfill gas control systems), (see Chapter 1, "Project Description" for a discussion of these systems).

Potential impacts to natural resources as a result of these activities would be minimized through the implementation of measures and guidelines discussed below.

Measures to Reduce Potential Wildlife Impacts During Construction

A detailed discussion of the potential natural resources impacts of the project during construction is presented in Chapter 20, "Construction." As detailed in that chapter, short-term construction impacts to wildlife would include direct impacts such as loss of habitat from land-clearing activities and development of staging areas for construction equipment and work sites, loss of individuals due to wildlife/construction vehicle impacts, habitat degradation due to partial removal of habitat or necessary substrate for wildlife activity (i.e., non-permanent removal or damage of vegetation as a result of a temporary project, such as tree trimming or temporary blocking of a drainageway to limit stormwater runoff), and indirect impacts such as wildlife avoidance of construction sites due to noise, human disturbance, lighting, and other factors that cause habitat to be unsuitable. Wildlife use of a particular area would be expected to return upon completion of construction and enhancement activities. The enhanced habitats proposed for Fresh

Kills Park would be expected to benefit wildlife through the introduction of plant communities of higher quality and diversity than currently present within much of the project site.

Strategies to limit wildlife impacts as a result of the above construction activities would depend on the duration and extent of the disturbance. The use of physical barriers at construction and staging areas, such as drift fencing, would be useful to restrict movement of ground-dwelling wildlife (i.e., small mammals, reptiles and amphibians), thereby limiting loss of individuals from direct contact with construction vehicles. Direct impacts to wildlife would also be reduced by limiting the speed of construction vehicles, and avoiding nighttime construction operations. Additionally, the phasing of the park development activities over a 30 year period would limit the extent of land disturbance and area of in-water construction activities at a given time, increasing the potential that suitable habitats may be available to wildlife affected by development of a certain elements of the park and reducing the potential for significant adverse impacts.

Site-Specific Erosion and Sediment Control Plan (Stormwater Pollution Prevention Plan)

As discussed in Chapter 20, "Construction Impacts," a conceptual site-wide erosion and sediment control plan has been prepared and would be implemented on a project-by-project basis through 2036. It is expected that stormwater runoff from the project construction sites not associated with landfill closure or maintenance would be regulated through the SPDES program (see "Regulatory Context" under Section B, "Methodology") under the General Permit for Stormwater Discharges from Construction Activity Permit No.GP-0-08-001. In order to meet the requirements of this permit, a stormwater pollution prevention plan (SWPPP) would be prepared and a Notice of Intent (NOI) would be submitted to DEC for each site-specific capital project. The SWPPP would comply with all of the requirements of this general permit, DEC's technical standard for erosion and sediment control presented in "New York Standards and Specifications for Erosion and Sediment Control," and DEC's technical standard for the design of post-construction stormwater control practices presented in New York State Stormwater Management Design Manual. The site-specific erosion control plan would include design controls and describe practices that will be implemented during construction to minimize the release of pollutants in stormwater runoff, and would take into account unique site conditions such as proximity to landfill units, environmental control systems, slopes, and proximity to sensitive natural resources. These measures would be detailed in the SWPPP which would be expected to contain the following (see also additional details in Appendix H):

- Flagging and staking to define the limits of disturbance and locations to install controls—This would include identification of the tree protection zone (TPZ) by a certified/registered arborist for trees that are to be preserved;
- Stockpile management controls;
- Stabilized construction entrances/exits and construction entrance postings;
- Appropriate inlet and outlet protection areas that have the potential to be affected by land disturbing activities—It is anticipated that during construction, site drainage would be equipped with appropriate outlet protection devices and best management practices as specified in the SWPPP. Specific details for inlet and outlet protection devices would be included in the site-specific erosion control plan, but would likely include sediment barriers such as drop inlet protection and inlet filter berms;
- Perimeter controls in areas to be disturbed during grading activities (i.e., sediment barriers such as compost socks, gravel bag/sand bag berms);

- Stormwater conveyances (i.e., channels, swales, diversion berms, etc) to direct runoff to one of the existing stormwater basins, as is appropriate for the site-specific erosion control plan;
- Fugitive dust control measures (e.g., seeding or wet suppression), including minimizing the amount of exposed soil at any given time;
- Stabilization of disturbed areas with temporary seeding or permanent cover—seeding should be consistent with landscaping and enhancement plans developed for the portion of the park under construction; and
- Removal of temporary BMPs following final stabilization.

A construction monitoring program would be implemented during construction to document that construction is consistent with and meets the requirements of the SWPPP including all ongoing monitoring and record keeping during construction that would be defined for each capital park project. In addition, the design must reflect that the existing environmental monitoring control systems (i.e., landfill gas and leachate collection systems) and landfill cover remain intact and functioning during and after road construction to minimize the potential for adverse impacts to terrestrial and aquatic resources as well as public health and safety.

Protection Plan for Trees and Plant Communities to be Preserved

A protection plan will be prepared for each portion of the park under development that identifies trees, sensitive plant communities such as wetlands, and any other plant communities that have been identified for retention throughout the development of the proposed project, and establishes a protection zone around these resources to minimize the potential for adverse impacts. The protection zone for these resources would be flagged and staked in the field by a professional (i.e., certified/registered arborist for trees, and by a horticulturist or botanist for wetlands and other sensitive plant communities), and will be identified on all construction drawings along with notes indicating activities allowed and prohibited within each protection zone.

Clearing of staging areas for roadway construction, as well as construction of other park elements, should be conducted in a manner consistent with minimizing impacts to large trees (>12 inches dbh), relative to PlaNYC initiatives regarding the importance of urban forests and reforestation (i.e., the "Million Trees" initiative). Maintaining existing mature trees provides benefits in temperature reduction (via shading, evapotranspiration potential, air quality improvements) and aesthetic value to park visitors that would take decades to restore through reforestation programs. When plans have been finalized for a particular park area, trees located within areas of disturbance will be inventoried prior to construction. Should construction be delayed for a period of time greater than eight years, the area of disturbance will be re-inventoried for trees.

IN-WATER CONSTRUCTION ACTIVITIES

Construction of the proposed park[1] would result in the following in-water activities that have the potential to affect the existing aquatic resources described as occurring within the project site in Section C, "Existing Conditions."

[1] Given that the ferry/water taxi landing at the Point is proposed for a location with existing bulkhead and waterfront infrastructure, it is assumed that it could be developed with limited additional maritime infrastructure or dredging. Because the marina is to be used by small craft with shallow drafts, it is assumed that the development of the 50-slip marina at the point would not require dredging. Both of these project elements are also long-term (2036) program elements.

- Construction of stormwater outfalls and aprons;
- Placement of fill material, culverts, and other structural elements within the existing surface waters or wetlands as required for the construction of the proposed park roads, viaducts, and bridges; West Shore Expressway service roads and ramps, and pedestrian/bicycle bridges and paths;
- Removal of sediment and grading of shoreline required as part of the proposed wetland enhancement activities;
- Installation of piles within surface waters and tidal wetlands required for proposed kayak launch, wildlife observation decks, boardwalks, fishing piers, barge garden, 50-slip small craft marina, and ferry/water taxi landing;
- Repair of existing shoreline stabilization features;
- Removal of in-water debris; and
- Installation of underground utilities.

These activities have the potential to impact aquatic resources and wetlands through:

- Temporary increases in suspended sediment and resuspension and redeposition of sediment contaminants during sediment disturbing activities such as piling installation, bulkhead repair/replacement, and removal of sediment and grading as a result of wetlands enhancement efforts;
- Temporary loss of fish habitat (i.e, breeding or nursery habitat, foraging, or EFH identified by the NMFS) from temporary water quality changes and noise impacts associated with pile driving;
- Temporary loss of wetland habitat due to installation of underground utilities; and
- Direct loss of wetlands, or bottom habitat and associated benthic invertebrates and fish habitat within the footprint of piles, fill material, culverts, and other structural elements associated with the proposed park road and bridge network, and waterfront amenities.

On the basis of the high degree of mixing and relatively quick flushing observed in the Fresh Kills system discussed above, any temporary increase in suspended sediment resulting from in-water construction activities would be localized and would be expected to dissipate shortly after the completion of the sediment disturbing activity. Therefore, in-water construction activities would not be expected to result in significant adverse impacts on water quality or aquatic biota. Similarly, any contaminants released to the water column as a result of sediment disturbance would be expected to dissipate rapidly and would not be expected to result in significant long-term impacts on water quality. While Arthur Kill and Fresh Kills system sediments have been found to contain contaminants at concentrations that may pose a risk to some benthic macroinvertebrates, the relatively rapid flushing of the Fresh Kills system and large influence from the Arthur Kill suggests that these sediments would dissipate such that redeposition within or outside the project area would not be expected to significantly adversely affect benthic macroinvertebrates or bottom fish. Additionally, measures would be developed in consultation with DEC and the USACE during the permit review process to minimize potential impacts to fish and fish habitat resulting from sediment disturbing construction activities (e.g., use of silt curtain and seasonal restrictions on in-water construction activities to protect specific aquatic biota).

Life stages of estuarine-dependent and anadromous fish species, bivalves and other macroinvertebrates are fairly tolerant of elevated suspended sediment concentrations and have developed behavioral and physiological mechanisms for dealing with variable concentrations of

suspended sediment (Birtwell et al. 1987, Dunford 1975, Levy and Northcote 1982 and Gregory 1990 in Nightingale and Simenstad 2001a, LaSalle et al. 1991). Fish are mobile and generally avoid unsuitable conditions in the vicinity such as increases in suspended sediment and noise (Clarke and Wilber 2000). While the localized increase in suspended sediment may cause fish to temporarily avoid the area around where piles or other in-water structures are being installed, the affected area would be expected to be small. Similar suitable habitats would be available for use by fish to avoid the area of in-water construction. Fish also have the ability to expel materials that may clog their gills when they return to less sediment-laden waters. Most shellfish are adapted to naturally turbid estuarine conditions and can tolerate short-term exposures by closing valves or reducing pumping activity. More mobile benthic invertebrates that occur in estuaries have been found to be tolerant of elevated suspended sediment concentrations. In studies of the tolerance of crustaceans to suspended sediments that lasted up to two weeks, nearly all mortality was caused by extremely high suspended sediment concentrations (greater than 10,000 mg/L) (Clarke and Wilber 2000) which would not occur from the in-water work associated with the proposed project.

Pile driving can produce underwater sound pressure waves that can affect fish, with the type and intensity of sounds varying with factors such as the type and size of the pile, firmness of the substrate, depth of water, and the type and size of the pile driver. Larger piles and firmer substrate require greater energy to drive the pile resulting in higher sound pressure levels (SPL). Hollow steel piles appear to produce higher SPL than similarly sized wood or concrete piles (Hanson et al. 2003). Sound attenuates more rapidly in shallow waters than in deep waters (Rogers and Cox 1988 in Hanson et al. 2003). SPLs generated by the driving of hollow steel piles with impact hammers can reach levels that injure fish (Hanson et al. 2003), and may not cause an avoidance behavior in fish. Impact hammers generate short pulses of sound with little of the sound energy occurring in the infrasound frequencies; the sound frequencies that have been shown to elicit an avoidance response in fish (Enger et al. 1993, Knudsen et al. 1997, and Sand et al. 2000 in Hanson et al. 2003). Therefore, fish have been observed exhibiting an initial startle response to the first few strikes of an impact hammer, after which fish may remain in an area with potentially harmful sound levels (Dolat 1997, NMFS 2001 in Hanson et al. 2003).

While there is little data available on the SPL required to injure fish, fish with swim bladders and small fish have been shown to be more vulnerable (Hanson et al. 2003). Because the area where pile driving would occur for each proposed in-water element is small when compared the amount of open water area available, fish would have sufficient available habitat to avoid pile driving activity. Additionally because the length of time for driving each pile is expected to be short, individual fish would not be expected to be exposed to potentially dangerous SPLs long enough to result in mortality. Therefore, the pile driving that would occur for the development of proposed in-water elements of the proposed project would not be expected to result in significant adverse impacts on aquatic biota.

The installation of the piles, boat ramps, outfall structures, or bulkhead would result in the permanent loss of a small amount of bottom and water column habitat for each structure, and the benthic macroinvertebrates associated with the bottom habitat within the structure footprint. The loss of this small area of habitat that could occur would be determined for each capital project with an in-water element. However, the majority of in-water elements are limited and the benthic habitat for macroinvertebrates and fish is not expected to be significantly impacted nor are the populations of aquatic species using the Arthur Kill or the Fresh Kills system. For example, assuming 50 piles for the proposed marina would only be expected to affect about 60 square feet of bottom habitat. The affected area for each in-water capital project would be

determined for each project as part of the permitting process. However, given the proposed program (see the project description) and the design intent to minimize in-water infrastructure, the expected permanent loss of benthic habitat and individuals within the structural footprints would not significantly impact the food supply for fish foraging in the area. Additionally, some of the in-water structures, such as piles, would provide surface for encrusting organisms.

Potential impacts to natural resources as a result of these activities would be minimized through implementation of the following:

- Measures to minimize increases in turbidity and suspended sediment in the water column, and to capture floating debris during sediment removal and grading activities, and installation of in-water structures. Examples of measures to be considered include silt curtains and coffer dams. Measures would be selected on the basis of on-site conditions and consultation with DEC and the USACE; and
- Measures to stabilize the wetlands enhancement areas as necessary during planting, such as the use of a biodegradable/geosynthetic erosion control mats or revegetation mats.

OPERATION

Operation of the proposed park would include the following project elements in common that have the potential to affect the existing terrestrial and aquatic resources and are described in described as occurring within the project site in Section C, "Existing Conditions."

- Nighttime lighting;
- Park Roads;
- Stormwater management;
- Overwater cover/shading;
- Wind turbines;
- Human Use; and
- Habitat and Wildlife Management.

The following sections provide a general discussion of the potential impacts to natural resources resulting from these project elements and identifies measures that would be incorporated into the Park Projects to reduce these impacts.

NIGHTTIME LIGHTING

Limited nighttime lighting is currently in-place within the project site, making Fresh Kills one of the darkest sites in the New York City area. Nighttime lighting within the project area is limited to the West Shore Expressway, public streets (such as Arthur Kill Road and Richmond Avenue) that surround the project site, and roadway lights along paved roads, bridges and facility areas within former Fresh Kills Landfill. The majority of existing secondary roads, such as those surrounding or traversing capped mounds, are presently unlit.

Nighttime lighting can have a significant impact on wildlife activity, including that of insects, birds, and mammals. Pertinent features of lighting design include luminance (brightness of a light's surface), illumination (lighting a feature near the source of a light), and the quality or physical composition of the light (Health Council of the Netherlands 2000). Light pollution, the condition of periodically or chronically increased light conditions in an area, has known impacts on wildlife orientation or disorientation (i.e., birds or insects attracted to a light source), that may

affect feeding, communication, reproduction, communication, critical interspecific interactions, and other behaviors (Longcore and Rich 2004). Light pollution may have effects on individuals, communities, or ecosystems, influencing local behavioral patterns in communication (i.e., disruption of visual displays occurring only in dark settings) to community level effects (i.e., shift in movement of aquatic prey species, increasing food availability for predators).

Examples of wildlife impacts due to ecological light pollution include increased bird and bat collisions with structures, disorientation and reproductive effects in moths and other primarily nocturnal insects, disruption of biorhythms (i.e., sensitivity to photoperiod for species that use light as a cue for starting reproductive cycles), degradation of habitat quality (i.e., making grassland habitats unsuitable for breeding birds) and other effects. While some of the results of artificial lighting may appear positive for species that habituate to elevated light levels (i.e., increased feeding success due to the presence of artificial light), they may cause shifts in behavior and population structure that are not readily apparent from qualitative observation.

Long term field studies would typically be necessary to distinguish the ecological effects of nighttime lighting from those due to other disturbances that are co-located or in close proximity to lighting (i.e., traffic noise, proximity to human activity, etc.; Health Council of the Netherlands 2000). Measurements of current light levels within the project site are unavailable for use in projecting future nighttime light levels. However, measures to reduce light pollution or 'trespass' (i.e., light or glare from an adjacent local lighting source) within Fresh Kills Park (e.g., type of light source, light placement, and lighting schedules) will be explored that are consistent with safety requirements for lighting a particular area (i.e., illumination of roadways, paths, and parking areas where public safety is a primary concern).

Exterior lighting guidelines developed by the New York City Department of Design and Construction (2005), and the Illuminating Engineering Society of North America (IESNA, 1999), suggest that areas with "intrinsically dark landscapes" (Zone E1, IESNA 1999), such as national parks and natural areas, receive zero lux or foot candles for areas where safety and security are not an issue. Some examples of strategies to light structures in the vicinity of Zone E1 areas include use of a limited, non-continuous lighting schedule in areas where darkness is preferred (reducing light use during low use periods), the use of shielding devices and cutoff-type luminaries with visors or hoods, reduction of ground-reflected light and upward light emissions (which accounts for up to 20 percent of 'sky glow' or atmospheric light pollution) by assigning proper directionality and pole heights suited to the appropriate use, limiting or adjusting illumination of non-target structures (i.e., bridges, secondary roads, etc.) to minimize light trespass, and using light sources suitable for the surface material of roadways or pathways (i.e. concrete vs. asphalt surfaces reflect light differently).

With the exception of areas of Fresh Kills Park where human activity would necessitate light while open to the public (i.e., park facilities open after dark, such as walkways, recreational fields, and roadways), most areas of the park would not need to be lighted throughout the night. For areas being illuminated through the night, minimizing glare and avoiding lights that illuminate structures in silhouette would be appropriate in these cases. Careful design and planning of lighting arrays—taking into consideration the amount of lighting, directional leakage, and wavelengths, compliance with the New York City Deparment of Design and Construction guidelines and those of the Illuminating Engineering Society of North America, and using lighting fixtures with the International Dark-Sky Association (IDA) Fixture Seal of Approval—would minimize many significant adverse impacts associated with proposed project in relation to wildlife activity. The objectives of the International Dark Sky Association would

also be reviewed and applied at the site, where feasible. A light diagram will be prepared to graphically evaluate the potential for lighting areas beyond the intended limits in order to minimize the potential for adverse impacts to wildlife.

FRESH KILLS PARK ROADS

As presented in Chapter 1, "Infrastructure," the intent of the proposed vehicular circulation plan at Fresh Kills Park is that it be integrated to the natural setting, while providing new east-west connections between Richmond Avenue on the east and the West Shore Expressway on the West, and providing visitors with easy access to park facilities, while limiting environmental impacts to the extent possible (i.e., avoiding placing road infrastructure along the edges of the tidal creeks within the project site; avoiding conflicts with new habitats; placing roads above the 100-year flood plain and outside wetlands and regulated adjacent areas to the extent feasible; mitigating for impacts to freshwater or tidal wetlands; and providing stormwater runoff control and treatment). The portions of the Park Roads traversing landfill sections would be designed so as to not compromise the function or integrity of the existing environmental control systems. Construction activities will be monitored to ensure consistency with the design. A post-construction monitoring plan will be developed and implemented to document the long-term protections and maintenance of the landfill closure structures and environmental control systems, and an Operations and Maintenance Plan developed to ensure that operation and maintenance of the Park Roads minimizes the potential for impacting terrestrial and aquatic resources.

The proposed West Shore Expressway Service Roads and Ramps would have a design speed of 45 miles per hour (mph), two 12-foot-wide lanes, and a shoulder of 4 feet on the left and 10 feet on the right. The proposed Park Roads would have a design speed of 35 mph, 11-foot-wide lanes for four lane operation and 12-foot-wide lanes for two-lane operation (see Chapter 22, "Alternatives"), a shoulder width between 2 and 6 feet (possibly textured), and a flush textured median width of up to 4 feet. Chapter 1, "Project Description," provides a detailed discussion of the proposed design for the West Shore Expressway Service Roads and Ramps and the Park Road.

As discussed above under "Construction," the development of the park roads has the potential to result in direct impacts to natural resources through the loss of habitat removed during road construction. Operation of the park roads has the potential to result in long-term adverse impacts to aquatic resources due to:

- Contamination of stormwater runoff by oil, grease, and application of road salt; and
- Hydrologic changes associated with the impervious surface of the roadway (Evink 2002).

Operation of the park roads has the potential to result in long-term adverse impact to terrestrial biota where the roadway cuts through proposed landscape enhancement areas, or areas where existing plant communities would be retained. Roadway sections with the greatest potential to result in adverse impacts to natural resources would include:

- South segment of the Loop Park Road in the Confluence where the roadway runs adjacent to stormwater basins C1 and C2 (The Marsh and The Sunken Forest portions of the Confluence);
- Park Road South (Forest Hill Road Connection) as it runs through the previously described wetland and stormwater basin system on the east side of Landfill Section 6/7;
- Park Road South where it separates the woodland habitats proposed for enhancement at the southern portion of East Park;

- Southern Loop Park Road segment where it separates any landscape enhancement areas proposed for the Terrace portion of the Confluence from the landscape enhancement proposed for Section 2/8 within South Park; and
- Park Road North (Richmond Hill Road Extension) as the roadway runs through the wetland/stormwater management basin system on the east side of Landfill Section 6/7 (Yukon Avenue) and crosses over Landfill Section 6/7 (Yukon saddle) and through proposed woodland and meadow landscape enhancement areas, and the alternative alignment of the Park Road North that runs along the western base of Section 6/7 and then connects to Richmond Avenue (see also Chapter 22, "Alternatives").

HABITAT FRAGMENTATION

Overview

The proposed park roads, service roads, multipurpose paths, and footpaths/trails have the potential to result in long-term conflicts with existing and proposed wildlife habitats at the site due to: fragmentation—i.e., corridors that can impede wildlife movement between or within habitat areas, subdividing species into smaller subpopulations and disrupting wildlife movement. While this potential exists, the maintenance of corridors and provision of connectivity between habitats can also positively affect movement and species richness (Evink 2002). For example, the potential for fragmentation of habitat for the Florida panther, black bear and other species north and south of I-75 in Florida lead to the development of wildlife crossing structures along this roadway (Evink 1990 in Evink 2002). Similar potential impacts were identified for the TransCanada Highway through Banff National Forest (Leeson 1996 in Evink 2002). Nonetheless, the fragmentation of wildlife habitats by roads and other corridors has the potential to impede the dispersal of individuals between populations of the same species that is important for gene flow, movement of individuals to maintain small populations, and recolonizing areas where a species has been eliminated (Shaffer 1981, Dodd 1990, Gibbs 1993, Fahrig and Merriam 1994 in Evink 2002).

People have long had—and must continue to have—a significant presence at Fresh Kills, particularly in its history as an active landfill. Even as landfill maintenance and monitoring continues, the development of Fresh Kills Park will create and enhance vast areas of natural habitat in a previously degraded urban site. The co-existence of these functions—as a closed landfill, park, and habitat—is a key feature of the park design, which seeks to bring a broader public to experience this unique example of urban nature, and to deepen visitors' appreciation for and relationship to their environment.

Hundreds of acres of habitat will be introduced at Fresh Kills Park, many in vast, uninterrupted stretches. Areas that today are dominated by invasive plants such as phragmites, or that contain only limited vegetation and habitat communities, will be replaced by new species selected specifically for their potential to thrive, and placed with techniques painstakingly developed to ensure their best chance for growth. At the same time, DSNY must maintain miles of access roads throughout the site for its extensive ongoing operations, while new trails and roads will give people access to new park amenities. The park design seeks to minimize any potential impacts that might arise from the proximity of people and wildlife.

One method for controlling the interaction between people and wildlife is to create a well-designed circulation network. For instance, sensitively siting roads and paths can help alleviate potential impacts. Where possible, proposed paths at Fresh Kills re-use existing Sanitation

access roads. New proposed roads largely follow the perimeter of existing mounds, leaving hundreds of on-mound acres uninterrupted.

The design of specific roads and paths is also critical to minimizing impacts. For instance, trails that are properly designed, located, constructed and maintained can minimize potential impacts from humans active in and around wildlife habitats. Conversely, poorly designed trails can impact wildlife habitats by creating edge effects and barrier effects, and increasing species competition by providing additional access by invasive or non-native species. The degree of impact associated with a trail and its potential to cause habitat fragmentation is site specific and highly dependent on the location, design, construction and maintenance of the trail as well as the types of species, habitat, and corridor width in the habitats; use of the trail is a minor factor.

Consequently, design proposals at Fresh Kills Park will consider many well-established guidelines that have been demonstrated to minimize impact on wildlife communities, and apply them based on site-specific factors, including location, and habitat and wildlife types. As each specific proposal is developed, it will be submitted to DEC for review by the Natural Resources division.

Guidelines

The following general principles can minimize the potential impact of a trail on a natural habitat:

- In areas where habitat is to be created as part of the overall park design, design trails so that they do not compromise the development and sustainability of the future functions and structures associated with the habitat;
- Develop the trail system to avoid hydrological systems; and
- Develop trails to avoid existing habitats and, where appropriate, to include a vegetated buffer between the two.

A number of specific guidelines that follow these general principles have been developed for use in and around sensitive habitat areas; these may be applied at Fresh Kills.

All proposed trails will be 20- to 30-inch natural surface tread, built to standards for sustainable, non-motorized, dispersed recreation for multiple users (primarily hikers). Design and construction would be coordinated and supervised by appropriate personnel as follows:

- Trails would be constructed to maintain and preserve any existing habitat;
- Trails would be designed to preserve natural hydrologic processes, and will be located away from riparian zones where possible;
- Trails would be designed and located to preserve or restore natural hill slope hydrologic process;
- Trails would be designed to mitigate impacts to erosive soils and unstable areas;
- Operating periods for certain trails would be limited if determined necessary;
- Downed woody material encountered during trail construction would be retained within project areas to the extent possible;
- Trails would be located from low capability to high capability land where possible. For example, areas with steep slopes and erodible soils would be avoided when possible;
- Best Management Practices (BMPs) would be used in all project areas. These can include planting vegetation to control erosion, diverting runoff from exposed surfaces, and controlling the volume and velocity of runoff;

- Weed-free practices would be followed during trail implementation, and follow-up inspections for invasive and non-native species would be completed after construction;
- Trailhead signs would include information about invasive and non-native species and their spread;
- Vegetative matter cleared during trail construction would be scattered to avoid fuel build-up; and
- Trails would be designed to minimize use conflicts (e.g., between bikers and hikers) through the use of signs.

The above-referenced measures are also presented in Chapter 23, "Impact Avoidance and Mitigation Measures."

Park Roads and Habitat Fragmentation

Park roads have the potential to impact or conflict with existing or proposed wildlife habitat in the following ways:

- Indirect impacts due to degradation of habitat quality and habitat avoidance (i.e., avoidance response. See also Appendix H for additional information on avoidance response)—noise, reduced air quality, light pollution, increased human activity and invasive exotic plant species along the road edge can lower the quality of the habitat adjacent to park roads. This change in habitat quality may result in a decreased use or avoidance of habitat within a zone near roads, as well as decreased wildlife diversity (Evink 2002). The size of this avoidance zone varies with wildlife species and individual. According to Forman and Deblinger (2000), white-tailed deer, for example, may adapt to roads by avoiding nearby habitats where traffic noise inhibits predator detection and by selecting advantageous routes and times to cross roads. Other species, such as amphibians or reptiles, would cross when needed to migrate to or from breeding locations For example, Forman and Deblinger (2000) identified that within 650 meters of a busy four-lane highway, populations of forest-interior bird species are one-third lower than at greater distances, and grassland birds were believed to be reduced in density and species number for hundreds of meters from the roadway. Decreases in breeding bird populations adjacent to roadways with high traffic volumes reported by Reijnen et al. (1995) and Reijnen and Thissen (1997) was attributed primarily to roadway noise, possibly due to its interference with bird communication during the breeding period.
- Direct loss of wildlife individuals due to impact with vehicles—Road type, adjacent habitat and abundance of individuals have been found to influence the number of deer, elk and other ungulates/vehicle collisions along roadways (Bissonette 2006). Wildlife/vehicle collisions were also affected by length of road barrier and presence of median structure that limits or slows crossing (Bissonette 2006.
- Decreased access to habitat vital to the lifecycle of certain species—Amphibians and turtles may be cut off from aquatic or upland habitat necessary for breeding or foraging (Evink 2002).

Measures incorporated into the proposed project that would minimize the potential for park roads to result in significant adverse impacts to aquatic resources include the following:

- Collection and treatment of stormwater runoff within the overall management plan for each drainage area within Fresh Kills Park, incorporating control measures for oil, grease and grit;

- Implementation of an "Operations and Maintenance Plan" that includes alternative strategies for de-icing traveled routes recommended in the "High Performance Infrastructure Guidelines: Best Practices for the Public Right-of-Way" (NY City Department of Design and Construction and Design Trust for Public Space 2005). Recommendations include prohibiting use of sodium chloride, considering the use of calcium magnesium acetate (CMA) near sensitive ecological areas and on bridges, using grit on less traveled pathways and within park areas, where de-icing salt is necessary, using good spreading techniques using a mix of de-icing salt and sand; and pre-treating roads to help prevent bonding of ice;
- Incorporate road-side maintenance in the IPM Plan prepared for the park to minimize the potential for adverse effects to stormwater runoff quality;
- Maintain hydrologic connection between existing wetlands and surface water bodies using viaducts where feasible, and culverts designed to facilitate movement of aquatic organisms, and to minimize impairment of flow pattern; and
- Consider restricting access to park roads by trucks carrying hazardous materials or petroleum products. The proposed park roads would be open to public and City vehicles, but would not be open to public commercial and truck traffic.

Measures that would minimize the potential for park roads to result in significant adverse impacts to terrestrial wildlife include the following:

- Incorporating measures to mitigate potential impairments to wildlife movement in the areas identified above by incorporating wildlife underpass features into culverts constructed under the park roads to maintain stormwater drainage and flow patterns, or separate wildlife underpass features where feasible;
- Using viaducts where feasible to minimize impairment of wildlife movement under roadways;
- Incorporating wildlife crossing warnings into roadway signage;
- Monitoring wildlife/vehicle collisions to identify the need for additional measures (e.g., speed reduction) to minimize wildlife losses and adverse effects to motorist safety due to collisions;
- Using vegetation that does not attract wildlife in roadside landscaping and keeping vegetation adjacent to the road low to provide wildlife with unobstructed view of oncoming traffic; and
- Establishing vegetation screens along roadway to reduce traffic noise in certain landscape enhancement areas.

STORMWATER MANAGEMENT

Discharge of stormwater from the proposed project has the potential to result in long-term impacts to water quality and aquatic biota of Fresh Kills, Main, and Richmond Creeks. Although overall the project is expected to reduce impervious surfaces, there are a number of park elements that, if constructed, would convert existing pervious surfaces (e.g., woodlands, wetlands, turf, landscaped areas, etc.) to impervious surfaces[1]. Because impervious surfaces do

[1] Impervious surface is a land cover that cannot be penetrated by water. Examples with the proposed project would include rooftops of park facilities, road, and parking lots.

not allow precipitation to infiltrate into the soil, precipitation that falls on these surfaces runs off to down slope areas, infiltrating into soil where conditions are suitable, or conveyed into a ditch, storm sewer system, wetland, or receiving waterbody. Stormwater runoff from impervious surfaces can carry pollutants (i.e., suspended solids, nutrients, fecal coliform bacteria, petroleum hydrocarbons, metals, chlorides, insecticides and herbicides) that can affect the water quality and aquatic habitats of the receiving waterbody (USEPA 2005). Stormwater discharges have been identified as one of the leading sources of pollution for all waterbody types in the United States (USEPA 2007).

As discussed above, the construction and operation of Fresh Kills Park would be covered under the DEC State Pollution Discharge Elimination System (SPDES), which would include the General Permit for Stormwater Discharges from Construction Activity Permit No. GP-0-08-001 as well as individual permits. As discussed above in order to obtain coverage under the General Permit, an SWPPP would be prepared and a Notice of Intent (NOI) would be submitted to DEC. The SWPPP would comply with all of the requirements of the general permit as well as DEC's technical standard for erosion and sediment control as presented in "New York Standards and Specifications for Erosion and Sediment Control," and DEC's technical standard for the design of post-construction stormwater control practices presented in *New York State Stormwater Management Design Manual* ("Design Manual").

As discussed in Chapter 1, "Project Description," the conceptual stormwater management plan prepared for Fresh Kills Park has identified stormwater control practices that can be integrated with, and enhance, proposed park features, meet site constraints, and provide water quality treatment and quantity management in accordance with DEC's Design Manual during the operation of the proposed project (see Table 1-9). The proposed stormwater plan for the various capital phases of park development would complement and enhance the aesthetic and ecological purposes of the proposed park, and the overall stormwater management objective to improve upon the current hydrologic and water quality management provided by the stormwater management infrastructure developed for the Fresh Kills Landfill.

As described in Chapter 1, "Project Description," the approach to stormwater management includes a mix of traditional conveyance and storage measures that would incorporate existing armored downchutes and large-scale detention basins) and Low Impact Development (LID) practices located throughout each subcatchment. LID is a stormwater management approach and set of practices to reduce runoff and pollutant loadings by managing the runoff close to its source using a set or system of small-scale practices that are linked together. LID techniques promote the use of natural systems to achieve stormwater quality requirements, and volume control through infiltration and evapotranspiration. Table 1-9 lists the stormwater Best Management Practices (BMPs) identified as appropriate for the proposed park features. Most of these BMPs are suitable LID techniques. BMPs such as bioretention and pocket wetlands that provide water quality treatment of stormwater runoff and wildlife habitat, aesthetic improvements and educational opportunities were included to the extent possible. Implementation of these measures, as well as other aspects of the SWPPP prepared for each phase of park development will minimize the potential for significant adverse impacts to aquatic resources resulting from the discharge of stormwater from Fresh Kills Park.

Based on the above assumptions for the proposed park features and roads, a hydrologic analysis conducted of the proposed Fresh Kills Park stormwater management plan (Geosyntec 2008) concluded that all New York State stormwater quality and quantity requirements would be met,

with the proposed project.[1] For the portions of the park that would discharge to non-tidal waters, the proposed stormwater management plan would decrease in the 10-year and 100-year, 24-hour storm event peak discharges. Although not required under the New York State Storm Water Management Design Manual, peak discharges of stormwater would also be reduced for the portions of the park discharging to tidal waters. With the proposed stormwater management measures in place, the project would provide peak control and water quality benefits above and beyond those currently provided at the site. Additionally, the results of the pollutant loading under the proposed stormwater management plan indicate that in general, the total annual loading of total suspended solids (TSS), total nitrogen (TN), and total phosphorus (TP) would decrease in the 2016 and 2036 analysis years due to the overall decrease in impervious area that would occur within the project site as a result of the proposed project, and the proposed modifications to the existing stormwater basins. Compared to the existing conditions, the proposed stormwater management plan would result in reductions of 67,626 pounds per year for TSS, 676 pounds per year for TN, and 296 pounds per year for TP. With the implementation of LID practices, the estimated peak discharge rates and volume of stormwater runoff discharged from the park, as well as the estimated pollutant annual loading rates, would be reduced still further. Therefore, it is concluded that the discharge of stormwater with the proposed project would not result in significant adverse impacts to water quality or aquatic biota of the Fresh Kill creek system or the Arthur Kill.

OVERWATER COVER/SHADING

The proposed project includes elements that would provide access to the waterfronts of the Arthur Kill, and Fresh Kill, Main and Richmond creeks, as well as on-water recreational opportunities. The development of some of these elements would require the placement of structures over the tidal surface waters present within the project site, and have the potential to result in long-term impacts to fish and benthic macroinvertebrates due to shading of aquatic habitat. Proposed overwater project elements include short-term elements such as a floating dock for launching kayaks in North Park, and long-term elements such as a 50-slip marina for small craft (The Point), a ferry/water taxi landing (The Point), fishing piers (The Point and Creek Landing), Arthur Kill overlook and dock (West Park), and the development of a floating garden on Fresh Kills using permanently moored former trash barges ("barge garden," The Point). In addition to these overwater structures, the proposed Fresh Kills road system includes the development of the Signature Bridge over Fresh Kills, viaducts over wetlands (East Park), and possible replacement of the existing bridges over Main and Richmond Creeks with wider bridges to accommodate the 4-lane road alternative; and the non-vehicular circulation plan would include two pedestrian/bicycle bridges (over Main and Richmond creeks) as part of the 4-lane Fresh Kills road system alternative.

Shading of estuarine habitats is of concern because decreased light levels can lower productivity of primary producers and adversely affect fish and invertebrates that use these areas to provide passage for various life stages, and as important areas for feeding, refuge, and spawning (Nightingale and Simenstad 2001b). Alteration of light regimes by overwater structures and activities such as docks, floats, piling, and moored vessels can limit plant growth and

[1] The following conclusions are summarized from Fresh Kills Park Stormwater Management Plan Part I: Meeting New York State Criteria, Prepared by Geosyntec Consultants (February, 2008); Fresh Kills Park Plan Part II: Meeting Additional Criteria and Project Goals, Geosyntec Consultants, March 24, 2008.

recruitment and result in altered animal behavior and assemblages. Factors affecting the shade footprint include height of overwater structure, width, construction materials, and orientation to the arc of the sun (Burdick and Short 1995, Fresh et al. 1995 and 2000, Olson 1996 and 1997 in Nightingale and Simenstad 2001b). Piling density and construction materials can also affect the extent of light limitation, with shading increasing with the number of pilings. Piling material (i.e. concrete, wood, or steel) also affects underwater light. Concrete and steel refract more light to the underwater environment than wood piles which absorb light (Thom and Shreffler 1996 in Nightingale and Simenstad 2001b). Adequate spacing between piles reduces light limitations and minimizes interference with water and sediment movement (Fresh et al. 1995 in Nightingale and Simenstad 2001b).

Light is necessary for the photosynthetic process, and shading may result in some degree of impairment, resulting in a decrease in primary production. Light energy beneath a dock can be reduced by 90 to 100 percent, which can affect prey visibility and prey capture, and the availability of microalgae and macrophytes. The minimal light requirement for estuarine primary producers such as phytoplankton is that 1 percent of the surface irradiance reach the lower depth limit for that species (Stickland 1958 in Nightingale and Simenstad 2001b). Potential shading impacts on phytoplankton would be limited because of the low light requirement of phytoplankton combined with the relatively short residence time in areas shaded by the proposed on-water recreational platforms. Moreover, the relatively narrow width of the shaded area and of the proposed platforms (assumed to be less than 15 feet wide) would further reduce the potential of an impact to phytoplankton. Even the large widths for the 2- and 4-lane Signature Bridge (approximately 55 and 75 feet, respectively) and the two approximately 18-foot wide pedestrian/bicycle bridges proposed over Main and Richmond creeks, would not be expected to result in significant adverse impacts to phytoplankton. Similarly, the increased shading resulting from the overwater coverage that would occur as a result of the proposed project would not be expected to result in adverse effects to zooplankton communities. Many zooplankton graze on phytoplankton as well as detritus, and a steady supply of these suspended materials provides an adequate availability of food sources. While the increase in shaded area may decrease a visual feeder's ability to locate prey, residence time of these planktonic organisms in such areas is expected to be short; thus, no significant adverse impacts would be expected.

Shading can adversely impact habitat for certain fish species because of these species' dependence on sight and light for feeding, prey capture, schooling (due to dispersal under low light conditions), spatial orientation, predator avoidance and migration (change in migratory route to deeper waters to avoid shaded areas). Juvenile and larval fish are primarily visual feeders and can be affected by light levels (Nightingale and Simenstad 2001b). It has been maintained that shading of estuarine habitats can result in decreased light levels which can lower productivity of primary producers and adversely affect invertebrates, and fish that use these areas particularly with respect to use as foraging habitat (Able et al. 1998). Shadows cast by overwater structures may also increase predation on certain fish species by creating a light/dark interface that allows predatory fish to remain hidden from prey in a darkened area ((Helfman 1981 in NMFS 2003).

Measures to minimize the potential for overwater structures to adversely impact aquatic resources include:

- Locating overwater structures in sufficiently deep waters to avoid intertidal and shade impacts and minimizing the need for dredging;

- Designing overwater structures to be multi-use facilities in order to reduce the overall number of such structures;
- Including measures that increase ambient light transmission under piers and docks such as:
  - Maximizing the height of the structure and minimizing the width to decrease the shade footprint;
  - Using grated decking material or other measures to permit additional light to penetrate under the structure;
  - Using reflective paint or materials (e.g., concrete or steel) rather than material that tends to absorb light (e.g., wood) on the underside of the structure to reflect ambient light;
  - Using the fewest number of pilings necessary to support the structure through the use of floating docks and allow light under the pier;
  - Aligning overwater structure in north-south orientation to the extent possible to allow the arc of the sun to cross perpendicular to the structure and reduce the duration of light limitation;
  - Locating floating platforms in deep water to avoid light limitation and grounding impacts to the intertidal areas and maintain at least two feet of water between the substrate and the bottom of the float;
  - Orienting night lighting such that waters surrounding the structures are not illuminated; and
  - Mitigating for unavoidable impacts to benthic habitats (NMFS 2003).

Lastly, the in-water projects would be subject to the permitting requirements of DEC and USACE. With respect to protection of wetlands and waters, any additional protection measures resulting from that permit review process would be incorporated into the individual capital projects prior to construction.

A detailed discussion of the potential for the overwater structures proposed as part of Fresh Kills Park to adversely affect aquatic resources is presented below for 2016 and 2036.

COMMERCIAL WIND TURBINES

The Fresh Kills Wind Project, as described in detail in Chapter 1 "Project Description," would involve the potential placement of five wind turbine structures.[1] Each structure is assumed to be about 460 feet tall, and would consist of a 300-foot tower with a 320-foot-diameter rotor. The wind turbines would be place on the highest elevation points of North, East, and South Parks. A commercial wind turbine project at Fresh Kills would allow the production of renewable, clean, and locally-produced energy. However, an important consideration in siting a commercial-scale wind energy project at Fresh Kills is the potential for increased potential for wildlife mortality, specifically for migrating and resident wildlife (i.e., birds, bats, and insects).

The project site is located along the Atlantic Flyway, a major route for numerous species migratory birds (i.e., raptors, waterbirds, and songbirds) and several species of migratory bats (i.e., red, hoary, silver-haired, and Indiana bat). Both bird and bat migration peaks are known to

[1] Alternative 1 in the BQ Energy feasibility study conducted for Fresh Kills included two wind turbines in West Park for a total of seven; it was the conclusion of DPR that wind turbines in West Park would be incompatible with City plans for the proposed 9-11/WTC Monument at this location. This five-turbine design is consistent with Alternative 2 in the BQ Energy study.

occur in spring (March through May) and fall (August to November), although migration or dispersal may also occur as a result of weather systems, following reproduction, and due to other factors (Cryan 2003, Kerlinger 1995). As the proposed project would be sited within a major migratory flyway, hundreds of migratory bird and bat species (each with the number of individuals varying from thousands to millions) would be expected to pass through the project area each year. Additionally, at least 80 bird species (DEC 2007) and several bat species are known to breed in the project area under existing conditions, including several species of soaring raptors (i.e., red-tailed hawk, northern harrier) that are known to feed on landfill slopes and have been subject to high rates of mortality at wind-energy facilities (Hoover and Morrison 2005). A confounding factor to drawing conclusions about or comparisons among studies of wind turbine-related mortality is the variation in methodology used to quantify mortality, which species are included in such studies, and the physical arrangement of wind turbine arrays (i.e., ridgelines, grasslands, offshore). While such studies generally find some degree of bird and bat mortality associated with wind turbines, clarity is lacking on certain guiding principles: which configurations generally cause highest mortality, what levels are "acceptable" (based on a cost-benefit analysis, in comparison with ecological damage to species and habitats associated with fossil fuel- based energy production), how to appropriately quantify mortality rates, and how to avoid arrays that cause high rates of mortality. Substantial research into these issues has only been occurring over the past 10 years.

Bird monitoring studies aimed at quantifying rates of mortality at wind-energy facilities generally report collisions with rotors, towers, nacelles (tower hub), and other associated structures as the primary sources of mortality, with some evidence that the vortex created by rotors may also capture and force birds into the ground (Winkleman 1992). Collision risk depends on factors such as a particular species' behavior and size, weather, topography, and turbine structure (i.e, height, lighting of structures taller than 200 feet, as required by the FAA); with the risk highest for species using standard migratory pathways, large bodied birds, and birds that fly at periods of low visibility (Drewitt and Langston 2006). The potential for collisions in areas where threatened or endangered species are present or prevalent may also drive risk of collisions to unacceptable levels, in terms of wildlife protection laws. Estimated bird mortality rates as a result of wind power projects vary widely, from 0 birds per megawatt (MW) over a 5 month period at a facility in Vermont (Kerlinger 1997) to 11.7 birds per MW at a facility in Tennessee (Nicholson 2003), with more recent concern focused on mortality of night-migrating songbirds (Kunz et al 2007b).

Monitoring studies aimed at quantifying bat mortality have indicated a preponderance of migratory, tree-roosting bats as the species most often killed by striking wind turbines, with mortality levels for turbines located on forested ridgetops reaching 4.1 to 15.3 bats per MW of installed capacity per year (Kunz et al 2007a). A number of potential hypotheses have been proposed to explain the causes of bat mortality at wind energy projects, including the perception of turbines as roost sites, as elevated sites where insects and other prey tend to congregate, the presence of turbines along high corridors within typical migratory routes, attraction based on sound frequency, movement, and heat, or failure to distinguish moving rotor blades by echolocation (Kunz et al 2007). Convincing evidence to support any of these hypotheses is limited because bat mortality at wind turbine facilities has only recently been raised as an issue, and most publications call for a need for additional, empirical, and local research on the potential effects of wind turbines prior to their development.

Several recent studies have identified the need for improved guidelines for the assessment of wind turbine impacts on wildlife in environmental impact statements and mitigation measures

(Fox et al 2006, Drewitt and Langston 2006, Smallwood 2007). Since adverse impacts to birds and bats are reasonably expected as a result of the proposed project at Fresh Kills (based on location within a known migratory flyway and proximity to breeding birds at risk of collision), existing design elements and present procedures to reduce collision-related mortality would require an empirical analysis of potential collision risks. The proposed wind-energy project should meet the requirements of recent DEC draft '*Guidelines for conducting bird and bat studies at commercial wind energy projects*' (December 2007). These guidelines offer a protocol for both planning pre- and post-construction studies, including a thorough site and project description, designs of potential studies to detect and quantify bird and bat presence before, and actual impacts after a proposed wind energy project is constructed.

Potential mitigation for the proposed wind energy project would include an evaluation of alternative locations to avoid wildlife collision risk by reducing the elevation of turbines, reducing the overall height of turbine structures or rotor heights, determining whether the proposed project could cease to operate at times (daily and seasonal) when birds and bats are placed at highest collision risks, and the consideration of locating fewer turbines within Fresh Kills Park.

HUMAN USE

Human use expected to occur as a result of the proposed project would include vehicular traffic on designated roadways (described above), various modes of individual and group recreation in both aquatic systems (i.e., use of boat launches for non-motorized watercraft, fishing, activity on shoreline trails and observation decks, construction of a marina) and terrestrial systems (i.e. walking, running, bicycling, horse riding, use of future park facilities such as restaurants). Based on the current low-levels of human presence that define existing conditions within the project site, increased human use as a result of the proposed park project would be expected to have some effect on wildlife populations. The degree to which any significant adverse impacts would occur would be proportional to the degree of access afforded into contiguous areas of wildlife habitat by the construction of boat launches and trails. Any reduction in the ability for wildlife to move unimpaired from one habitat area to another, without mitigating measures, would result in some decline in suitability of habitat (Bissonette 2006). Impacts to wildlife that would be expected to occur within areas accessible to the public would include noise, motion, and other direct effects on wildlife behavior as a result of pedestrian and non-motorized vehicle activity, increased interspecific predation rates in proximity to trail edges (Miller and Hobbs 2000), and rare mortality associated with wildlife collisions with non-motorized vehicles (i.e., kayaks, bicycles, horses).

Wildlife communities occupying urban habitats have been observed to comprise a collection of subsets—where species in low species-richness locations are nested within more species-rich communities ("nestedness") (Fernandez-Juricic 2002). In fragmented systems, human disturbance occurs at different levels (i.e., undisturbed meadows versus meadow edge along a path), and species tolerate, or become accustomed to, human intrusion in different ways. The type and magnitude of respond may depend on behavioral traits (i.e., larger birds being less tolerant to human disturbance; Burger and Gochfeld 1991). When effects of pedestrian rate, fragment size of a particular habitat, and habitat structure on nestedness of bird communities within an urban forest fragment were examined, birds tended to occupy larger fragments with higher stem densities, spent less time foraging, or left to seek cover (Fernandez-Juricic 2002). This suggests that in some areas, as human activity increases, the suitability of smaller patches as wildlife habitat decreases, placing a premium on the preservation of larger, contiguous areas. Similar patterns of reduced suitability of fragmented areas as habitat has been observed for a variety of wildlife groups in urban landscapes, although species-specific differences in response to disturbance can be strong (Ficetola et al 2007).

Increased rates of disturbance can result in decreases in local population size of a particular species due to increased anti-predator investment, decrease in body condition, and decreased reproductive success (Frid and Dill (2002).

In terms of disturbance to terrestrial invertebrates, a less well studied group, human disturbance of the landscape associated with metrics of biodiversity (i.e., total number of invertebrate families, number of Dipteran families, and taxa richness of predators and detritovores) indicated that undisturbed sites had the highest biological value, followed by construction and current waste disposal sites, with the lowest values at agricultural sites (Kimberling 2001). Also, indices of biological value were lowest in frequently disturbed sites. Therefore, the degree of disturbance may be expected to regulate some terrestrial invertebrate assemblages (Kimberling 2001).

At Fresh Kills Park, it would be reasonable to expect that increased levels of habitat segmentation driven by physical barriers (i.e., creation of pathways and roads) coupled with increased levels of human access throughout the entire park would have the potential to adversely impact wildlife using existing and restored habitats. One strategy to minimize these potential adverse wildlife impacts, while still allowing for acceptable levels of public access to the various regions of Fresh Kills Park, would be to reduce the number of trails, trail density, or intersections within certain portions of the park. Another strategy would be to modify habitat structure along trails to allow for wildlife access to nearby cover, effectively increasing tolerance of wildlife to human presence (Fernandez-Juricic et al. 2001).

HABITAT ENHANCEMENT

As discussed above, the objectives of the park are to protect existing natural resources, while building on these resources to create a more diverse landscape. Integral to the plan is the enhancement of wetland and upland habitats to enhance and encourage complex associations between native habitats and wildlife found in limited abundance in urban areas. The proposed overall enhancement plan includes:

- Enhancement of wetland and upland habitats through the use of native plant species and genotypes that would be expected to colonize former landfill areas, where conditions are suitable for these species; and
- Establishment of novel upland and wetland communities in areas previously used for landfill activities (i.e., detention basins, drainage ditches).

Closed landfill sites are excellent candidates for habitat management projects to promote habitat diversity and wildlife habitat through habitat restoration or creation (Simmons 1999, Mackey 1996). At Fresh Kills Park, several upland and wetland landscape enhancement projects have been proposed for the 2016 and 2036 Build Years. For 2016, landscape enhancement of grasslands, upland and wet woodlands, and freshwater and tidal marshes have been proposed for North Park, South Park, and within the Confluence (see Table 10-12).

For 2036, landscape enhancement of grasslands, upland woodlands, and freshwater and tidal marshes have been proposed for East Park, West Park, and the Confluence (see Table 10-13).

Table 10-12
2016 Upland and Wetland Landscape Enhancement Acreages at Fresh Kills Park

Location	Total acreage of park areas	Projected upland enhancement (acres)		Projected wetland enhancement (acres)	
		Grassland	Woodland	Freshwater	Tidal
North Park	280	130	65	9.5	40
South Park	425	75	12	14	4
East Park	482	0	0	0	0
West Park	545	0	0	0	0
Confluence—The Marsh	20	0	0	4	0
Confluence—The Terrace	10	0	0	1	0
Confluence—The Point	50	0	0	0	0
Confluence—Creek Landing	20	0	0	1	1
Total	1,832	205	77	29.5	45

Source: Total park areas and projected upland and wetland enhancement acreages derived from Fresh Kills Park: Lifescape, Staten Island New York, Draft Master Plan, prepared by Field Operations for the City of New York, March 2006.

Table 10-13
2036 Upland and Wetland Landscape Enhancement Acreages at Fresh Kills Park

Location	Total acreage of park areas	Projected upland enhancement (acres)		Projected wetland enhancement (acres)	
		Grassland	Woodland	Freshwater	Tidal
North Park	280	130	65	9.5	40
South Park	425	75	12	14	4
East Park	482	130	153	24.5	28
West Park	545	178	220	0	0
Confluence—The Marsh	20	0	0	4	0
Confluence—The Point	50	0	0	2	3
Confluence—The Terrace	10	0	0	1	0
Confluence—Creek Landing	20	0	0	1	1
Total	1,832	513	450	56.0	761

Source: Total park areas and projected upland and wetland enhancement acreages derived from Fresh Kills Park: Lifescape, Staten Island New York, Draft Master Plan, prepared by Field Operations for the City of New York, March 2006.

The following sections describe the habitat restoration and creation projects suggested for the future Fresh Kills Park, as noted in the Fresh Kills Park: Lifescape Draft Master Plan of March 2006, and discussed further in Biohabitats' "Fresh Kills Park Upland Plant Communities" narrative (Biohabitats 2007).

WETLAND IMPACTS AND ENHANCEMENT

Wetland enhancement would include tidal wetlands (i.e., Spartina and mixed marsh enhancement along tidal creeks), freshwater wetland enhancement (i.e., palustrine scrub shrub and forested wetlands) and possible freshwater wetland creation (i.e., conversion of detention basins to sunken forest habitats). The Fresh Kills Park Plan proposes to protect and enhance the condition and value of the wetland systems currently present and proposed in future conditions, while offsetting unavoidable adverse impacts to wetlands resulting from construction of park roads and bridges which need to cross waterways and wetlands. Table 10-14 identifies the area of wetland and aquatic habitats that would be permanently and adversely impacted as a result of the construction of the proposed park roads and bridges for the 2016 and 2036 build years, as well as the areas of proposed wetland enhancement and mitigation measures for these impacts. A detailed discussion

of these potential adverse impacts to wetlands and aquatic habitats is presented below for the 2016 and 2036 build years. The proposed project wetland activities include enhancement of degraded wetlands, enhancement of significantly altered wetlands, and creation of new wetland habitats, as described below. Measures to minimize temporary adverse impacts to wetlands due to development of park elements were described above.

Table 10-14
Potential Impacts to Wetlands and Aquatic Habitats: Project Roads, Bridges, and Habitat Enhancement Projects for the 2016 and 2036 Analysis Years

Project Element	Area of Wetlands Filled (Acres)		Area of Wetlands or Aquatic Habitat Shaded (Acres)		Proposed Area of Wetlands Enhancement[1]	
	Freshwater	Tidal	Freshwater	Tidal	Freshwater	Tidal
2016 Analysis Year						
Forest Hill Road Connection of Southern Park Road			1.10		*North Park*— 9.5 acres	*North Park*— 40 acres
Loop Park Road, North Segment		0.3			*South Park*—14 acres	*South Park—4 acres*
Loop Park Road, South Segment		0.4				
Northbound West Shore Expressway Service Road—Loop Park Road to Wild Avenue	0.02				*Confluence, The Marsh*—4 acres	*Confluence, The Marsh*—0 acres
Northbound West Shore Expressway Service Road—Arden Avenue to Loop Park Road	0.20		0.02		*Confluence, The Terrace*—1 acre	*Confluence, The Terrace—0 acres*
					Confluence, Creek Landing—1 acre	*Confluence, Creek Landing*—1 acre
Main Creek Pedestrian/Bicycle Bridge				0.3		
Richmond Creek Pedestrian/Bicycle Bridge (e.g., marina, public overlooks, docks)				0.4		
Marine Infrastructure	0.0	0.0	0.0	0.2		
Subtotal (Acres)	-0.22	-0.7	-1.1	-0.9	+29.5	+45
2036 Analysis Year						
Park Road North—Richmond Road Connection	4.3				*East Park*—24.5 acres	*East Park*—28 Acres
Signature Bridge		0.03		1.7	*Confluence, The Point*—2 acres	*Confluence, The Point*—3 acres
Marine Infrastructure (e.g., marina, public overlooks, docks)	0.0	0.0	0.0	0.5		
Subtotal (Acres)	-4.3	-0.03		-2.1	+26.5	+31
Total	-4.52	-0.73	-1.1	-3.0	+56	+76

Note: [1] See Figure 1-13a in Chapter 1, "Project Description."

- Tidal—Tidal wetland enhancement would include enhancement and expansion of the existing tidal wetlands. Methods would include removal of invasive species (primarily *Phragmites*) and enhancement of the native intertidal and high marsh plant communities. Tidal enhancement would include mudflats, low salt marsh, and high salt marsh.
- Freshwater—Enhancement and expansion of the existing freshwater wetlands present within the project site would occur, with possible creation of additional wetland habitats within existing stormwater management basins, primarily forested wetlands, where compatible with the stormwater management plan developed for the park.
- Wetland enhancement—Enhancing vegetation and other conditions of existing functioning, but degraded wetlands.

Tidal wetland enhancement at Fresh Kills Park would require the treatment and management of invasive *Phragmites* that currently dominates much of the project area. These measures may include repeated herbicide application, cutting and removal (some grubbing, very little

excavation) with intensive native vegetation plantings, and modification of sediment surface elevations to create water depth/inundation conditions that do not support *Phragmites*.

In terms of the tidal wetland enhancement approach, edge conditions along tidal waterways are proposed to be improved using softer and less intrusive processes that do not involve significant excavation or dredging. These techniques include tidal wetland edge enhancement that can include minor water-ward fill with clean sandy material that would minimize impacts on open water habitat, along with marsh toe stabilization (rocks, logs, coir fiber rolls, etc), that improves hydrologic inundation periods, and native marsh plantings that are encompassed in a 'living shoreline' stabilization and enhancement approach. Further development of tidal wetland enhancement measures will involve determining tidal flows, tidal elevations, and sedimentation patterns.

Some elements of existing wetland conditions may be enhanced through very minor surface elevation changes, debris removal, targeted invasive species management, in-fill native plantings or channel modifications. Enhancement designs would be patterned after local native wetland systems in form, function and biological diversity.

Upland Enhancement

Upland vegetation communities are an important ecological feature of the Fresh Kills Park site in terms of enhancing native plant biodiversity, enhancing wildlife habitat and species diversity, soil stabilization and erosion control, nutrient management/carbon sequestration, and air and water quality enhancement. Upland plant communities proposed would include managed, non-native/non-invasive grasses turf in park areas, native grassland communities on former mounds, and native woodlands and scrub-shrub communities on moderate to steep slopes and off-mound areas.

Enhancement of upland communities at Fresh Kills Park would include retaining existing native vegetation where possible, planting and seeding native plant species, and encouraging natural succession. Long-term monitoring of vegetation conditions and management and maintenance of native communities including control of invasive species, supplemental planting, and other maintenance activities would be carried out. Soil stabilization measures would comply with standard erosion and sediment control regulations, and would include the use of silt fences, sediment traps, swales, temporary seeding, phased grading, and permanent cover establishment via native plantings.

Grassland

Grassland enhancement projects, through a considered management approach, have been known to be successfully reestablished on previously degraded landscapes in short time periods (2-4 years, Chino Farms, MD; Gill et al. 2006). Former landfills can offer some additional barriers to native grassland enhancement, such as infrastructure, slope, soil composition and source, hydrology, and existing vegetation. Successful reestablishment of grasslands and suites of grassland-obligate species have been noted (Simmons 1999), with two ongoing enhancement projects in the NYC area (Pennsylvania and Fountain Avenue Landfills, Brooklyn, NY) showing positive signs of development (J. McLaughlin, NYCDEP).

Target species would include those found in meadows (with native wildflowers and prairie grasses such as switchgrass, big bluestem, indian nut grass, blue grama, butterfly weed, beardtongue, black-eyed susan, and smooth aster) and typical Eastern dry grassland habitats (including indian nut grass, little bluestem, sideoats grama, broomsedge, switchgrass, Canada goldenrod, grass-leaved goldenrod, and frost aster). The initial grassland enhancement project would include the following habitat types: flowering meadow, native grassland, and maintained turfgrass.

Scrub-shrub and Forest

Previous habitat restoration research conducted at Fresh Kills suggested that woody plants (i.e., trees and shrubs) did not compromise clay caps on Landfill Section 2/8, and showed somewhat restricted root growth (Handel et al. 1997). Wildlife may serve as one mode for seed dispersal of fruiting woody plant species (Robinson and Handel 1993), although the preponderance of invasive species on the project site with fruiting bodies dispersed by wildlife or by air suggest that target woody species would not successfully compete early in the enhancement process by these mechanisms alone. Mulching may also have a positive effect on seedling survivorship on nutrient-poor landfill slopes (Athy et al. 2006).

In non-slope areas of Fresh Kills, species prevalent in upland hardwood forest (i.e., white, red, post, and scarlet oaks, black cherry, tulip poplar, American beech, sassafras, witch hazel, and lowbush blueberry) and lowland mesic forest (e.g., American sycamore, Eastern cottonwood, Sweetgum, American hornbeam, Spicebush, Sweet pepperbush, Southern arrowwood, and Highbush blueberry) would be planted. Woody plant species known to be hosts for the Asian Longhorn Beetle will not be planted as part of enhancement efforts.

At initiation, trees and shrubs planted in non-slope areas would typically be 2 to 6 feet for container-grown specimens, and between 8 and more than 16 for balled and burlap specimens. At maturity, heights would generally range from 4 to 12 feet for smaller shrubs, 16 to 30 feet for understory species, and 50 to 100 feet for canopy trees. The initial scrub-shrub and forest enhancement would include approximately 65 acres of mixed woodlands in North Park.

VEGETATION AND WILDLIFE MANAGEMENT

The ultimate goal of the various enhancement projects over the 30 year build period would be the development of a suite of self-sustaining ecosystems. These ecosystems would ideally require minimal management effort (e.g., mowing, continued plantings, etc.) to maintain the desired communities over time, and would target complex wildlife-habitat relationships, such as the creation of grassland habitat, to encourage development of grassland-breeding bird communities. The overall vegetation and wildlife management plans include:

- Managing of invasive or introduced plant species through mechanical removal (e.g., mowing), development of cover soil appropriate for successful revegetation with native plant species, and other methods (e.g., herbicides) to allow enhanced communities to recolonize areas and compete with existing monocultures of dominant vegetation (mugwort, *Phragmites*, *Lespedeza cuneata* (Chinese lespedeza), etc);
- Allowing existing desirable communities (i.e., maturing forests, clay barrens, etc.) to progress with minimal intrusion or manipulation other than invasive species management; and
- Employing Integrated Pest Management (IPM) practices in controlling invasive or introduced plant species, the Asian Longhorned Beetle, and in controlling vector species such as mosquitoes.

Mowing

Grasslands composed of native species, exceedingly rare in urban systems, are also some of the rarest ecosystems in North America (Noss et al. 1994). The loss of grasslands has been accompanied by a severe decline of bird species dependent on grasslands, such as grasshopper sparrow, dickcissel, upland sandpiper, and others (Peterjohn and Sauer 1999). In the early stages of native grassland enhancement projects, mowing is an important management tool for early

establishment (Gill et al. 2006) in addition to herbicide application. Proscribed burning, another grassland management tool, is not likely to be employed purposefully on former landfills with sophisticated methane-collection systems, as is present at Fresh Kills.

During the DSNY closure activities, DPR has recommended that mowing activities in upland mound areas should occur between early September and spring thaw; with an ideal period of September to October. This mowing schedule would accommodate the nesting schedule of grassland birds (i.e., late spring to late summer), would adequately control invasive or otherwise non-target plant species on the landfill mounds, and would allow the majority of mowing activity to occur outside of the warmest months of the year (Edward Toth, DPR, 4 January 2008). An alternate time to mow, from a vegetation control perspective, would be at the beginning of spring plant growth. However, this would necessitate mowing activity on wet slopes (from spring precipitation) and could conflict with nesting activity of grassland bird species. Mowing height is also critical, and typically mowing grasses to at least six inches is recommended (Lauren Stewart, DPR, 4 January 2008).

Integrated Pest Management (IPM)

It is anticipated that the New York City Department of Health and Mental Hygiene, Office of Vector Surveillance and Control, would conduct larval mosquito surveillance of the freshwater and tidal water bodies that are existing or created throughout the 30 year development of Fresh Kills Park, as well as adult mosquito surveillance to detect the presence of mosquito-borne pathogens and assess the effectiveness of control measures. As with other areas of the city, known mosquito-breeding locations within Fresh Kills Park would be routinely inspected and treated with EPA-approved larvicides. The city's mosquito control program has undergone environmental review and has been determined not to result in a significant adverse impact to the environment (CEQR Number 00DOH0024). The implementation of mosquito control measures within the park would not result in significant adverse impacts to aquatic or terrestrial resources.

Asian Longhorned Beetle (ALB) populations were discovered in northwest Staten Island in April 2007. The continued presence or expansion of ALB populations could result in removal of target host tree species (i.e., maples, birches, etc.) in existing forested habitats, or in areas targeted for forest enhancement within Fresh Kills Park. The primary control method presently used by the Metropolitan NY ALB Cooperative Eradication Team (USDA-APHIS, DEC, DPR, and other local, state, and federal agencies) is removal of infested host trees (i.e., trees preferred by adult ALBs for egg-laying based on suitability for rearing young). On Staten Island, over 13,000 trees were cut and chipped at Prall’s Island and Old Place in 2007. Any surveys that reveal similar infestations would result in the removal of all host trees within a 0.5 mile radius of any infested trees, chemical treatment of host trees up to 0.5 miles from the removal zone, and inspections up to 0.25 miles from the treatment zone. As this is the present federally-mandated policy, all enhancement efforts on the project site should not use known ALB host tree species in enhancement projects, and an ALB monitoring effort within the project site should be established immediately. If ALB-infested host trees are located within the project site, the ALB Eradication Team should be notified, and a reasonable plan for mitigating the impacts of tree removal (including the destination of chipped material, plans and funding for enhancement of denuded habitat to avoid the colonization of invasive species, and preventative measures to avoid future infestations) should be discussed.

2016: THE FUTURE WITH THE PROPOSED PROJECT

Table 10-1 lists the park projects anticipated to be completed by the 2016 analysis year. These short-term projects are located primarily in North Park, South Park, and the Confluence, with some activities proposed for East Park such as the wind turbines and Park Roads, as summarized below and described in detail in Chapter 1, "Project Description."

NORTH PARK

By 2016, the approximately 280-acre North Park (see Figures 1-33 through 1-37) is proposed to include the following:

- Travis Neighborhood Park located along the northwest and northern section of North Park—Elements to be completed by 2009/2010 include parking (off Wild Avenue Phase A) with lighting, a comfort station (600 square feet), two entrances to the park (the Schmul Park entrance would include a pedestrian bridge across the creek that runs along the northwest border of the park), trails leading from the two entrances down to Main Creek and through portions of the upland landscape enhancement areas, an 800-square-foot overlook at Main Creek along with an approximately 1,200-square-foot kayak dock, about 20 acres of off-mound upland landscape enhancement , and about 40 acres of tidal wetlands enhancement along Main Creek.
- North Park Multi-Use Path and Habitat Enhancement—Additional North Park elements to be completed by 2016 include an approximately 12-acre lawn-softball field-picnic area, two tennis courts, grassy play mounds, a 1-acre wooded picnic grove, enhancement of freshwater wetlands running along the northwest portion of the park between the two parking areas (about 9.5 acres), enhancement of an existing stormwater basin (4 acres) to be used for skating in winter, an 800-square-foot outdoor classroom, 700-square-foot comfort station located at a 3,000-square-foot visitor center, a 200-square-foot café/comfort station, a 450-square-foot cafe, 2 miles of recreational multi-use path (20 feet wide) at the base of Landfill Section 3/4, tidal wetlands enhancement along Main Creek, a 1,600-square-foot bird observation tower, a plant nursery/seed farm, a flare station exhibit, and a maintenance/greenhouse facility building (2,000 square feet).
- North Park Landfill Section 3/4 Landscape enhancement with footpath trails—Overlooking the William T. Davis Wildlife Refuge, the enhancement of Landfill Section 3/4 in North Park is intended to transform the landfill section into a dramatic open landscape, with large expanses of native meadow and accents of flowering meadow for seasonal interest. New woodland would flank the western slopes, partly to screen the expressway but also to establish a larger north-south ecological corridor. The width of this corridor was designed to provide a reasonably-sized woodland interior for habitat migration, maintain an open interior at the top of the mound, and minimize interference with landfill infrastructure.

The interior of North Park is proposed to consist largely of self-sustaining meadow habitats in various stages of succession, requiring only minimal maintenance in accordance with the vegetation management measures (e.g., mowing, IPM) discussed previously, and little or no irrigation once established. Lawn areas for more active recreation and picnicking are included, but were minimized in order to favor rich habitat and low-maintenance.

Existing low areas of the site, such as the swamp forest and stormwater basin, would be transformed into ecological educational features. The eastern edge of North Park—currently composed of tidal wetland habitats including low and high salt marshes and mud flats—would be restored to full functionality.

The following sections discuss the potential impacts to natural resources resulting from the construction and operation of these project elements.

Geology, Soils, and Groundwater

As presented in Chapter 1, "Project Description," the development of North Park would result in the placement of a minimum of 2 feet of soil in all publicly accessible areas. There would be limited excavation or project elements that would reach groundwater (such as utility trenches). Operation of North Park would not result in any significant adverse impacts to geology, soils or groundwater. Comfort stations would be connected to the local utility system and would not have the potential to affect groundwater.

Floodplain

Development of North Park would require activities in the floodplain of Main Creek that would include vegetation clearing, possible placement of fill, and construction of the North Park project elements that are off the landfill sections as described above. While the development of these elements such as parking lots, tennis courts, structures such as a visitor center, comfort stations, café, and operations and maintenance building, that would increase impervious surface, the increase resulting from these project elements would be limited and would not be expected to result in a significant increase in surface runoff that would affect the floodplain. While the development of North Park may require the placement of clean fill within some portions of the 100-year floodplain in off-mound areas, this would not exacerbate flooding conditions at or in the vicinity of the project site. New York City is affected by local (e.g., flooding of inland portions of the City from short-term, high-intensity rain events in areas with poor drainage), fluvial (e.g., rivers and streams overflowing their banks), and coastal flooding (e.g., long and short wave surges that affect the shores of the Atlantic Ocean, bays such as Raritan Bay, and tidally influenced rivers, streams and inlets FEMA 2007). The Arthur Kill, Fresh Kill, Main and Richmond Creeks within the project site are tidally influenced—water levels in these waterbodies are controlled by tidal conditions at the mouth of these rivers and creeks, with little or no influence from the flow in the stream. The floodplain within and adjacent to the project site is affected by coastal flooding, which is influenced by astronomic tide and meteorological forces (e.g., northeasters and hurricanes [FEMA 2007]). This tidal flooding would not be affected by North Park construction activities in the floodplain.

In addition, the majority of the North Park project elements are either natural plant communities or grasslands that would not adversely impact the floodplain. Additionally, the implementation of the proposed stormwater management measures would minimize potential increases in stormwater flow rate and volume. Lastly, the placement of the small overwater structures such as the bird observation tower and kayak docks within the floodplain would not adversely impact the floodplain or result in increased flooding.

Wetlands

Development of North Park would not result in significant adverse impacts to freshwater or tidal wetlands. A field survey performed by Geosyntec in September 2007 identified the limit of freshwater wetlands in this area based on USACE methodologies. Construction activities in wetlands would be limited to the placement of a pedestrian foot bridge over the stream near Schmul Park, placement of overwater platforms with small footprints over tidal wetlands (kayak launch, and bird observation platform) and wetlands enhancement. While these structures would have the potential to affect wetland plants located under them, the footprint of each of these structures is small (1,200 and

1,600 square feet 0.03 and 0.04 acres, respectively) and would not result in significant adverse impacts to tidal wetlands. In addition, the minimal adverse impacts to tidal wetlands associated with the placement of these structures would be more than offset by the wetlands enhancement efforts discussed below. As discussed above, implementation of erosion and sediment control measures as part of the SWPPP prepared for construction of various portions of North Park would minimize the potential for adverse impacts to wetlands during construction activities.

The proposed North Park project would include the enhancement of approximately 9.5 acres of freshwater wetlands in a corridor located along the northwest border of North Park. The preliminary plan for this wetland corridor is for a mosaic of open water, emergent and wooded wetlands. A plant list for wetland species is presented in Chapter 1, "Project Description."

In addition to the freshwater wetlands, approximately 40 acres of tidal wetlands would be enhanced along the west bank of Main Creek between the bridge crossing and the north boundary of the park. As discussed above, tidal wetland enhancement would include grading, invasive species control, and planting with native tidal wetland plants.

In summary, the development of North Park would result in positive impacts to wetlands resources with a limited introduction of DPR public access facilities more than offset by the wetland enhancement of approximately 9.5 acres of freshwater wetlands and 40 acres of tidal wetlands.

Aquatic Resources

As presented above under the general discussion of potential impacts from upland construction and wetland enhancement activities, implementation of erosion and sediment control measures included in a SWPPP for development of the North Park projects would minimize the potential for significant adverse impacts to water quality and aquatic resources during construction. Implementation of post-construction stormwater management measures would also minimize the potential for significant adverse impacts to water quality and aquatic biota of Main Creek, and the tributary to Main Creek running along the northwest border of North Park, from the discharge of stormwater.

In-water construction activities for North Park would be minimal. These activities would include a limited number of piles that may be used for overwater structures that may include floating kayak launches, a bird observation platform, and a public fishing pier. The installation of piles for these structures would result in a loss of bottom habitat within the footprint of the piles. However, these structures have a small footprint and would require a limited number of piles. Therefore, the loss of bottom habitat is expected to be small and would not result in significant adverse impacts to aquatic resources. As presented above under the discussion of in-water construction activities, any temporary increase in suspended sediment resulting from pile installation would be localized and would be expected to dissipate shortly after the completion of the sediment disturbing activity. Therefore, in-water construction activities associated with North Park would not be expected to result in significant adverse impacts on water quality or aquatic biota. Similarly, any contaminants released to the water column as a result of sediment disturbance would be expected to dissipate rapidly and would not be expected to result in significant long-term impacts on water quality.

The overwater structures proposed for North Park were examined for the potential to result in long-term impacts to fish and benthic macroinvertebrates due to shading of aquatic habitat. DEC generally considers aquatic habitat under an overwater structure to be shade-impacted after the first 15 feet from the structure's edge. Most of the overwater structures proposed as part of North Park are anticipated to be narrow (less than 15 feet wide) and would allow light to reach the

aquatic habitat beneath them. Therefore, the minimal new overwater coverage that would result from the development of North Park (total of approximately 1,800 square feet (0.07 acres) would not be expected to result in significant adverse impacts to aquatic resources.

All in-water activities would require the review and approval of DEC and USACE permits that would avoid and minimize impacts to aquatic structures. Any requirements for the protection of resources that may result from that permitting process would become part of the capital projects. In addition, all structures proposed over or within the water would be proposed for the purposes of providing public recreational access to the water.

Terrestrial Resources

Construction of North Park would result in the clearing of the existing upland vegetation (i.e., clearing and grubbing to remove trees and other woody vegetation, and herbicide application, mowing and other physical/mechanical removal for the treatment of invasive plant species such as *Phragmites*) on Landfill Section 3/4, and within upland areas at the base of the landfill section, regrading, and placement of clean fill. Soil stabilization measures will be specified for the earthwork components of the project in compliance with the erosion and sediment control measures specified in the SWPPP prepared for each park capital project.

Land clearing and construction activities associated with the development of the upland portions of North Park have the potential to disturb wildlife individuals currently using this portion of the site, and habitats in the adjacent secondary study area such as in the William T. Davis Wildlife Refuge to the east, and the limited urban habitats available to the north of the project site. Adverse impacts would occur to some individual birds and other wildlife currently using these limited wildlife habitats if construction activities cause them to leave the project vicinity and there are no suitable habitats that are available nearby. However, as described in Chapter 20, "Construction Impacts," these impacts would be limited and only temporarily intrusive. In addition, in the long term, it is expected that post-construction, the project would provide positive impacts (see Table 10-12).

Currently, approximately 70 percent of the upland areas within North Park are covered by *Phragmites* and mugwort, two invasive, non-native species that are prevalent throughout the project site. These vegetation types have limited wildlife value beyond shelter, nesting substrate for some passerines (i.e., sparrows and marsh-dwelling birds, such as marsh wren and possibly rail species), and various native and non-native rodents. Temporary loss of this habitat until the proposed approximately 130 acres of meadow habitat is enhanced would not represent a significant adverse impact to wildlife species, as similar habitat exists in close proximity to North Park (i.e., along Main Creek's east shore, on Landfill Section 3/4, etc.).

Approximately 13 small, isolated pockets of native vegetation (i.e., various grasses and sedges, young to maturing canopy of sweetgum, red maple and green ash, and an understory of elderberry, blackberry, and arrow-wood) presently exist in the central and northern sections of North Park. With the exception of a band of these habitat patches that could be incorporated into the western portion of the woodland enhancement, clearing of these areas would be performed in order to create new recreational facilities (see Figure 1-12, "Passive Recreation"). These isolated habitats are non-contiguous, and are well represented in the palustrine emergent/forested wetlands along the western border of North Park and throughout the project site in locations that would not be affected by clearing. The loss of some of these individual acreages, although potentially valuable for cover, nesting substrate, and food for a variety of relatively common songbirds (i.e., gray catbird, white-eyed vireo, yellow warbler, black-capped chickadee), woodpeckers, mammals, and

other wildlife species, would not be expected to result in a significant adverse impact on the overall habitat for the area or individual wildlife populations as a result of the proposed project.

Development of North Park would create approximately 65 acres of upland woodlands (see Table 10-12), approximately 130 acres of meadow enhancement, and approximately 12 acres of turf within the lawn-softball field-picnic area. Overall, the proposed North Park project is expected to benefit terrestrial resources by enhancing native plant biodiversity, enhancing wildlife habitat and species diversity, providing soil stabilization and erosion control, and enhancing the quality of stormwater runoff. The placement of clean fill within North Park as part of the habitat enhancement would also improve habitat quality and minimize the potential plant and animal uptake of contaminants present in the soil used for landfill closure (top soil and subsoil) at Landfill Section 3/4. The upland vegetation enhancement strategy developed for Fresh Kills Park has also taken into consideration native Staten Island remnant plant communities, remnant native plant assemblages observed within the project site, and New York specific vegetation communities known to have occurred within New York.

As discussed above, the upland plant communities proposed for North Park would include non-native/non-invasive grasses and naturalized/native representatives for the turf areas, native grassland communities on ridge tops and gentle to moderate slopes, and native woodlands and scrub-shrub communities on moderate to steep slopes and flatter off-mound areas. Off-mound patches of native vegetation would be retained in site-specific park designs where feasible. Planting and seeding would be done using native plant species, and would be integrated with the natural succession process. All enhanced plant communities would undergo long-term monitoring, management, and maintenance, including invasive species control, supplemental planting, and any adjustments to management/maintenance procedures. Table 10-15 presents representative examples of native plant species proposed to be included in the revegetation planting for the approximately 65 acres of upland hardwood forest (e.g., Maritime Oak Forest) and lowland mesic forest (e.g., Oak-Tulip Tree Forest or Floodplain Forest) proposed for North Park.

Table 10-15
Examples of Plant Species Proposed for Enhancement of Upland Woodlands Within North Park

Common Name	Scientific Name
Upland Hardwood Forest	
White oak	*Quercus alba*
Red oak	*Quercus rubra*
Post oak	*Quercus stellata*
Scarlet oak	*Quercus coccinea*
Black cherry	*Prunus serotina*
Tulip poplar	*Liriodendron tulipifera*
American beech	*Fagus grandifolia*
Sassafras	*Sassafras albidum*
Witch hazel	*Hamamelis virginiana*
Lowbush blueberry	*Vaccinium angustifolium*
Lowland Mesic Forest	
American sycamore	*Platanus occidentalis*
Eastern cottonwood	*Populus deltoids*
Sweetgum	*Liquidambar styraciflua*
American hornbeam	*Carpinus caroliniana*
Spicebush	*Lindera benzoin*
Sweet pepperbush	*Clethra alnifolia*
Southern arrowwood	*Viburnum dentatum*
Highbush blueberry	*Vaccinium corymsbosum*
Source: Biohabitats, December, 2007.	

Three meadow habitats have also been proposed within approximately 130 acres of meadow enhancement proposed for North Park (see Table 10-16). These include moist and dry meadow, and dry grassland. Representative examples of native plant species proposed to be included in the revegetation planting for feature meadow (e.g., showy native wildflowers and prairie grasses) and Eastern dry grassland forest (e.g., Rocky Summit Grassland) are provided in Table 10-16.

Table 10-16
Examples of Plant Species Proposed for Enhancement of Meadow and Grassland Habitats Within North Park

Common Name	Scientific Name
Meadow	
Switchgrass	*Panicum virgatum*
Big bluestem	*Andropogon gerardii*
Indian nut grass	*Sorghastrum nutans*
Blue grama	*Bouteloua gracilis*
Butterfly weed	*Asclepias tuberosa*
Beardtongue	*Penstemon digitalis*
Black-eyed Susan	*Rudbeckia hirta*
Smooth aster	*Aster laevis*
Dry Grassland	
Indian nut grass	*Sorghastrum nutans*
Little bluestem	*Schizachyrium scoparium*
Sideoats grama	*Bouteloua curtipendula*
Broomsedge	*Andropogon virginicus*
Switchgrass	*Panicum virgatum*
Canada goldenrod	*Solidago canadensis*
Grass-leaved goldenrod	*Euthamia graminifolia*
Frost aster	*Aster pilosus*
Notes: See Appendix C for additional representative species proposed for habitat restoration within Fresh Kills Park.	

For the proposed habitat restoration efforts in North Park and other areas of the proposed park, native plants would be re-established through the seeding of native species from pure live seed using local genetic stock collections and founder plot material to the extent practical (both from production rate and economic standpoints). Trees, shrubs, vines and certain herbaceous wildflowers, grasses and emergent wetland plants would be established from plugs or peat pots plants, container grown stock (quart, gallon, and 2 to 7 gallon pots), and balled and burlap (B&B) larger caliper stock. The trees and shrubs would typically have a height range of between 2 and 6 feet for container grown plants, and between 8 and more than 16 for B&B specimens, upon initial planting. At maturity (years to many decades), small to medium shrubs would range in height from 4 to 12 feet, understory trees and larger shrubs would range in height from 16 to 30 feet, and mid-story and large canopy trees would range in height from 50 to 100 feet.

The proposed enhanced woodlands would provide habitat for woodland wildlife species, with habitat suitability for particular wildlife species changing as the habitat matures. Upon maturity, these woodlands would be expected to provide suitable habitat for forest dwelling birds, mammals, reptiles and amphibians, and insects. This enhanced woodland would be similar in composition to the lowland mesic forest patches lost as result of habitat enhancement, though it would represent a contiguous swath of a similar community type. The value of the relatively contiguous woodland enhancement adjacent to the forested wetland to the east would allow for greater habitat permeability for reptile and amphibian species that breed in those areas (i.e., spring peeper, red-backed salamander, etc.), and result in an overall improvement in habitat complexity.

The proposed meadow and grassland habitats would be expected to provide suitable habitat for diverse wildlife species during the first growing season, as one season of growth would provide adequate cover and foraging resources for the majority of grassland bird species in the vicinity of North Park (Gill et al 2006). Additional diversity would likely be apparent as wildlife species attracted to open areas would be expected to colonize the site during the early phase of grassland development (i.e., killdeer, foraging raptors and owls). As meadow and native grassland habitats mature and diversity of forbs and grasses increases, benefits would result from the presence of plant species with greater food value for seed-eating birds (i.e., sparrows, songbirds) and mammals, pollinators (i.e., lepidopterans, bees), and insectivorous birds and bats. However, limiting the number, arrangement, and proximity of pathways designed for the area would greatly increase habitat quality for wildlife species.

North Park is primarily planned as a natural area programmed for wildlife and passive recreation, consistent with the current quite nature of this portion of the park. Currently Landfill Section 3/4 and the adjacent area is predominantly a vegetative cover of species from the final closure, intermingled with invasive species, such as hop clover, fescue, and phragmites, with switchgrass and asters. Phragmites is not as dominant on the landfill slopes as it is in the low lying areas around the edges. The landfill cover is also regularly mowed and maintained as part of the DSNY landfill management requirements.

With the proposed project, vegetation over the landfill cover would be a designed habitat and managed to provide a more diverse vegetation cover, not only in its selection of plant species, but also in its objective to provide enhanced wildlife habitat. The landfill cover uses in North Park are intended to provide for passive recreation in the upper elevations and habitat with people (principally trails) through the mid- and lower elevations with the base defined by a multi-use path. Nighttime lighting of North Park would be restricted to the two parking areas, and designed to minimize the lighting of habitats beyond these parking areas. No nighttime lighting is proposed for the facilities near Main Creek and the William T Davis Wildlife Refuge.

Operation of North Park would have the potential to affect wildlife through increased human presence afforded by footpaths and trails throughout North Park, the use of non-motorized watercraft (e.g., kayaks) on Main Creek within the park and in the William T. Davis Wildlife Refuge, and the potential operation of a wind turbine on Landfill Section 3/4. The habitat suitability of the upland and wetland enhancement areas within North Park could be enhanced by a lower concentration of public trails and paths which would minimize impacts from fragmentation (see Figure 10-46a). Potential adverse impacts to sensitive habitat areas along Main Creek, and within the William T. Davis Wildlife Refuge, resulting from the operation of non-motorized vessels would also be minimized through park management, educational programs, and posted signs (see also Chapter 23, "Impact Avoidance and Mitigation Measures").

Threatened or Endangered Species

Construction of North Park would not be expected to result in significant adverse impacts to colonial waterbird nesting activity on Isle of Meadows, or inhibit the future re-establishment of such activity. North Park is situated at a substantial distance from the Isle of Meadows former nesting colony, and presently supports no nesting wading bird nesting activity. Significant disturbance to colonial wading bird nesting would mainly be expected through direct disturbance within a colony site (Burger 1981). Such is not the case with the proposed project. In the event that the colony is re-established at some point in the future, herons that would nest at Isle of Meadows predominantly feed in estuarine systems. As suitable estuarine habitat presently exists in Main and Richmond creeks for foraging wading birds, the salt-marsh enhancement proposed

for the North Park would not be expected to result in significant adverse impacts to foraging for either wading birds re-established at Isle of Meadow, local non-breeding wading birds, or wading birds from colonies within 10 miles (i.e., Hoffman Island, Lower NY Harbor). The only species that formerly nested on Isle of Meadows and fed primarily in terrestrial systems, the cattle egret, would not be expected to recolonize the project area, as they have undergone a precipitous population decline in New York City, dropping from hundreds of nesting pairs in the early 1990s to 2 nesting pairs in 2007 (one each in western Long Island Sound and Jamaica Bay) with similar nesting declines experienced elsewhere in New York and New Jersey.

North Park would also not be expected to result in significant, long term adverse impacts to barn owls or northern harriers. On the contrary, landscape enhancement efforts at North Park could provide additional foraging habitat for barn owls and northern harriers, which feed predominantly on small mammals in grassland habitats; such mammalian species are known to rapidly re-establish populations in suitable grassland habitat (i.e., meadow vole). Grassland areas, such as meadows proposed for the center of North Park, can also provide breeding habitat for northern harriers if located away from active trails or pathways. Nesting northern harriers at a nearby site (i.e., Saw Mill Creek) have been observed within 500 to 1,000 feet of existing roads and paths.

The northern diamondback terrapin (a New York State Game Species and NYNHP Watch List Species) was captured and observed in Main Creek in the vicinity of William T. Davis Refuge in 1995, and again in 2005 (Johnson and Matarazzo 2006). Therefore, any low shoreline areas adjacent to open sand or other unvegetated soils could potentially support nesting diamondback terrapins, and would also be expected to support foraging adults (Feinberg and Burke 2003). In order to avoid impacts to this species (see also Chapter 23, "Impact Avoidance and Mitigation") prior to any construction activities along the shoreline of Main Creek, a survey would be conducted of this area by a wildlife biologist familiar with the habitat requirements for northern diamondback terrapins to identify areas with the potential to provide suitable nesting habitat for this species, and locate any active or disturbed nests. All potential habitat areas would be identified in the field with a temporary barrier (i.e., drift fence) approved by the DEC and DPR to eliminate the potential for intrusion by construction equipment, or movement of terrapins into a construction area. Should potential habitat be located within an area identified for wetlands enhancement activities, or in-water structures (i.e., bird observation platform, kayak launch, fishing platform), additional measures would be developed in consultation with DEC and DPR to minimize the potential for significant adverse impacts to this species. With the implementation of these measures, construction and operation of North Park would not be expected to result in significant adverse impacts to terrapin nesting or foraging activity in Main Creek. Lastly, shoreline enhancement projects proposed for North Park (i.e., Spartina marsh enhancement, *Phragmites* removal) would be expected to increase the suitability of these sites as both foraging and nesting sites for terrapins in the long term.

Significant Coastal Fish and Wildlife Habitat

The proposed construction and operation of North Park would not conflict with the Fresh Kills Significant Coastal Fish and Wildlife habitat. In fact, it would support the designation as the tidal creek systems would continue to provide spawning and nursery habitat for anadromous, estuarine, and resident fish, and would continue to be used by wading birds, waterfowl, shorebirds, raptors and passerines and the on-site habitats would be expanded.

SOUTH PARK

The approximately 425-acre South Park is proposed for active recreational uses (e.g., soccer fields, equestrian facility, mountain biking venue) with landscape and restoration activities. The more intensive active recreational uses would be concentrated in the 155-acre dry lowland area of South Park. By 2016, South Park would include the following:

- Arden Heights Neighborhood Park and wetland enhancement—entrance from Arthur Kill Road and lighted bosque parking (3 acres), information center/DPR maintenance and operations (secondary), enhancement of a stormwater basin/freshwater wetland (about 2 acres in size, swamp forest basin), picnic area and playground (4 acres), berm overlook (900 square feet), and signage.
- South Park Multi-use Paths and Recreation Facilities—recreational multi-use path (paved path about 8 miles long and 20 feet wide) around Landfill Section 2/8, including pedestrian and high-speed bikeways, equestrian center and stable (approximately 5 acres), horseback riding trails, indoor track and field facility and sports barn (29,500 square feet (0.7 acres)), tennis center (12 acres), open meadow and recreational fields (15 acres), wet woodlands between the two areas of Landfill Section 2/8 (12 acres), woodland and berm trail (50 acres), café, comfort stations, entrance off Arthur Kill Road opposite Arden Heights Woods, bosque parking (3 acres), and signage.
- South Park Landfill Section 2/8 Final Cover Landscape Enhancement —enhancement of existing landfill cover for habitat restoration and public access on top of Landfill Section 2/8 with approximately 12 miles of mountain biking trails within dry grassland, pedestrian trails, hilltop meadow (7 acres) with overlook deck (900 square feet) and hilltop meadow (2 acres) on smaller area of Landfill Section 2/8, comfort stations and mixed woodland and trails (74 acres).

The following sections discuss the potential impacts to natural resources resulting from the construction and operation of these South Park project elements.

Geology, Soils, and Groundwater

As presented in Chapter 1, "Project Description," the development of South Park includes the placement of approximately 2 feet of new soil in all publicly accessible areas. The placement of soil would be subject to all soil erosion and sediment control plans that would minimize the adverse effects of sedimentation (the construction-period impacts are presented in Chapter 20, "Construction Impacts").

Operation of South Park would also not result in significant adverse impacts to geology, soils or groundwater. All comfort stations would be connected to the sanitary sewer system and would not have the potential to affect groundwater quality.

Floodplains

Development of South Park would require activities in the floodplain including vegetation clearing, placement of fill, mixed woodland enhancement at the base of Landfill Section 2/8, and development of forested wetlands between the two portions of Section 2/8. Development of these park elements would not result in increased impervious area or increased stormwater runoff and would not result in adverse impacts to the Richmond Creek floodplain. The increase in elevation from filling would not exacerbate flooding conditions in the vicinity of the project site. As discussed above under North Park, the floodplain of the tidal creeks within the project site is affected by coastal flooding. Water levels in the tidal creek systems of the project site are

controlled by the more influential tidal conditions of the Arthur Kill, with little or no influence from stormwater flows into the tidally connected waterbodies. As a result, the floodplain at the site would not be affected by the South Park project.

Similar to North Park, the majority of the South Park project elements in the vicinity of Richmond Creek are either natural plant communities or grassland communities that would not adversely impact the floodplain. Additionally, the implementation of the proposed stormwater management measures discussed above would minimize potential increases in stormwater flow rate and volume.

Wetlands

The development of South Park would not result in significant adverse impacts to freshwater or tidal wetlands. Construction activities in wetlands or wetland setbacks could include the following:

- A picnic area and playground facilities proposed for the Arden Heights Neighborhood Park—The development of this 4-acre area designated at this location has the potential to impact existing freshwater wetlands (*Phragmites*-dominated emergent/scrub shrub) within this area. However, the specific location of wetlands within this 4-acre area can be delineated and the wetlands avoided as part of the design of this project element.
- Wetland Enhancement—South Park includes the enhancement of 12 acres of wet woods and 2 acres of forested wetlands within an existing stormwater management basin. The vegetation that would be planted in these areas would be similar to those described above for the forested and scrub-shrub wetlands, and lowland mesic forest (Table 10-16) for North Park.

As discussed above, implementation of a soil erosion and sediment control plan as part of the SWPPP prepared for construction of South Park and each of its capital projects would minimize the potential for adverse impacts to wetlands during construction activities.

Development of South Park would have limited instrusions into freshwater or tidal wetlands (the project has been largely designed to avoid these systems), with the expectation of the positive impacts through the enhancement of approximately 2 acres of forested wetlands (currently located within a structured a stormwater basin), and enhancement of approximately 12 acres of wet woods.

Aquatic Resources

As presented above, implementation of erosion and sediment control measures included in the SWPPP would minimize the potential for significant adverse impacts to water quality and aquatic resources during South Park construction. Implementation of post-construction stormwater management measures in accordance with the projects overall stormwater management plan (see the discussion above) would also minimize the potential for significant adverse impacts to water quality and aquatic biota of Richmond Creek, and the tributary to Richmond Creek that parallels the West Shore Expressway, from the discharge of stormwater during project operation.

Limited in-water activities are proposed with South Park, and include the possible construction of drainage best management practices and low impact design as a part of the stormwater management system. It is expected that these drainage outlets would be constructed as natural drainage systems that both convey stormwater flows and enhance natural systems (see Table 1-9

in Chapter 1, "Project Description"). In addition, drainage systems could be subject to the review and approval of DEC which would avoid and minimize impats to natural resources.

All in-water activities would require the review and approval of DEC and USACE permits that would avoid and minimize impacts to aquatic structures. Any requirements for the protection of resources that may result from that permitting process would become part of the capital projects. In addition, all structures proposed over or within the water would be proposed for the purposes of providing public recreational access to the water.

Terrestrial Resources

Construction of South Park would necessitate clearing of existing vegetation to remove trees and other woody vegetation, as well as mowing and other physical/mechanical techniques for removal/control of invasive plant species (such as *Phragmites*) and placement of fill. Soil stabilization measures would be specified for the earthwork components of the project in conformance with the erosion and sediment control measures specified in an SWPPP.

Construction of the South Park recreation facilities (i.e., tennis courts, bosque parking, equestrian center and stable, indoor track and field facility and sports barn) requires clearing of approximately 21 acres upland habitat. The proposed recreational and parking facilities would result in the permanent loss of habitat of marginal value, consisting of an area largely previously disturbed and near the West Shore Expressway (see Figure 1-12). Current habitats in this area include primarily *Phragmites*/mugwort dominated fields with a small area of maturing woodland. Another 15 acres of upland habitat, primarily consisting of *Phragmites*/mugwort dominated field would be cleared for meadows and recreational fields. Construction of the Arden Heights Neighborhood Park would also result in the clearing and permanent loss of primarily grass/forb dominated uplands within the bosque parking area (3 acres) and within the footprint of the 600-square-foot information center.

A small "clay barren" area (approximately 2 acres) exists southwest of Landfill Section 2/8. It is a valuable site for enhancement due to its potential to support plant communities occurring in similar local clay soils in southwestern Staten Island, and its tendency to deter the colonization of *Phragmites* found in adjacent areas (Lynch 2007). Presently, only palustrine forest enhancement projects have been proposed in the vicinity of this potentially important habitat, and measures would be implemented by the project to encourage the continued natural regeneration of this habitat.

Land clearing and construction activities associated with the upland portions of South Park have the potential to disturb and displace wildlife individuals currently using this portion of the site. Impacts could occur to some individual birds and other wildlife currently using wildlife habitats if construction activities cause them to leave the project vicinity and there are no suitable relocation habitats nearby. However, the temporary loss of some wildlife individuals would not result in significant adverse impacts to populations of these species within the study area.

With respect to the habitats currently on and around Landfill Section 2/8, this area is predominantly covered by invasive species such as hopclover, fescue, and *Phragmites*, as well as switchgrass, and asters. *Phragmites* is not as dominant on the landfill slopes as it is in low lying areas. Landfill cover at Landfill Section 2/8 was neither designed nor managed as habitat. In addition, it should be noted that the current landfill maintenance operations limit the opportunity for habitat creation. For example, the landfill cover is also regularly mowed and maintained as part of the landfill management requirements. With the proposed project, the landfill cover would be designed and managed to provide an improved vegetative cover both in

its selection of plant species (see also Chapter 1, "Project Description" under "Landscaping Plan") and creation of habitat. While the landfill cover at Landfill Section 2/8 would be an enhanced landscape, it is also proposed for a number of active recreational pursuits, including mountain biking, footpaths and trails, and a multi-use path at its base (see Figure 10-46b). Therefore, in order to maximize the potential for wildlife enhancement, a number of design measures would need to be incorporated in order to minimize habitat fragmentation with the proposed design and to maximimze the beneficial impacts of the project (these measures are described above and in greater detail in Chapter 23, "Impact Avoidance and Mitigation).

Clearing the current non-native habitat on the landfill cover and replacing it with an ecological-based habitat design would not be expected to result in a significant adverse impact on either vegetative coverage or wildlife habitat. The current vegetative cover posseses limited wildlife value beyond shelter, nesting substrate for some passerines (i.e, sparrows and songbirds, some non-obligate grassland birds such as ring-necked pheasant) and native and non-native rodents, and as foraging habitat for raptors (i.e., red-tailed hawk). Thus, loss of this habitat until the proposed grassland habitat becomes established would not represent a significant adverse impact to these species.

Adverse impacts to wildlife could occur in existing woodlands that contain red maple, gray birch, sassafras, pin oak, and black tupelo, with an understory of black cherry, poison ivy, and cinnamon fern as a result of construction and operation of the proposed equestrian center and stables, parking bosques, an indoor gym, recreational fields, and a tennis center occupying approximately 28 acres or South Park (total park area is 425 areas). The subsequent increase in human activity with those recreational facilities could have an indirect impact by reducing the value for potential woodland nesting species (i.e., great horned owl, chuck-will's-widow, etc.) as a result of increased noise and lighting, although a meadow buffer would exist as a barrier to direct impacts. As a result, site-specific designs in this area would need to be sensitive to these nearby natural areas (see also Chapter 23).

Development of South Park would also and enhance up to 75 acres of upland woodlands (see also Figures 1-13 and 1-35a), meadows (15 acres for the meadow enhancement around the recreational facilities plus the mounds), up to 12 acres of wet woods, and 2 acres of wetlands, that would be designed to offset the approximately 28 acres that would be dedicated to development of recreational facilities and parking. The proposed enhancement of upland vegetation communities would be designed to benefit terrestrial resources by building upon the existing vegetative cover and expanding native plant biodiversity, thereby enhancing wildlife habitat and species diversity, providing soil stabilization and erosion control, improving the quality of stormwater runoff and providing new soil cover in publicly accessible areas.

Similar to North Park, the upland plant communities proposed for South Park would include non-native/non-invasive grasses and naturalized/native representatives for the turf areas, native grassland communities on ridge tops and gentle slopes, and native woodlands and scrub-shrub communities on moderate to steep slopes and flatter areas. Off-mound patches of native vegetation would be retained where feasible. Planting and seeding will be done using native plant species, and integrated with the natural succession process.

The proposed enhanced woodlands would provide habitat for woodland wildlife species, with habitat suitable for particular wildlife species evolving as the habitat matures. Upon maturity, these woodlands would be expected to support species found in the adjacent forested wetlands and wet woods, including forest-dwelling birds (i.e., owls, thrushes, grackles, numerous songbirds during breeding and migration), reptiles and amphibians that require several different

habitat types over their life cycle, mammals (i.e., raccoon, opossum, various rodents, muskrat) and insects (i.e., moths).

As discussed above for North Park, the proposed meadow and grassland habitats is expected to provide suitable habitat for diverse wildlife species during the first growing season. Additional species diversity would be apparent as the vegetation matures and wildlife species are attracted to these areas and would colonize the habitat during the early phase of grassland development, particularly foraging raptors and owls nesting in adjacent woodlands. As meadow and native grassland habitats mature and diversity of forbs and grasses increases, benefits resulting from the presence of plant species with greater food value for seed-eating birds (i.e., sparrows, songbirds) and mammals, pollinators (i.e., lepidopterans, bees), and insectivorous birds and bats would increase.

While South Park includes active recreational facilities on and around Landfill Section 2/8, such as footpaths, mountain biking, and horseback riding, as well as the active recreational facilities discucced above, the remaining areas of the 425-acre South Park are programmed for less intensive recreational and passive recreational uses and natural areas. Nighttime lighting of South Park would be restricted to the two parking areas and the tennis courts, and designed to minimize the lighting of habitats beyond these parking areas. No nighttime lighting is proposed for the meadow habitats, on the landfill sections, or the enhanced woodlands. Therefore, nighttime lighting of South Park would not be expected to result in significant adverse impacts to nocturnal wildlife activity along Richmond Creek.

Overall, the implementation of South Park would be expected to provide new improved habitats, clearing of some existing vegetation, and the potential to indirectly affect wildlife through increased human presence throughout South Park. Overall, it is the conclusion of this analysis that the future habitat within South Park would be improved over the current (existing) condition. It is also expected that the potential operation of any commercial wind turbine would be subject to its own environmental review.

Threatened or Endangered Species

Construction and operation of South Park would not be expected to result in significant adverse impacts to colonial waterbird nesting. Barn owls have nested north and east of South Park in recent years, however, no barn owls or northern harriers are known to, or would be expected to nest in the vicinity of the proposed South Park development, and the proposed project would not result in significant, long term adverse impacts to breeding barn owls or northern harriers. Presently, it is likely that both northern harriers and barn owls feed in the vicinity of South Park, although suitable foraging habitat exists for these species in other areas of the project site. Overall habitat improvements under the proposed project, including increased high quality grasslands through landscape enhancement efforts, would provide additional foraging habitat for barn owls and northern harriers, which feed predominantly on small grassland mammals. Such mammals are known to rapidly colonize suitable grassland habitats (i.e., meadow voles). The grasslands developed at South Park may provide breeding habitat for northern harriers if located away from active trails or pathways, although the 15 acres of meadow proposed for east of the equestrian center would likely be too close to several active uses with little buffer area for the ground-nesting northern harrier.

Significant Coastal Fish and Wildlife Habitat

Because the proposed construction and operation of South Park would result in minimal in-water activities and would not be expected to adversely affect water quality of Richmond Creek, it is concluded that the development of South Park would not adversely affect the Fresh Kills Significant Coastal Fish and Wildlife habitat. With the proposed project, the tidal creek systems would continue to provide spawning and nursery habitat for anadromous, estuarine, and resident fish, and would continue to be used by wading birds, waterfowl, shorebirds, raptors and passerines.

CONFLUENCE—THE MARSH, TERRACE AND SUNKEN FOREST, AND CREEK LANDING

As presented in Chapter 1, "Project Description," the Confluence park area encompasses the center of the proposed park and is defined by the north and south Loop Park Roads that would provide access to all five park areas. It is the central area of intensive park activity, containing most of the recreational, cultural, commercial and educational facilities, and the principal point of arrival by car, bus, ferry, or on foot, for the 2016 analysis year. The Confluence comprises two distinct areas of development for 2016: The Marsh, Terrace, and Sunken Forest; and Creek Landing. Both of these areas are large, flat, paved, bulkheaded and structured surfaces formerly used for receiving municipal solid waste at Fresh Kills Landfill. These areas are currently being used as part of the ongoing landfill closure activities for Sections 6/7 and 1/9 and are anticipated to be used for closure activities beyond the 2016 analysis year.

By 2016, the proposed Marsh, Terrace, and Sunken Forest within the Confluence (see Figures 1-33 through 1-37) would include the following:

- The Marsh—freshwater wetlands enhancement within two stormwater basins: the Sunken Forest (2 acres) with boardwalk pedestrian and bike paths; and a freshwater pond/emergent wetland (2 acres), and a parking area north of the Marsh; and
- The Terrace—Freshwater wetland enhancement within a stormwater basin (1 acre), and possible tidal edge enhancement at the Terrace on the south bank of Richmond Creek at the confluence with Main Creek (about 10 acres), and parking area.

By 2016, the approximately 20-acre Creek Landing portion of the Confluence, located on the west bank of Main Creek south of Landfill Section 3/4, would re-use the existing hard constructed surfaces and waterfront infrastructure and bulkhead to support the following active recreational programming:

- Activities on existing built surfaces and reuse of existing bulkhead for market roof area of private concessions (13,750 square feet);
- Boathouse and kayak and canoe rental (900 square feet);
- Café (900 square feet) and cultural space;
- Event lawn (4 acres);
- Possible tidal wetland creation in areas of bulkhead deterioration within a former barge slip (about 1 acre of enhancement) bordered by a boardwalk;
- Bosque parking with lighting (4 acres); and
- Visitor center/DPR maintenance and operations (secondary) (5,200 square feet, within existing structure).

The majority of this park area has been previously disturbed as part of DSNY Plant 2 when the site was operating as a landfill. It therefore is comprised of highly engineered surfaces and structures both on the upland and along the water's edge and is an optimal location for more intensive recreational activities proposed within Fresh Kills Park (see Figure 1-12). The following analysis discuss the potential natural resources impacts resulting from the construction and operation of these project elements.

Geology, Soils, and Groundwater

The development of the Marsh, The Terrace, and the Creek Landing portions of the Confluence would not result in significant adverse impacts to geology, soils or groundwater.

Floodplain

Development of the 2016 Creek Landing project elements would be generally outside the 100-year floodplain with the exception of the proposed activities in The Marsh and a portion of the event lawn at the Creek Landing. Neither of these project elements would result in an increase in impervious surface and stormwater runoff, or impacts on the floodplain. Thus, these project elements would not affect flooding conditions. Additionally, the implementation of the proposed stormwater management measures discussed above would minimize potential increases in stormwater flow rate and volume.

Wetlands

The Creek Landing, Marsh, Sunken Forest and Terrace projects within the Confluence would not result in adverse impacts to freshwater or tidal wetlands. Rather, project elements would benefit wetlands resources through the enhancement of at least 4 acres of freshwater wetlands within two stormwater basins (Sunken Forest at The Marsh, and within stormwater basins C1 and C2 in The Terrace), as well as enhancement of about 31 acres of tidal wetlands.

Construction of the Confluence 2016 project elements would benefit natural resources by establishing freshwater forested wetlands within two stormwater basins that are currently sparsely vegetated. As stated above, this area is largely developed currently, and is therefore programmed or more intensive recreational activities. However, the enhanced wetland habitats proposed for the existing stormwater basins would have the potential for increased use by wildlife such as waterfowl, shorebirds, wading birds, gulls, cormorants, and any birds that forage in wetland habitats. Additionally, mammals that typically forage around aquatic systems, such as muskrats, raccoons, Virginia opossums and various native and non-native rodents would be expected to use these enhanced freshwater wetlands, as would bats feeding on insects that are attracted to or hatch in aquatic habitats. Depending on water quality, and the continued functioning of these basins for stormwater management, the basins may not be suitable for reptiles or amphibians.

As discussed above, implementation of erosion and sediment control measures as part of the SWPPP would minimize the potential for adverse impacts to wetlands during upland construction activities. Restoration of these basins would also be in keeping with the overall best management practices/low impact designs of the projects overall stormwater management plans.

Aquatic Resources

As presented above, implementation of erosion and sediment control measures included in an SWPPP would minimize the potential for significant adverse impacts to water quality and aquatic resources during construction of the Confluence 2016 Park elements. The increase in

pervious surface, combined with the implementation of post-construction stormwater management measures included in the projects stormwater management designs would also minimize the potential for significant adverse impacts of stormwater discharge to the water quality and aquatic biota of Richmond and Main creeks.

In-water construction activities for the 2016 Confluence elements are minimal, and are associated with wetland enhancements and limited improvements for recreational access, in particular for providing public recreational access to the water. As presented above, any temporary increase in suspended sediment resulting from modifications to the shoreline for the purposes of providing that access or to facilitate tidal wetlands enhancement projects would be minimial, localized, and are expected to dissipate shortly after the completion of the short-term sediment disturbing activity. Additionally, silt curtains could be used in association with to any bottom disturbing activities to further minimize the area of aquatic habitat affected by temporary increases in suspended sediment. Therefore, it is concluded that in-water construction activities associated with the Confluence would not be expected to result in significant adverse impacts on water quality or aquatic biota. Similarly, any contaminants released to the water column as a result of sediment disturbance would dissipate rapidly and not result in any significant long-term impacts on water quality. Lastly, the in-water projects would be subject to the permitting requirements of DEC and USACE with respect to protection of wetlands and waters. Any additional protection measures resulting from that permit review process would be incorporated into the individual capital projects.

Terrestrial Resources

Land clearing and construction activities associated with the upland portions of the Confluence (i.e., parking areas) may disturb some wildlife individuals currently using these portions of the project site; however, this portion of the site provides limited terrestrial habitat given its mostly structural coverage.

Operation of the Confluence elements in 2016 would have the potential to affect wildlife through increased human presence afforded by the boardwalk around the sunken forest and the tidal wetlands enhanced at the Creek Landing; however, these impacts would not be significant given the current conditions at this area and would not be expected to conflict with the projects overall enhancement objectives.

Threatened or Endangered Species

Construction and operation of the Confluence park features would not result in significant adverse impacts to colonial waterbird nesting activity on Isle of Meadows or any threatened or engangered species identified in the area.

Significant Coastal Fish and Wildlife Habitat

Because the proposed construction and operation of the Confluence in 2016 has minimal in-water activities, it would not be expected to adversely affect water quality of Richmond or Main Creeks. Thus, the proposed activities are concluded to not adversely affect the designation of Fresh Kills as a Significant Coastal Fish and Wildlife habitat. The tidal creek systems would continue to provide spawning and nursery habitat for anadromous, estuarine, and resident fish, and would continue to be used by the wading birds, waterfowl, shorebirds, raptors, and passerines.

PROPOSED PARK ROADS AND WEST SHORE EXPRESSWAY/RICHMOND AVENUE CONNECTIONS

As discussed above, the proposed park roads and West Shore Expressway connections of the Fresh Kills Park project would provide new east-west connections between Richmond Avenue and the West Shore Expressway, as well as access to park facilities. Chapter 1, "Project Description," provides a detailed description of the proposed park road/West Shore Expressway connections. All park roads are designed for four lanes, with two-way circulation. The proposed West Shore Expressway service roads and ramps would have two 12-foot-wide travel lanes, and shoulders of 4 feet on the left and 10 feet on the right. The proposed park roads are designed for 11-foot-wide lanes, a shoulder width between 2 and 6 feet, and a flush textured median width of up to 4 feet. Chapter 22, "Alternatives," presents alternatives to the four-lane park roads, including a two-lane alternative. For the 2016 analysis year, the proposed vehicular circulation plan would include the following (see Figure 1-16a):

- A park road extending from the Forest Hill Road/Richmond Avenue intersection into the park, across a viaduct that spans the southern portion of the wetlands complex east of Landfill Section 6/7, along the southern edge of Landfill Section 6/7, to The Marsh portion of the Confluence. At The Marsh, the Park Road would connect with the Loop Park Road and bridge over Richmond Creek.
- Ramp and service road from the West Shore Expressway proposed from a location just north of Arden Avenue, running parallel to the expressway and connecting with the southern Loop Park Road.
- A connection to the southbound service road south of Victory Boulevard. Here, drivers would continue south across Victory Boulevard, onto the existing segment of road to access the park.
- New off ramp from the West Shore Expressway to the existing southbound service road, at a location south of Muldoon Avenue and a new on ramp from the existing southbound service road within the Expressway right of way.

The following sections discuss the potential natural resources impacts resulting from the construction and operation of these project elements. The overall impacts associated with road construction and operation were described previously.

Geology, Soils, and Groundwater

The development of the park roads and West Shore Expressway service roads and ramps would not result in significant adverse impacts to geology, soils or groundwater. As discussed in Chapter 1, "Project Description," a construction protection and monitoring plan would be implemented to ensure that the construction of the proposed 2016 roadway elements would not compromise the environmental monitoring control systems (i.e., landfill gas and leachate collection systems) and final landfill cover that needs to remain intact and functional during and after road construction.

Floodplain

Development of the 2016 park roads and West Shore Expressway connections would generally be outside the 100-year floodplain with the exception of the proposed activities at The Marsh, in the vicinity of the existing Main Creek and Richmond Creek Bridges, and where the Loop Park Roads cross under the West Shore Expressway on either side of Fresh Kills. The development of

these roadways would require activities in the floodplain that include some vegetation clearing, possible placement of fill and construction of road surface, and construction of stormwater management systems for the roads. The increase in impervious surface resulting from the proposed park roads would be directed to the stormwater management system to treat runoff prior to discharge to local waterbodies. The increased runoff from the roadways would not affect flooding conditions at the project site. As discussed previously, flooding of the tidal creeks within the project site is influenced by coastal flooding. Flow into these creeks from upland areas has little or no influence on the floodplain.

Wetlands

Introduction

As presented above under the general discussion of potential impacts from upland construction and wetland enhancement activities, implementation of erosion and sediment control measures included in the SWPPPs prepared for development of each section of the park, include its load system, would minimize the potential for significant adverse impacts to wetlands from roadway construction. Additionally, implementation of best management practices and low impact design stormwater management measures along with road management practices to minimize the introduction of roadway pollutants into stormwater runoff, would minimize the potential for significant adverse impacts from the discharge of stormwater. It is expected that the existing wetlands would be an integral component of the stormwater management practices that would be implemented throughout the park.

It is expected that development of the proposed park roads would result in adverse direct and indirect impacts to both freshwater and tidal wetlands due to filling and shading. As described in the following sections, and presented in Table 10-16, the proposed park roads and the West Shore Expressway service roads would result in the filling of approximately 0.70 acres of tidal wetlands, approximately 0.22 acres of freshwater wetlands, and the shading of 1.1 acres of freshwater wetlands by 2016. Significant adverse impacts to wetlands resources would be offset through implementation of mitigation (e.g., wetlands creation, enhancement) which is described in greater detail in Chapter 23, "Impact Avoidance and Mitigation." The wetlands enhancement proposed in Chapter 23 would offset these long-term adverse impacts on an area basis by a ratio of more than 20 to 1 for tidal and freshwater wetlands for the 2016 build year. The following sections provide a detailed discussion of the potential for the Park Roads, loop roads and West Shore Expressway Service roads to result in adverse impacts to wetlands.

Forest Hill Road Extension of the Southern Park Road

The Forest Hill Road extension crosses over a portion of the freshwater wetland system on the east side of Section 6/7 (see Figure 10-6). It is anticipated that the crossing of this wetland, would be accomplished with a viaduct structure. As currently contemplated, this viaduct would be approximately 665 feet long and about 60 feet wide, and would span the existing freshwater wetlands. The bottom of the viaduct would be elevated above from the freshwater wetlands by about 5 to 15 feet. These emergent wetlands are currently dominated by *Phragmites*.

Construction of the viaduct has the potential to result in impacts to wetlands within the construction corridor due to construction activites. Construction techniques to minimize damage to wetlands would be implemented as part of the construction management plan and in coordination with the DEC and the USACE. However, construction of the viaduct would be expected to ultimately result in permanent loss of freshwater wetlands within the footprint of the viaduct support structures, although the hydrology of the wetland system would be maintained through the viaduct design.

Although the viaduct has been designed to avoid the placement of fill within the freshwater wetlands (with the exception of the supports) the viaduct would result in shading of approximately 47,238 square feet (1.1 acres) of the freshwater wetlands beneath the structure. While the height of the viaduct above the wetlands would allow sufficient light to reach under the structure from either side, it is likely that the amount of light would be insufficient to support significant plant growth, resulting in adverse impacts to the wetland plant community under the viaduct that would need to be mitigated. However, spanning the wetland with the viaduct maintains the hydrologic characteristics of the wetland system, and minimizes adverse impacts to wildlife by allowing the continued free movement of wildlife through the wetland. Operational measures would also be instituted to control the application of road chemicals on the viaduct to minimize potential adverse impacts to wetland vegetation (see Chapter 23).

Loop Park Road (North Segment)

Construction of the Loop Park Road (north segment) would result in the permanent loss of approximately 2,182 square feet (0.05 acres) of tidal wetlands along Main and Fresh Creek due to the placement of fill. In addition, at the underpasses beneath the expressway, there would be permanent loss of approximately 8,534 square feet (0.2 acres) of tidal wetlands due to bulkhead construction and placement of fill behind the bulkhead in order to to expand the existing DSNY road at this location.

Loop Park Road (South Segment)

The construction of the southern Loop Park Road (south segment) under the West Shore Expressway would result in the permanent loss of approximately 16,167 square feet (0.4 acres) of tidal wetlands due to bulkhead construction and placement of fill behind the bulkhead needed to expand the DSNY road at this location.

Northbound West Shore Expressway Service Road (Loop Park Road to Wild Avenue)

Construction of the northbound West Shore Expressway Service Road would result in the filling of about 784 square feet (0.02 acres) of freshwater wetlands, identified in accordance with the USACE methodology, and associated with a wetland system that runs along the expressway. This determination of impact is based on the fresh water delineations performed in December 2007.

Northbound West Shore Expressway Service Road (Arden Avenue to Loop Park Road)

Construction of the northbound West Shore Expressway service road on the western border of South Park would result in the filling of approximately 8,959 square feet (0.2 acres) of freshwater emergent/scrub-shrub wetlands identified in accordance with the USACE methodology. These freshwater wetlands are primarily three small runoff swales from the West Shore Expressway. These swales feed the linear freshwater wetland that parallels the highway and drains north to the tidal wetlands of Richmond Creek between the two mounds of Landfill Section 2/8. This impact is minor and would not be expected to result in significant adverse impacts to plant or wildlife resources within or adjacent to the project site. It is also anticipated that the proposed service road would maintain the hydrologic connection of the three tributaries to this freshwater wetland.

Aquatic Resources

As presented above under the general discussion of potential impacts from upland construction and wetland enhancement activities, implementation of erosion and sediment control measures of the SWPPP, as well as the use of silt curtains and other measures to minimize sediment suspension during in-water construction activities (installation of sheet pile, culverts, outfalls,

etc.) would minimize the potential for significant adverse impacts to water quality and aquatic resources during road construction. The implementation of post-construction stormwater management measures included in the projects stormwater management plan, and the proposed road stormwater runoff management practices would minimize the potential for significant adverse impacts associated with the increased pervious surface from the proposed roads and the discharge of stormwater during road operation.

Spanning the freshwater wetlands within the alignment of the Forest Hill Road connection using a viaduct bridge minimizes potential adverse impacts to surface water resources and aquatic biota. The hydrologic connection above and below the viaduct would be maintained and disturbance of any stream channels under the viaduct would be minimal. The viaduct would result in adverse impacts to the streams within the wetland due to shading, as discussed above under "Wetlands." Operational measures would also be instituted to control the application of road chemicals on the viaduct, thereby minimizing potential adverse impacts to water quality of the streams receiving roadway runoff.

Lastly, the in-water elements of the road construction would be subject to the permitting requirements of DEC and USACE with respect to protection of waters and wetlands. Any additional protection measures resulting from that permit review process would be incorporated into the road design and construction implementation.

Terrestrial Resources

Construction of the 2016 park roads and West Shore Expressway service roads has the potential to result in direct natural resources impacts (i.e., physical removal of plant community or grading of soil within the roadway alignments, loss of individual wildlife due to collision with or as a result of operation of construction equipment) and indirect impacts (avoidance of habitat due to noise, vehicle traffic, or other human disturbance) to wildlife. The proposed project has minimized direct losses of upland habitat by using the existing landfill road network to the extent possible, thereby limiting habitat loss to areas previously disturbed. One exception is the Forest Hill Extension along the Richmond Avenue berm and east of *Phragmites*-dominated wetlands (described above). This area includes a linear wooded corridor along Richmond Avenue containing planted white pine, Douglas fir, and Norway spruce. This is a landscaped area that was created to screen the landfill and no natural resources impacts would occur from clearing this area. As described above, further west, the Forest Hill Extension viaduct would span an area of mixed upland and freshwater wetlands of native and non-native scrub-shrub and *Phragmites*. The proposed road would extend through woodlands along the berm and the associated forested area, resulting in removal of few large trees (i.e., greater than 12 inches diameter at breast height). It is concluded that the limited loss of habitat associated with this road construction would not result in significant adverse impacts to terrestrial wildlife resources.

While certain wildlife individuals may avoid undisturbed habitats in the vicinity of road construction due to noise, vehicle traffic or increased human activity, the phased approach to development of the park would be expected allow wildlife to seek suitable available habitat impacted by decreases in habitat quality near roadway construction.

A detailed discussion of operational impacts to wildlife associated with the proposed road was presented above. Potential impacts to wildlife include degradation of habitat quality due to noise, or nighttime lighting, habitat fragmentation, direct losses due to collisions with vehicles, and decreased access to vital habitat. Operation of the proposed park roads has the potential to result in long-term adverse impacts to terrestrial biota where the road cuts through proposed landscape

enhancement areas (e.g., on Landfill Section 6/7), or areas where existing plant communities would be retained. Road sections completed by 2016 with the greatest potential to result in adverse impacts to wildlife resources would include the south segment of the Loop Park Road in the Confluence where the road runs adjacent to stormwater basins C1 and C2 (The Marsh and The Sunken Forest portions of the Confluence),the Forest Hill Road Connection where it separates the proposed woodland habitats proposed at the southern portion of East Park as well as the existing wetlands, and the southern Loop Park Road segment where the road would separate landscape enhancement areas proposed for the Terrace portion of the Confluence from the landscape enhancement proposed for Landfill Section 2/8 within South Park.

As described above, the reduced suitability of habitat associated with operation of the park roads has the potential to reduce wildlife utilization of the habitats within the park, potentially reducing existing wildlife use of the tidal creek and wetland areas, impeding daily activity patterns that require passage from upland to waterfront areas, and possibly impeding access to habitats needed for breeding. However, reductions in habitat quality adjacent to the roads could be minimized by incorporating vegetation screening into the roadside landscaping to reduce noise levels Additional measures to reduce habitat fragmentation associated with the proposed roads are provided in Chapter 23, "Impact Avoidance and Mitigation Measures." In addition, roadside lighting would permanently change the existing nighttime habitat within the central portion of Fresh Kills Park. This change in nighttime conditions has the potential to result in adverse impacts wildlife individuals that use the waterfront of Fresh Kills, Main and Richmond creeks near these roadways, for whom elevated nighttime light levels would make these areas unsuitable. Changes in habitat suitability due to increased nighttime lighting may not be negative for all species. Wading birds, for instance, have been observed feeding throughout nighttime hours along existing bridges at Main and Richmond creeks, including species that are considered primarily active during daylight hours (i.e., snowy egret, little blue heron, great egret). This suggests that wading birds, to a certain extent, may have habituated to increased light around existing bridge structures during the peak of reproductive demands (May-June). This increased nighttime foraging may have population or community level effects on estuarine fish, invertebrates, and other preferred prey species for wading birds. However, documentation of similar effects at other locations is limited. The habituation of urban nesting birds to many aspects of urban life (i.e., noise, light pollution) may indicate ecosystem-level effects of "non-natural" conditions in human dominated landscapes, although any ultimately negative effects of habituation are not readily apparent.

In order to minimize the potential for adverse impacts associated with nighttime lighting, design measures would be implemented for the park roads to minimize light pollution to the greatest extent possible while meeting safe operating conditions for the park roads (see Chapter 23).

Adverse impacts to wildlife associated with the Forest Hill Road connection have been minimized by spanning existing wetlands with a viaduct. The proposed viaduct would allow unimpaired movement of wildlife under the roadway, providing a safe route below the road and between the wetland and upland areas to the north and the wetland and those to the south. Lighting of the viaduct would be the minimum necessary to maintain safe road operations. Adverse impacts to wildlife associated with the Forest Hill Road Connection and the southern segment of the Loop Park Road due to impedance of wildlife movement, and losses of wildlife due to collisions with vehicles, would be minimized by incorporating measures into the road design to facilitate safe passage from one side of the roadway to the other. Examples of measures include: wildlife tunnels within segments of the roadways identified has having the potential for wildlife crossing, vehicle signage warning of wildlife crossing area, providing

unimpeded view of oncoming traffic, and monitoring of wildlife vehicle collisions to identity areas where losses may require additional measures (see also Chapter 23, "Impact Avoidance and Mitigation Measures.".

Threatened or Endangered Species

Construction and operation of the 2016 park roads and West Shore Expressway service roads would not be expected to result in significant adverse impacts to colonial waterbird nesting activity on Isle of Meadows.

Barn owls have nested on bridges in the vicinity of Richmond Creek in recent years, and both road and bridge construction in the vicinity would be expected to have significant short-term adverse impacts and potential long term impacts on nesting barn owls as a result of construction and increased use of interior roadways in the vicinity of the Park Roads and West Shore Expressway. Measures to minimize potential adverse impacts to barn owls would be developed in coordination with the DEC, DPR, and the USFWS. Examples of measures that would be considered include inspection of previous nesting locations as well as potential nesting locations prior to the start of construction activities, and establishing a buffer around active nests during the nesting season, and developing a protection plan that identifies what construction activities are allowed in the vicinity of the nest and buffer and when these activities are permitted (see also Chapter 23).

Significant Coastal Fish and Wildlife Habitat

Because the proposed construction and operation of the 2016 park roads and West Shore Expressway service roads requires minimal in-water activities and would not be expected to adversely affect water quality of Richmond, Main, or Fresh Kills, the proposed road are not expected to conflict with the designation of Fresh Kills as a Significant Coastal Fish and Wildlife Habitat. With the proposed project, the principal objectives of the designation including protection of the tidal creek systems and their functions for spawning and nursery habitat for anadromous, estuarine, and resident fish, and would continue as would use by wading birds, waterfowl, shorebirds, raptors and passerines.

PEDESTRIAN/BICYCLE BRIDGES

The 2016 analysis year includes the construction and operation of two pedestrian/bicycle bridges, one over Main Creek and one over Richmond Creek. Both bridges would be constructed adjacent to the existing Main and Richmond Creek bridges that would be used as part of the park road system. The current width of these two existing bridges is not sufficient to allow operation of four vehicle lanes and a pedestrian/bicycle lane. Thus, two pedestrian/bicycle bridges are proposed to be constructed parallel to these existing bridges.

Both of the pedestrian/bicycle bridges would be pile-supported structures. The Richmond Creek pedestrian/bicycle bridge would be located to the north of the existing bridge. It would be about 18 feet wide and 572 feet long. The base of this bridge would be about 26 feet above mean high water.

The Main Creek pedestrian/bicycle bridge would be located on the south side of the existing bridge. It would be about 18 feet wide and 588 feet long. The base of the bridge would be about 12 feet above mean high water.

Construction of these bridges would include driving of piles within the two tidal creeks, and the outer bridge supports to be located outside the waterway. Installation of piles for these structures

would result in the permanent loss of bottom habitat within the footprint of the piles.[1] With a 25-foot spacing the number of new piles would be limited, and the loss of this area of bottom habitat would not result in significant adverse impacts to aquatic benthic habitat or resources. As presented above under the discussion of in-water construction activities, any temporary increase in suspended sediment resulting from pile installation would be localized and dissipate shortly after the completion of the sediment disturbing activity. Therefore, in-water construction activities associated with the construction of the pedestrian/bicycle bridges would not be expected to result in significant adverse impacts on water quality or aquatic biota. Similarly, any contaminants released to the water column as a result of sediment disturbance would be expected to dissipate rapidly and would not be expected to result in significant long-term impacts on water quality. The proposed pile spacing for the pedestrian/bicycle bridges is also wider than the existing vehicular bridges and would therefore not impede tidal action or result in long-term impacts to water quality.

These two pedestrian/bicycle bridges do have the potential to result in long-term adverse impacts to fish and benthic macroinvertebrates due to shading of aquatic habitat. The Main Creek pedestrian/bicycle bridge would result in the shading of approximately 13,746 square feet (0.30 acres) of aquatic habitat and tidal wetlands. The Richmond Creek pedestrian/bicycle bridge would result in the shading of approximately 16,460 square feet (0.4 acres) of aquatic habitat and tidal wetlands. The 18-foot width and 26-foot elevation above mean high water of the Richmond Creek bridge would allow some light to penetrate to the aquatic habitat at different periods throughout the day. The narrow separation between the Main Creek pedestrian/bicycle bridge and the existing bridge (approximately 52 feet wide), plus the smaller separation between the bottom of the bridge and mean high water (12 feet) would allow less light to penetrate to aquatic habitat and tidal wetlands under the Main Creek bridge, and only on the north side of the bridge. Adverse impacts to aquatic resources due to shading of approximately 0.70 acres of aquatic habitat will be offset through implementation of tidal wetland mitigation.

The proposed construction of these bridges would not result in significant adverse impacts to colonial waterbird nesting on Isle of Meadows. The same measures to minimize the potential for adverse impacts to the northern diamondback terrapin discussed for North Park would be implemented during the construction of these two pedestrian/bicycle bridges (see also Chapter 23).

2036: THE FUTURE WITH THE PROPOSED PROJECT

Chapter 1, "Project Description," describes the long-term projects for the park which are located primarily in the East and West Park, and also include the completion of Creek Landing in the Confluence.

EAST PARK

By 2036, East Park. some 530 acres in size, would comprise a mix of fields and landscape enhancement areas for passive recreational opportunities that would include the following:

- Hilltop field (23 acres)—Located in the north portion of the closed landfill mound of Landfill Section 6/7.

[1] Although final bridge designs are yet to be developed, it is assumed that each bridge expansion would require about 50 piles, or about 100 total for the two bridges. Estimating about 5 square feet per pile, the total affected benthic area is about 500 square feet. All calculations are subject to more advanced designs and would require permit review.

- A successional meadow (187 acres) located on Landfill Section 6/7. Approximately 130 acres of this area is anticipated to be meadow habitat, similar to that described for North Park.
- Picnic lawn (2 acres), and flare station screen, located on Landfill Section 6/7, south of the recreational fields/successional meadow.
- Mixed woodland community (187 acres) would be sited along the northern, eastern and southern base of Landfill Section 6/7. This mixed woodland community would be expected to contain species similar to those described for the upland woodland community for North Park.
- Freshwater wetland enhancement (13 acres) on the east side of Landfill Section 6/7 that would include the enhancement of the existing stormwater basins with public access via a boardwalk constructed at the edge of the wetland and a nature education center (outdoor classroom [600 square feet] and nature education center [4,000 square feet]).
- Berm overlooks (about 900 square feet each).
- Marsh enhancement (about 28 acres)—The wetlands south of stormwater basins B1 and B2 would be enhanced, a portion of which would include tidal wetlands.
- Multi-use recreational path (12 miles)—Located around the base of Landfill Section 6/7.
- Bosque parking (6 acres) along the east side of the freshwater wetland complex on the east side of Landfill Section 6/7, and along the Loop Road.

The following sections discuss the potential impacts to natural resources resulting from the construction and operation of these project elements.

Geology, Soils, and Groundwater

As presented in Chapter 1, "Project Description," the development of East Park would occur following landfill closure construction (expected to be completed in 2012). It would be designed to avoid or minimize impacts ot the landfill system (see Chapter 23).

To the extent that the project affects soils, this would be through the additional soil cover in publicly accessible areas of the proposed East Park. The addition of this soil cover would not adversely effect local geology or soils. Lastly, operation of East Park would not result in significant adverse impacts to geology, soils or groundwater. The proposed nature center would be connected to the sanitary sewer system and would not have the potential to affect groundwater quality.

Floodplain

The majority of East Park development activities would be located outside the 100-year floodplain. Activities that may be located in the 100-year floodplain include vegetation clearing, possible placement of fill for roads and mixed woodland enhancement at the base of Landfill Section 6/7, and possibly some estuarine wetland enhancement activities. The development of these elements would not result in increased impervious area or increased stormwater runoff and would not result in adverse impacts to the floodplain. The implementation of the proposed stormwater management measures discussed above would minimize potential increases in stormwater flow rate and volume.

Wetlands

Development of East Park would not result in significant adverse impacts to freshwater or tidal wetlands. Construction activities in wetlands would generally be limited to the potential impacts due to construction and operation of the proposed Forest Hill Road connection with the park

road system (these impacts are discussed separately above for the Forest Hill Road Connection, and below for the Richmond Hill Road Connection). The proposed park elements in East Park would result in 24.5 acres of enhanced freshwater wetlands within the existing wetland complex on the east side of the park, and up to 28 acres of enhanced freshwater/tidal wetlands (see Chapter 23, "Impact Avoidance and Mitigation Measures," Table 23-1). These are beneficial impacts ot the proposed project.

As discussed above, implementation of erosion and sediment control measures as part of the SWPPP prepared for construction of various portions of East Park would also minimize the potential for adverse impacts to wetlands during upland construction activities. Implementation of stormwater best management practices and low impact designs would also minimize impacts on wetlands due to park facilities such as building and parking areas.

In sum, it is concluded that development of East Park would result in overall positive impacts to wetlands through the enhancement of approximately 53 acres of freshwater and tidal wetlands within the existing wetland system on the east side of the park.

Aquatic Resources

As stated above, implementation of the project's erosion and sediment control measures included in an SWPPP would minimize the potential for significant adverse impacts to water quality and aquatic resources during construction of the East Park elements. In addition, implementation of post-construction stormwater management measures including best management practices and low impact designs (see Chapter 1, "Project Description," "Stormwater Management" and Chapter 23) would minimize the potential for significant adverse impacts to water quality and aquatic biota of Richmond and Main creeks from the discharge of park stormwater.

Limited in-water activities are proposed with the development of East Park. These activities would include implementation of certain recreational facilities and construction of stormwater management systems. These are later phases of the park project. As stated above, the in-water projects would be subject to the permitting requirements of DEC and USACE with respect to protection of wetlands and waters. Any additional protection measures resulting from that permit review process would be incorporated into the individual capital projects.

Terrestrial Resources

Construction of East Park would result in the clearing of some existing vegetation (i.e., clearing and grubbing to remove trees and other woody vegetation, possibly herbicide application, mowing and other physical/mechanical removal for the treatment of invasive plant species such as *Phragmites*) for wetland and habitat restoration around the base of Landfill Section 6/7. For these activities, specific construction measures would be specified, including in compliance with the erosion and sediment control measures specified in the SWPPP prepared for each park section.

Land clearing and construction activities associated with the development of East Park would also have the potential to disturb wildlife currently using this portion of the project site. Adverse impacts would be expected with respect to some individual birds and other wildlife currently using these habitats if construction activities result in wildlife species leaving the project vicinity and there are no suitable habitats available nearby. Potential indirect impacts to natural resources associated with the construction of East Park include adverse impacts to wildlife species due to loss of habitat and noise associated with construction activities. However, because these activities would be phased in over time, it is expected that sufficient suitable habitat would be

available in other parts of Fresh Kills Park (e.g., the earlier phases of North and South Parks) and the study area as a whole that would support individuals displaced by construction and enhancement activities.

In the future without the proposed project, Landfill Section 6/7 is assumed to be closed and maintained solely as a landfill cover. This would involve a stabilization cover comprised of a mix of grasses, and regular maintenance including mowing in accordance with the post-closure care and maintenance plan.

The Fresh Kills Park Plan for the East Park creates the opportunity for new habitats in East Park and on Landfill Section 6/7. For example, development of East Park would create up to 130 acres of mixed woodlands, with approximately 153 acres of meadow enhancement. These proposed habitats would more than offset the approximately 6 acres that would be permanently lost due to development of the proposed parking facilities, for example (see Figure 1-23). The proposed enhancement of upland vegetation communities would benefit terrestrial resources by enhancing native plant biodiversity, enhancing wildlife habitat and species diversity, providing soil stabilization and erosion control, and enhancing the quality of stormwater runoff.

Similar to North Park, the upland plant communities proposed for East Park would include non-native/non-invasive grasses and naturalized/native representatives for the turf areas, native grassland communities on ridge tops and gentle to moderate slopes, and native woodlands and scrub-shrub communities on moderate to steep slopes and flatter areas off the landfill section. Off-mound patches of native vegetation would be retained where feasible. Planting and seeding would include native plant species, and will be integrated with the natural succession process.

The proposed enhanced woodlands would provide habitat for woodland wildlife species, with habitats for particular wildlife species changing as the habitat matures. For example, upon maturity, the woodlands would be expected to support wildlife species similar to those discussed for the North and South parks. The meadow and grassland habitats would be expected to provide suitable habitat for meadow and grassland species during the first growing season, as was described for the North and South parks. Nighttime lighting of East Park would be restricted to the overflow parking areas, and designed to minimize indirect lighting of impacts beyond these parking areas. No nighttime lighting is proposed for the meadow habitats to be enhanced on the mounds, or the enhanced woodlands (see also Chapter 23, "Impact Avoidance and Mitigation Measures").

The upper elevations of East Park are also proposed for passive recreation and would also include trails (see Figures 1-12, 1-25, and 10-46c). While the proposed park would create new habitats, the design would also incorporate measures to ensure that habitats are not fragmented by footpaths, multi-purpose paths, and roads. Measures to avoid and minimize these impacts are presented in Chapter 23.

Threatened or Endangered Species

Construction and operation of East Park would not be expected to result in significant adverse impacts to colonial waterbird nesting activity on Isle of Meadows, or inhibit the re-establishment of such activity in the future, as was discussed for the North and South parks.

Barn owls and northern harriers are not known to use or expected to nest in the vicinity of the proposed East Park, and it is concluded that the proposed East Park would not result in significant, long term adverse impacts to breeding barn owls or northern harriers. Presently, it is likely that both northern harriers and barn owls feed in the vicinity of East Park, although suitable foraging exists for these species in other areas of the project site. Moreover, overall

habitat enhancements, including an increase of high quality grasslands through landscape enhancement efforts, would be expected to provide additional foraging habitat for barn owls and northern harriers, which feed predominantly on small mammals in grasslands. Such mammalian species are known to rapidly colonize suitable grassland habitats. The grasslands proposed for the East Park mound may also provide breeding habitat for northern harriers if located away from active trails or pathways.

Significant Coastal Fish and Wildlife Habitat

Because the proposed construction and operation of East Park would have minimal in-water activities and would not be expected to adversely affect water quality of Richmond or Main Creeks, the development of East Park would not be expected to adversely affect the designation of Fresh Kills as a Significant Coastal Fish and Wildlife Habitat. With the proposed project, the tidal creek systems would continue to provide spawning and nursery habitat for anadromous, estuarine, and resident fish, and would continue to be used by wading birds, waterfowl, shorebirds, raptors and passerines. The enhancement of the estuarine marsh at the south end of the park (where there is a transition from freshwater wetlands to tidal wetlands associated with Richmond Creek), is expected to provide an overall benefit to the Fresh Kills Significant Coastal Fish and Wildlife Habitat.

WEST PARK

By 2036, West Park would be developed. West Park, some 560 acres, and the largest of the planning areas, is proposed to provide a mix of habitat restoration areas on Landfill Section 1/9, along with passive recreational opportunities among the recreational fields and landscape enhancement areas. Specifically, West Park includes the following:

- West Park South Section (south of Muldoon Avenue)
  - hilltop monument (12 acres) and presentation area (50 acres) that would include footpaths, and 1-acre parking area.
  - meadow and successional grassland (173 acres) to be located north of the monument.
  - mixed woodlands (200 acres) to be created around the base of Landfill Section 1/9. Footpaths would traverse through the woodlands.
  - a 3-mile-long recreational loop path (3 miles) around the base of the mound.
  - overlook and dock (450 square feet) on the Arthur Kill that connects to the loop path.
  - overlook (450 square feet) on Great Fresh Kill with a view of Isle of Meadows that connects to the loop path.
- West Park North Section (north of Muldoon Avenue)
  - hilltop field (3 acres) for passive recreational or informal active recreational opportunities.
  - earthwork art feature (2 acres) with an overlook (about 450 square feet).
  - meadow (5 acres) with an area for meadow seating (2,000 persons) that faces an amphitheater.
  - woodland area (20 acres) on the east side to serve as a buffer between the recreational areas and the West Shore Expressway.

The following sections discuss the potential impacts to natural resources resulting from the construction and operation of these project elements .

Geology, Soils, and Groundwater

As presented in Chapter 1, "Project Description," the development of West Park would be conducted following landfill closure construction activities and would be designed to not affect the integrity of the landfill cover or the environmental monitoring systems. No activities or very limited activities in West Park (e.g., limited utility trenches) would be expected to reach groundwater and the project would not be expected to result in significant adverse impacts to groundwater. Any necessary modifications to the final cover or landfill environmental control systems for the proposed park would be designated to avoid or minimize impacts to these systems (see also Chapter 1, "Project Description" and Chapter 23, "Impact Avoidance and Mitigation Measures").

The importation of soils to provide a cover in publicly accessible areas is not expected to adversely impact local geology or soil conditions. In addition, operation of the proposed West Park would not result in significant adverse impacts to geology, soils or groundwater. No groundwater pumping or discharges are proposed as part of the West Park project.

Floodplain

The majority of West Park would be located outside the 100-year floodplain. Activities that may be conducted in the 100-year floodplain include vegetation clearing, possible placement of clean fill, mixed woodland enhancement at the base of Landfill Section 1/9, construction of the small overlook on the Arthur Kill, and the overlook on Great Fresh Kill. These project elements would not result in increased impervious area or increased stormwater runoff and would not result in adverse impacts or changes in the local floodplain. The implementation of the proposed stormwater management measures discussed above would minimize potential increases in stormwater flow rate and volume. The placement of the small overwater structures within the floodplain would not adversely impact the floodplain or result in increased flooding outside the project site.

Wetlands

The development of West Park would not result in significant adverse impacts to freshwater or tidal wetlands. Construction activities in wetlands would generally be limited to the possible construction of stormwater drainage outlets (expected to be best management practices and low impact designs, see Table 1-9), and the limited installation of piles to support the two overlook structures. While these structures would have the potential to affect limited tidal wetland habitats within the footprint of the area of the proposed construction, the size of the overlook and waterfront access structures is small (estimated at 450 square feet (0.01 acres) each) and would not result in significant adverse impacts to tidal wetlands. The proposed project also includes mitigation for all potential impacts to tidal wetlands (see Chapter 23)

As discussed above, implementation of erosion and sediment control measures as part of the SWPPP prepared for construction of various portions of West Park would minimize the potential for adverse impacts to wetlands during upland construction activities.

Aquatic Resources

As presented above, implementation of erosion and sediment control measures included in the SWPPP prepared for the proposed project would minimize the potential for significant adverse impacts to water quality and aquatic resources during West Park construction. In addition, implementation of post-construction stormwater management measures would minimize the

potential for significant adverse impacts to water quality and aquatic biota of the Arthur Kill and the Fresh Kill from the discharge of stormwater.

Limited in-water activities are proposed as part of West Park. These activities may include the possible construction of drainage outlets (best management practices) as part of the West Park stormwater management system, and the installation of piles to support the two overlook structures. The installation of piles to support these structures would result in a very limited loss of bottom habitat within the footprint of the piles and similar to the structures proposed for North Park, these recreational structures are expected to use a limited number of piles. Therefore, the loss of bottom habitat is expected to be small and would not result in significant adverse impacts to aquatic resources. Any temporary increase in suspended sediment resulting from pile installation would be localized and is expected to dissipate within short distance of the project site and immediately after the completion of the pile installation activity. Therefore, it is concluded that in-water construction activities associated with West Park would not result in significant adverse impacts on water quality or aquatic biota. Similarly, any contaminants released to the water column as a result of sediment disturbance would be expected to be minimal, dissipate rapidly and not to result in significant impacts on water quality.

The overwater structures proposed for West Park have a limited potential to result in long-term impacts to fish and benthic macroinvertebrates due to shading of aquatic habitat. DEC generally considers aquatic habitat beneath an overwater structure to be shade-impacted after the first 15 feet from the structure's edge. Most of the overwater structures proposed as part of West Park are anticipated to be narrow (less than 15 feet wide) and would allow some light to reach the aquatic habitat under these structures. Therefore, given the minimal new overwater coverage that result from the development of West Park (total of approximately 900 square feet (10.02 acres) it is that West Park would not result in significant adverse impacts to aquatic resources.

Lastly, the in-water projects would be subject to the permitting requirements of DEC and USACE with respect to protection of wetlands and waters. Any additional protection measures resulting from that permit review process would be incorporated into the individual capital projects.

Terrestrial Resources

Construction of the proposed West Park upland elements would result in the clearing of some vegetation (i.e., clearing and grubbing to remove trees and other woody vegetation, possibly herbicide application, mowing and other physical/mechanical removal for the treatment of invasive plant species such as *Phragmites*) for landscape enhancement at the base of Landfill Section 1/9. Soil stabilization measures would be specified for the earthwork components of the project in compliance with the erosion and sediment control measures specified in the SWPPP prepared for each park section, as well as in accordance with the project's soil erosion and sediment control plan (see Chapter 20, "Construction Impacts").

Land clearing and construction activities associated with the development of West Park have the potential to disturb wildlife individuals using this portion of the project site at the time of construction. It is expected that some adverse impacts would occur to birds and other wildlife individuals using these wildlife habitats if construction activities displace them and there are no suitable habitats nearby. Thus, potential impacts to natural resources associated with the development of West Park include adverse impacts to wildlife individuals using the areas of West Park that would be cleared and re-graded for restoration. These impacts would include temporary loss of habitat and noise associated with construction activities. However, because

these activities would be phased in over time, and sufficient suitable habitat should be available to support individuals displaced due to construction and enhancement activities. Relocation areas would exist both on the Fresh Kills site and in the surrounding area. For example, the enhanced habitats of the earlier phases in North and South parks, as well as the nearby Staten Island Greenbelt, would be available for displaced wildlife.

Operations

In the future without the proposed project, Landfill Section 1/9 is assumed to be closed and maintained solely as a landfill cover. This would involve a stabilization cover comprised of a mix of grasses and regular maintenance and mowing in accordance with the post-closure care and maintenance plan.

The Fresh Kills Park plan for the West Park creates the opportunity for new habitats in the park and on the landfill section. For example, development of West Park would provide up to 220 acres of mixed woodlands and enhance approximately 178 acres of meadow/grassland on Landfill Section 1/9. The proposed restoration of upland vegetation communities would benefit terrestrial resources by restoring native plant biodiversity, enhancing wildlife habitat and species diversity, providing soil stabilization and erosion control, and enhancing the quality of stormwater runoff.

Similar to North Park, the upland plant communities proposed for West Park would include native/non-invasive grasses and naturalized/native representatives for the turf areas, native grassland communities on ridge tops and gentle to moderate slopes, and native woodlands and scrub-shrub communities on moderate to steep slopes and flatter areas. Planting and seeding will be done using native plant species, and integrated with the natural succession process.

The proposed restored woodlands would provide habitat for woodland wildlife species, with habitat suitability for particular wildlife species changing as the habitat matures. Upon maturity, these woodlands would be expected to support wildlife species similar to those discussed for the North and South parks. The meadow and grassland habitats would be expected to provide suitable habitat for meadow and grassland species during the first growing season, as was described for the North and South parks. Nighttime lighting of West Park would be restricted to the parking areas, and designed to minimize the lighting impacts beyond the proposed parking areas on the top of the landfill section (see also Chapter 23).

Operation of West Park would have the potential to affect wildlife through increased human presence afforded by footpaths throughout West Park as well as the monument on top of the park and the multi-purpose path at the base of the landfill section (see Figure 10-46d). The potential habitat suitability of the upland enhancement areas within West Park would be protected by keeping the width of the footpaths narrow, with a natural soil cover, and designing the pathways to minimize habitat fragmentation (design guidelines to minimize habitat fragmentation are presented in Chapter 23).

Threatened or Endangered Species

Construction and operation of West Park would not be expected to result in significant adverse impacts to colonial waterbird nesting activity on Isle of Meadows. Use of Isle of Meadows for waterbird nesting occurred when landfilling activities at Section 1/9 were ongoing and DSNY transported solid waste to the site by barge along the Arthur Kill and Fresh Kill. Construction and operation of West Park recreational facilities would not be expected to impair current or future nesting of herons on Isle of Meadows.

Barn owls and northern harriers are not known or expected to nest on or in the vicinity of the proposed West Park, and the proposed project would not result in significant, long term adverse impacts to breeding barn owls or northern harriers. Presently, both barn owls and northern harriers are known to forage in the vicinity of West Park, although suitable foraging habitat exists for these species in other areas of the project site. Overall habitat improvements, including and increase of high quality grasslands through landscape enhancement efforts, would be expected to provide additional foraging habitat for barn owls and northern harriers, which feed predominantly on small mammals in grassland habitats; such mammalian species are known to rapidly colonize suitable grassland habitats at former landfill sites. The grasslands proposed for West Park may also provide new breeding habitat for northern harriers at locations away from active trails or paths.

Significant Coastal Fish and Wildlife Habitat

Because the proposed construction and operation of West Park would result in minimal in-water activities and would not be expected to adversely affect water quality of the Fresh Kill or Arthur Kill waterways, the development of West Park would not be expected to adversely affect the Fresh Kills Significant Coastal Fish and Wildlife Habitat. With the proposed project, the tidal creek systems of Fresh Kills would continue to provide spawning and nursery habitat for anadromous, estuarine, and resident fish, and would continue to be used by wading birds, waterfowl, shorebirds, raptors and passerines.

CONFLUENCE—THE POINT

As presented in Chapter 1, "Project Description," the 50-acre Point would be the central facility and recreational area of the Park. It is proposed to contain the most intensive active recreational field sports (indoor and outdoor on constructed surfaces) as well as indoor commercial facilities and concessions, arts and entertainment, and event space, as listed below.

- Central multi-use field area (14 acres)—This facility will include a track and field area with bleacher seating, an amphitheater, and multi-use athletic fields. Nighttime lighting would also be available.
- Created swamp forest exhibit and basin (2 acres)—Located next to Great Fresh Kill, this freshwater wetland will be created within an existing stormwater basin,
- Enhanced Great Fresh Kill tidal wetland (3 acres)—Located next to Great Fresh Kill and the created swamp forest, this wetland area would be constructed from uplands currently used for landfill closure operations.
- Exhibition hall (8,590 square feet),
- Family fishing and picnic pier (4,100 square feet (0.09 acres))—Located on Great Fresh Kill, this pier would provide a central community facility along the waterfront.
- Pier overlook (3,500 square feet (0.08 acres))—Located at the tip of the Point where Great Fresh Kill converges with Little Fresh Kill.
- Fishing pier (4,900 square feet (0.1 acres)) located on Little Fresh Kill.
- Esplanade and activities area (37,300 square feet)—This esplanade will front along Fresh Kills and be developed on uplands currently covered with impervious surfaces and buildings used for landfill closure and other DSNY operations.
- Market roof (32,700 square feet) and restaurant row area (20,000 square feet) which would have space for about 3 facilities and would be located along Fresh Kills waterward of the esplanade.

- Barge garden (43,500 square feet (1 acre)) also to be located waterward of the esplanade and would be developed by re-using former DSNY barges for plantings,
- Marina/boating center (50 slips, 2 acres)—Located immediately west of the West Shore Expressway along south shoreline of Fresh Kills in area with existing bulkhead. Facilities would include a marina with about 50 slips for small recreational craft (assumed boat length 45 feet) and a boat launch (6,750 square feet). The proposed marina would include floating docks, gangways, and anchoring system covering about 10,000 square feet (0.28 acres) of water. The proposed marina would not include fueling or repair services. It is assumed that no additional dredging would be required and that the existing depth can accommodate the shallow drafts for the recreational boats that would use the marina.
- Ferry landing (6,000 square feet (0.13 acres))—Located on Fresh Kills west of the proposed marina along bulkheaded shoreline. It is assumed that no additional dredging would be required for the operation of the ferry.
- Banquet hall with maintenance facilities (13,750 square feet)—Located on the west side, near Great Fresh Kill.
- Event lawn (10 acres)—Located between the east and west portions of the Point, this grassy area would result in the conversion of the existing impervious surface to pervious cover.
- Discovery center (32,700 square feet)—Located near the marina, this area would be used for cultural and art features.
- Bosque parking area (5 acres) with lighting within two locations (east and west portions of the Point).

The majority of the park program in this area would occur in areas previously developed within the Plant 1 facilities of the DSNY Fresh Kills Landfill. It was here that DSNY received and handled the solid waste that arrived at Fresh Kills. Thus it has extensive infrastructure, both on the upland and along the water, including a bulkhead. As a result, it is the objective of the proposed Fresh Kills Park Project to reuse this area for the more intensive recreational and cultural facilities programming, thereby minimizing natural resources impacts. The following sections discuss the potential impacts to natural resources resulting from the construction and operation of these project elements.

Geology, Soils, and Groundwater

The development of the program elements in the Point would not result in significant adverse impacts to geology, soils or groundwater. All of the proposed facilities would be connected to the local water supply and sanitary sewer systems and would therefore not impact local groundwater quantity or quality.

Floodplain

Development of the project elements proposed for 2036 in the Point are generally outside the 100-year floodplain with the exception of some of the proposed activities on the western side of the Point. The proposed elements located within the 100-year floodplain include a proposed wooded wetland enhancement project within an existing stormwater basin, tidal wetland enhancement projects, the two overlooks, and a fishing and picnic pier. The placement of these overwater structures within the floodplain would not adversely impact the floodplain or result in increased flooding outside the project site. Additionally, the project elements proposed for development within the Point would result in a decrease in impervious surface and stormwater runoff, and would not result in adverse impacts to the floodplain.

Wetlands

Development of the Point in 2036 would not result in any significant adverse impacts to freshwater or tidal wetlands. Rather, the proposed project would benefit wetlands through the enhancement of at least 3 acres of tidal wetlands along Great Fresh Kill and creation of about 2 acres of wooded wetlands within what is currently a DSNY stormwater basin. The proposed fishing and picnic pier, overlooks, marian, boat launch, and fishing piers would have the potential to affect wetland habitat located under these structures (total of 0.27 acres) due to shading. However the widths of these structures is assumed to be less than 15 feet, allowing light to reach the tidal wetlands and open waters and mudflats below them during different periods of the day. The narrow widths and small footprints of these structures would not result in significant adverse impacts to the continuity of wetland habitat or to wildlife using these wetlands. The area affected by these public access structures is about 0.4 acres, or about 17,424 square feet. The proposed project would incorporate the measures described above to minimize the impacts at these structures. In addition, they would be located in an area previously disturbed by DSNY marine infrastructure (e.g., the bulkhead) which minimizes the impacts of new infrastructure. There are also approximately 210 acres of open water and 570 acres of existing wetlands at Fresh Kills, of which the area affected by these proposed structures is a small part of the total system. Measures such as narrow dock footprints, floating docks, and grated decking materials, would also be used to minimize the impacts of these structures on water quality and waterway habitats at Fresh Kills (see also Chapter 23). Increased human use along these shoreline habitats may result in some local and limited displacement of wildlife habitat within the footprint of the structures, although the structures would allow unimpeded movement along the shoreline and would not be expected to adversely impact wildlife activity within waterways and wetlands. Nor would the project fragment habitats of Fresh Kills Creek. For these reasons it is concluded that any impacts to waterways and tidal wetlands would be very limited and be more than offset by the proposed tidal wetlands enhancement of the project (see Table 10-14). As discussed previously, implementation of soil erosion and sediment control measures as part of the SWPPP prepared for construction of the Point would also minimize the potential for adverse impacts to wetlands during construction activities (additional details on construction activities and impacts are provided in Chapter 20, "Construction").

Lastly, for capital projects within regulated wetland areas, in particular tidal wetlands, these projects would be subject to the DEC and USACE permit review process, which would avoid and minimize impacts to the extent practicable, recognizing that the purpose of the proposed projects is to provide public access to the water for recreation.

Aquatic Resources

As stated above, implementation of erosion and sediment control measures included in the SWPPP that would be prepared for each individual capital project to be designed for the Point would minimize the potential for significant adverse impacts to water quality and aquatic resources during construction of the Point. The decrease in pervious surface that is expected in the Point from the proposed landscaping, as well as the construction and post-construction stormwater management measures such as best management practices and low impact designs, would minimize the potential for significant adverse impacts to water quality and aquatic biota of Fresh Kills from the discharge of stormwater.

In-water construction activities elements proposed in 2036 for The Point include installation of piles for a fishing pier, two overlooks, the fishing and picnic pier, anchor piles for the marina floats, construction of a boat launch, wetland enhancement activities, stormwater management

best management practices, anchoring for the barge garden, and possible support structures for the ferry landing. Any temporary increase in suspended sediment resulting from the limited modifications to the shoreline to facilitate these projects would be limited and localized and are expected to dissipate within a short distance of the activity and cease shortly after the completion of the in-water activity. Silt curtains or other techniques could be used prior to any bottom disturbing activities to further minimize the area of aquatic habitat affected by temporary increases in suspended sediment. The installation of piles for these structures would result in a loss of bottom habitat within the footprint of the piles, and would also include a portion of the 6,750 square foot boat launch.[1] The loss of this small amount of bottom habitat would not result in significant adverse impacts to aquatic resources. In sum, in-water construction activities associated with the Point would not be expected to result in significant adverse impacts on water quality or aquatic biota. Similarly, any contaminants released to the water column as a result of sediment disturbance would not be expected to result in any significant impacts on water quality.

The proposed fishing piers, the two overlooks, the ferry landing, and the marina floating docks would result in the shading of approximately 0.47 acres of aquatic habitat and tidal wetlands. As discussed above, the width of these overwater structures is anticipated to be less than 15 feet. Therefore, these structures would allow light to reach the aquatic habitats and wetlands below these structures at different periods throughout the day and the impacts are expected to be limited.

The proposed 43,500 square foot (1 acre) of barge garden could also result in significant adverse impacts to aquatic resources due to shading, assuming the structure is anchored in position. Adverse impacts to aquatic resources due to shading of approximately 1 acre of aquatic habitat would have to be offset through the tidal wetland and subtidal enhancement efforts of the proposed projects.[2]

Given the water depth in the vicinity of the proposed marina and water taxi landing (about 17 feet at MLW) and the proposed use for mostly small to mid-size vessels less than 45 feet long, it is unlikely that boating activity approaching and in the marina would contribute to sediment resuspension. The water depths of Fresh Kills are generally greater than the minimum 10-foot depth found to minimize sediment disturbance from boats (USACE 1994, Asplund 2000, Gucinski 1981 in Klein 1997), and would also be sufficient to allow a clearance of 2 to 3 feet between the propeller of smaller vessels and the bottom during mean low water. This is the depth identified as necessary to prevent increased turbidities associated with boat operations (NOAA 1976 in USACE 1993). Therefore, boat operations at the marina and the water taxi landing would not be expected to result in increased suspended sediment within the project area.

The wakes of vessels using the marina and the water taxi are not expected to be more energetic than the normal wind waves or the wake of ship traffic along the Arthur Kill and would therefore not be expected to result in shoreline erosion. Marina activities would present a small increase in the potential for accidental petroleum or sewage spills to the Arthur Kill, and Fresh Kills. However, the small sizes of the vessels and the fact that no fueling facilities are planned as part

[1] Although in a conceptual design at this stage, it is assumed that the totally affected benethic area due to piles and other marine infrastructure associated with the fishing piers, marina, and boat launch is estimated at about 7,250 square feet The calculation of this area is subject to future designs, and the requirements of the DEC/ACOE permit process.

[2] It is expected that this park element would be subject to more detailed investigations once the capital project has been designed.

of the proposed project limits the likelihood of an accidental discharge of any significance. The design of the marina and boat launch would also allow sufficient flushing (i.e., the exchange of an amount of water), thereby minimizing potential water quality impacts. In sum, the operation of the marina, boat launch, and water taxi landing would not be expected to result in significant adverse impacts on water quality or aquatic biota.

Lastly, the in-water projects would be subject to the permitting requirements of DEC and USACE with respect to protection of wetlands and waters. Any additional protection measures resulting from that permit review process would be incorporated into the individual capital projects.

Operations

As stated above, the Point is already developed with DSNY infrastructure, including bulkheads, roads, and concrete platforms, and is bisected by a regional highway, Route 440 (the West Shore Expressway). Therefore, maritime operations such as a ferry or water taxi and small motorized and non-motorized craft are expected to have only a limited impact on aquatic wildlife. Increased recreational activity in this area has a very limited potential to result in negative wildlife responses, both from direct impacts (i.e., removal by fishing or disturbance by passive or active recreation) and indirect impacts (i.e., habitat modification or pollution). These wildlife responses can cause short-term, temporary displacement, such as avoidance of a watercraft paths, to long-term impacts that can occur with removal or disturbance of prime foraging habitat (Knight and Gutzwiller 1995). Motorized and non-motorized boating activity has been documented to increase flight times and disturbance of foraging dives for waterfowl (Kahl 1991, Havera et al. 1992) and can increase nest abandonment due to motorized boat noise (Ames and Mersereau 1964). The extent of wildlife response is reduced for non-motorized boats, as disturbances is largely caused by movement; motorized boats also cause disturbance due to noise, wildlife responses tend to be greater (Tuite et al. 1982).

Increased recreational boat traffic within the waterways at Fresh Kills may result in some short-term impacts on aquatic-based wildlife (i.e, avoidance and temporary displacement of foraging birds or mammals), but overall would not be expected to result in any significant adverse impacts on fisheries, avian populations, or critical wildlife activities within Fresh Kills, such as nesting activity at the Isle of Meadows. Use of this island by nesting colonial waterbirds was at its peak when the landfill was operational, with steady delivery of solid waste by barges. Therefore, the limited operation of recreational boats and the proposed ferry would not be expected to result in significant adverse impacts on any future nesting activity at the Isle of Meadows. Since there historically has been and continues to be limited boat operations occurring within Fresh Kills since the landfill closure, and noise associated with boat activity along the Arthur Kill and a major highway (Route 440) passing through the Point, it is unlikely that significant adverse impacts on wildlife would result from the limited proposed additional recreational boating activity. Within Fresh Kills, access by motorized (and to some extent non-motorized) watercraft is also restricted greatly by tides and the contour of the kills. At low tide, near-shore areas are often quite shallow and inaccessible and these are generally areas where foraging activity is concentrated for many waterbird and aquatic mammal species.

Nighttime lighting of the elements proposed at the Point has the potential to result in adverse impacts to some nocturnal wildlife individuals. In order to minimize adverse impacts associated with nighttime lighting, measures will be implemented as part of the design of the Point lighting to minimize light pollution.

Minimizing adverse impacts associated with nighttime lighting and additional in-water recreational boat usage in the Point would be further addressed through project design the creation and enforcement of waterway and navigation regulations (i.e., no wake zones, restrictions on boat access due to depth and channel bottom contour, etc.), and regulation of the types of watercraft approved for usage within Fresh Kills (see also Chapter 23, "Impact Avoidance and Mitigation").

Terrestrial Resources

Construction of the Point would benefit terrestrial resources by establishing freshwater forested wetlands within an existing DSNY stormwater basin, and the planting of trees within the two bosque parking areas. While this area is proposed more for recreational activity than habitat enhancements. It is also currently largely developed and provides little habitat value. Erosion and sediment control measures specified in the SWPPP would apply to construction in this area. As a result of the intense prior disturbance in this area, land clearing and construction activities associated with development of the Point has limited potential to disturb terrestrial wildlife.

Threatened or Endangered Species

Given that this area is already heavily disturbed and developed, construction and operation of the Point would not be expected to result in significant adverse impacts to colonial waterbird nesting activity on Isle of Meadows, or impact any habitats used by threatened or endangered species in the area.

Significant Coastal Fish and Wildlife Habitat

With the exception of the barge garden, the proposed construction and operation of the Point would not be expected to adversely affect water quality or aquatic biota. Adverse impacts to aquatic resources due to shading would be offset through tidal wetland enhancement and subtidal habitat enhancement (see Chapter 23). With these measure in-place, the proposed project Point element of the Park would not be expected to conflict with the Fresh Kills Significant Coastal Fish and Wildlife habitat.

CONFLUENCE—CREEK LANDING

Project elements proposed by 2036 for Creek Landing include the following:

- Overlook (1,000 square feet) to be located at western portion of the Creek Landing area;
- Visitor center (5,200 square feet);
- Fishing pier (about 1,350 square feet);
- Waterfront esplanade (22,850 square feet) located along the existing bulkheaded shoreline containing an approximately 13,750-square foot market roof; and a
- Boating lawn and terrace (2 acres) overlooking a 4,750 square foot boat launch to be located next to an approximately 900-square-foot boathouse for canoe rentals and a 900-square-foot café.

Like the Point, the Creek landing area is also heavily disturbed due to prior Fresh Kills Landfill operations in this area. Therefore, natural resources impacts in this area are minimal. The following sections discuss the potential impacts to natural resources resulting from the construction and operation of these project elements .

Geology, Soils, and Groundwater

Development of the additional elements proposed for the Creek Landing in 2036 would not result in significant adverse impacts to geology, soils or groundwater. All of the proposed facilities would be connected to water supply and sanitary sewer systems and would not have the potential to affect groundwater quantity or quality.

Floodplain

Development of the 2036 project elements in the Creek Landing are generally outside the 100-year floodplain with the exception of waterfront features. The proposed elements located within the 100-year floodplain include a portion of the esplanade, the overlook, and the boat launch. The placement of these structures within the floodplain would not adversely impact the floodplain or result in increased flooding outside the project site.

Wetlands

With the exception of the public recreational water access structures, development of the park elements in the Creek Landing would not result in adverse impacts to freshwater or tidal wetlands. Development of the recreational water access facilities would require limited placement of piles in and piers over tidal wetlands. However, the in-water elements for this area, proposed for 2036, which include an overlook (about 1,000 square feet) and a fishing pier (about 1,350 square feet) are very limited. Therefore, any shading of wetlands due to construction in this area would be very limited; moreover, this indirect impact would be offset through the tidal wetland enhancement elements of the proposed project (see Chapter 23). The proposed overlook would also have a limited potential to affect wetlands due to shading; however the width of this structure is expected to be less than 15 feet, allowing some light to reach the tidal wetlands and open waters below it. It is therefore concluded that the small area of shading resulting from this 1,000-square-foot structure would not result in significant adverse impacts to wetlands. As discussed above, implementation of erosion and sediment control measures as part of the project's SWPPP would minimize the potential for adverse impacts to wetlands during construction activities.

Aquatic Resources

As stated above, implementation of erosion and sediment control measures included in the SWPPP would minimize the potential for significant adverse impacts to water quality and aquatic resources during construction. Stormwater management measures of the project including best management practices and low impact designs would minimize the potential for significant adverse impacts to water quality and aquatic biota of Fresh Kills from the discharge of stormwater.

In-water construction activities for the Creek Landing elements proposed for 2036 include installation of a limited number of piles for the overlook, and the fishing pier. As presented above under the discussion of in-water construction activities associated with the Point, any temporary increase in suspended sediment resulting from these limited in-water construction activities would be localized, are expected to dissipate within a short distance of the activity, and would cease shortly after the completion of the sediment disturbing activity. The installation of piles for these structures would result in a minimal loss of bottom habitat within the footprint of the piles, and with a portion of the 4,750-square-foot square foot boat launch. The loss of this small amount of bottom habitat would not result in significant adverse impacts to aquatic resources. It is therefore concluded that in-water construction activities associated with the Creek Landing 2036 project elements would not be expected to result in significant adverse impacts on water quality or aquatic biota.

The overlook would result in shading of approximately 1,000 square feet of aquatic habitat and tidal wetlands. As discussed above, the width of these overwater structures is anticipated to be less than 15 feet. Therefore, while this structure would have the potential to result in adverse impacts to aquatic resources due to shading, some light would be expected to reach the aquatic habitats and wetlands below these structures at different periods throughout the day. The operation of kayaks and canoes within the waterways of Fresh Kills would not be expected to result in significant adverse impacts to water quality or aquatic biota.

Lastly, the in-water projects would be subject to the permitting requirements of DEC and USACE with respect to protection of wetlands and waters. Any additional protection measures resulting from that permit review process would be incorporated into the individual capital projects.

Terrestrial Resources

Construction

Given that much of Creek Landing was previously developed as part of DSNY's Plant 2 facility, construction of the project elements proposed for 2036 at Creek Landing would not result in significant adverse impacts to terrestrial resources. Soil stabilization measures would be specified for the earthwork components of the project in compliance with the erosion and sediment control measures specified in the SWPPP. In addition, land clearing and construction activities would have limited potential to disturb wildlife as the majority of the Creek landing area would have been developed by DSNY as the 2016 project elements and limited additional areas would be disturbed for the 2036 project elements.

Operations

Similar to the project elements for the Confluence that would be operational by 2016, operation of the Creek Landing elements proposed for 2036 would have limited potential to impact terrestrial habitats or wildlife through increased human presence. Recreational boating use may affect limited wildlife individuals, resulting in decreased use of the area. Measures would be implemented to minimize intrusion by boaters into sensitive waterfront habitats, all of which are located outside of the Creek Landing planning area (see Chapter 23). In order to minimize adverse impacts associated with nighttime lighting, measures will be implemented as part of the design of the Creek Landing lighting to minimize light pollution (see Chapter 23).

Threatened or Endangered Species

Construction and operation of the Creek Landing in 2036 would not be expected to result in significant adverse impacts to colonial waterbird nesting activity on Isle of Meadows, or the habitats of any threatened or endangered species.

Significant Coastal Fish and Wildlife Habitat

The proposed construction and operation of Creek Landing in 2036 would not be expected to adversely affect water quality or aquatic biota, and would not adversely affect the Fresh Kills Significant Coastal Fish and Wildlife habitat.

PROPOSED PARK ROADS

The park road elements that would be completed by 2036 include the following:

- Completion of the Richmond Hill Road Connection—This park road would connect the Loop Park Road on the west to the exiting Richmond Avenue/Richmond Hill Road

intersection on the east. This portion of the road is anticipated to consist of a combination of viaducts or embankments and culverts where it crosses the northern wetlands of East Park.

- Completion of the Loop Park Road and the Signature Bridge over Fresh Kills in the Confluence—By 2036, a new signature bridge would be constructed over Fresh Kills to connect the north and south Loop Road Park Roads. The proposed Signature Bridge would be approximately 75 feet wide and approximately 1,200 feet long, about 600 feet of which would be over Fresh Kills. The bottom of the bridge would be about 30 feet above MHW.[1]

The following sections discuss the potential impacts to natural resources resulting from the construction and operation of these project road elements.

Geology, Soils, and Groundwater

Completion of the Park Roads Richmond Hill Road connection and the Signature Bridge would not result in significant adverse impacts to geology, soils or groundwater. As discussed above, for the proposed construction in areas of landfill infrastructure, a plan would be implemented to ensure that the construction of the 2036 roadway elements is consistent with the landfill closure design objectives such that the existing environmental control systems at Fresh Kills (i.e., landfill gas and leachate collection systems) remain functioning during and after road construction in order to minimize the potential for adverse impacts to the environment (see also Chapter 23). To the extent that any of these systems need to be modified for the proposed park roads, those modifications would only be made in accordance with DEC -accepted designs such that they maintain the objectives of the environmental control systems at Fresh Kills.

Floodplain

Development of the Richmond Hill Road Connection and Signature Bridge would generally be outside the 100-year floodplain with the exception of a limited segment of the park roads approaching the Main Creek Bridge and the approaches to the Signature Bridge. Development of these road segments would require activities in the floodplain that include vegetation clearing, placement of fill for construction of road bed and surface, the bridge support structures, and possible construction of stormwater outfalls associated with the management of stormwater runoff from the road surfaces. Stormwater runoff generated from the additional impervious surface developed on top of the new fill for these final portions of the park road system would be directed to the stormwater management system that would treat the runoff and attenuate the rate of discharge using best management practices and low impact designs. Neither the increased fill nor the increased runoff from the road would affect flooding adjacent to the project site. As discussed above, the floodplains of the project site are primarily influenced by coastal flooding. Increased stormwater flow into these creeks and the limited amount of fill and structure to construct the proposed roadways would therefore not impact the mapped floodplain at the project site or in the adjacent areas. It is expected that the supports for the proposed Signature Bridge would not impede tidal flow within Fresh Kills, since the bridge would be designed to limit or avoid supports within the water by spanning the waterway.

[1] It is recognized that given the long-term schedule for the Signature Bridge and that only very preliminary conceptual data is available at this time, a supplemental EIS would be necessary to fully evaluate the impacts of the proposed bridge. Provided below is a generic assessment.

Wetlands

As presented above, implementation of erosion and sediment control measures included in the project's SWPPPs would minimize the potential for significant adverse impacts to wetlands from road construction. Additionally, implementation of post-construction stormwater management measures including best management practices and low impact designs as well as road management practices that minimize the introduction of roadway pollutants into local waterways would minimize the potential for significant adverse impacts from the discharge of stormwater (see also Chapter 23).

The development of the proposed park road connection to Richmond Avenue at Richmond Hill Road and the proposed Signature Bridge would result in adverse impacts to both freshwater and tidal wetlands due to filling and shading. The park road extension to Richmond Hill Road would result in direct impacts by filling approximately 185,408 square feet (4.25 acres) of freshwater wetlands within the wetland/stormwater basin complex on the east side of Landfill Section 6/7. It is assumed that indirect impacts could be minimized through the use of culverts that would be installed to maintain hydraulic connections and minimize adverse impacts to the wetlands in this area. However, the expected wetland impacts would be a significant adverse impacts to wetlands resources that would be offset through implementation of the proposed project's wetland enhancement and mitigation program (see Chapter 23 "Impact Avoidance and Mitigation"). The wetlands enhancement proposed with the project would offset these long-term adverse impacts on an area basis by a ratio of at least 6 to 1 for tidal and freshwater wetlands for the 2036 build year. In addition, these long-term projects would be regulated by the USACE and DEC, which would involve a permitting process that would minimize the impacts to wetlands and ensure the implementation of the freshwater wetlands mitigation (see Chapter 23).

It is assumed that construction of the Signature Bridge could result in the placement of minimal fill or structure within tidal wetlands along the north shoreline of the northern bridge pier (approximately 1,320 square feet), and no impact to tidal wetlands along the southern shoreline because the southern bridge pier would be located on uplands. However, it would shade tidal wetlands and waters below the bridge potentially resulting in an indirect adverse impact. The area of this shading is estimated to be about 73,500 square feet (about 1.7 acres). A more detailed description of the potential for impacts on the aquatic resources associated with these wetlands is presented below.

Aquatic Resources

As stated above, implementation of erosion and sediment control measures included in the SWPPP prepared for development of the roadways described above, as well as the use of silt curtains and other measures to minimize sediment suspension during in-water construction activities (installation of sheet pile, culverts, outfalls, etc.) would minimize the potential for both direct and indirect significant adverse impacts to water quality and aquatic resources during construction of the 2036 road segments. Implementation of post-construction stormwater management measures such as best management practices and low impact designs prepared for the park, and road management practices to minimize the introduction of roadway pollutants into stormwater runoff, would also minimize the potential for significant adverse impacts associated with the increased pervious surface from the roadways and the associated discharge of stormwater during operation of the roadways.

Incorporating culverts within the Richmond Hill Road Connection design would maintain the hydrologic connections in this area and water levels within the stormwater basin/wetland

complex. Operational measures would also be instituted to control the application of road chemicals on the viaduct in order to minimize potential adverse impacts to water quality and freshwater wetlands (see Chapter 23).

Installation of limited bank supports for the Signature Bridge would result in limited permanent loss of bottom habitat within the footprint of the north shoreline bridge supports (approximately 1,320 square feet). As presented above under the discussion of in-water construction activities, any temporary increase in suspended sediment resulting from constructing this support would be localized and is expected to be controlled through the use of silt curtains and other techniques. With these proposed protections in place, in-water construction activities associated with the construction of the Signature Bridge would not be expected to result in significant adverse impacts on water quality or aquatic biota during construction. Similarly, any contaminants released to the water column as a result of sediment disturbance would not be expected to result in any short-term or significant short-term or long-term impacts on water quality.

The Signature Bridge would result in the shading of approximately 73,500 square feet (1.7 acres) of aquatic habitat, although the 30-foot elevation above MHW of the bridge would allow some light to reach to the aquatic habitat at different periods throughout the day. Adverse indirect impacts to aquatic resources due to shading of approximately 1.7 acres of aquatic habitat would be offset through implementation of mitigation (see Chapter 23).

Lastly, the in-water projects would be subject to the permitting requirements of DEC and USACE with respect to protection of wetlands and waters. Any additional protection measures resulting from that permit review process would be incorporated into the individual capital projects.

Terrestrial Resources

Construction

Construction of the park roads connection to Richmond Hill Road has the potential to result in direct impacts to habitats (i.e., physical removal of plant community or grading of soil within the roadway alignments, loss of individual wildlife due to collision with or as a result of operation of construction equipment) and indirect impacts (avoidance of habitat due to noise, vehicle traffic, or other human disturbance) to wildlife. The proposed project has minimized direct losses of habitat due to the proposed roads by using the existing landfill road network to the extent possible (e.g., the Confluence Loop Park Road), thereby limiting habitat loss. However, construction of this segment of 2036 roadway would require the removal of conifers and deciduous trees along the Richmond Avenue berm, and along a southerly segment west of the berm before heading west through a wooded area at the south end of Basin B1. The conceptual roadway design would require the removal of large trees along this route. While there would be impacts to trees, as described above, the proposed project would create extensive areas of woodlands and overall, even with the clearing for this segment of roads, there would be a significant net increase in woodland area at the project site with the proposed project. Thus, the limited loss of habitat associated with the road construction would not result in significant adverse impacts to woodland habitat or the associated wildlife in the context of the entire project.

Operations

Operation of this segment of roadway through the enhanced habitats of Landfill Section 6/7 has the potential to result in conflicts with wildlife due to noise, air quality, or nighttime lighting, fragmentation of the enhanced habitats on either side of the road, and direct losses due to collisions

with vehicles. This reduced suitability could reduce wildlife utilization of the habitats within this portion of the park. However, reductions in intended habitat quality adjacent to the road would be minimized by incorporating vegetation screening into the roadside landscaping and other practices that would reduce noise levels or road lighting to reduce light pollution (see Chapter 23).

Nighttime lighting of the Signature Bridge would also be reduced to the extent possible to minimize light pollution while maintaining safe operating conditions.

Threatened or Endangered Species

Construction and operation of the proposed 2036 road segments would not be expected to result in significant adverse impacts to colonial waterbird nesting activity on Isle of Meadows, or adversely affect other threatened or endangered species.

Significant Coastal Fish and Wildlife Habitat

The construction and operation of the 2036 road segments would not result in adverse impacts to water quality or aquatic habitat that would conflict with the Fresh Kills Significant Coastal Fish and Wildlife Habitat. Because mitigation would offset adverse impacts due to filling of freshwater wetland, shading from the Signature Bridge, and protections during construction, it is expected that the proposed project can meet the habitat protection objectives of this designation.

PEDESTRIAN BRIDGES

Two pedestrian/bicycle bridges have been proposed for 2036.

- Muldoon Avenue Pedestrian Bridge—This grade-separated pedestrian/bicycle bridge will cross over the West Shore Expressway from the southern portion of Muldoon Avenue (South Park) to the northern portion of Muldoon Avenue (North Park) (7,850 square feet for the base of the structure on each side of the Expressway),
- Forest Hill Road Pedestrian Bridge—This grade-separated pedestrian/bicycle bridge will cross over Richmond Avenue to East Park, just South of the Forest Hill Road Extension park road.

The approaches for both these pedestrian bridges would be helical ramps with a radius of 50 feet. Both bridges would require clearing of vegetation within the 100-foot diameter footprint of each bridge base. The loss of this habitat would not result in significant adverse impacts to terrestrial resources. The approach for the Muldoon Avenue Pedestrian Bridge in South Park has the potential to result in adverse impacts to a small area of freshwater wetlands and aquatic resources if it cannot be sited outside the stream channel and associated wetlands that run parallel and east of the West Shore Expressway. The design approach here would be to retain the hydrologic connectivity of the stream system. Thus, the potential adverse impacts to wetlands due to the bridge would be limited. Neither bridge would be located within the 100-year floodplain.

CONCLUSIONS

The proposed Fresh Kills Park would be a large public open space with significant cultural, recreational and environmental amenities developed in a manner that protects and enhances aquatic and terrestrial habitats and associated wildlife. The four former landfill sections would be enhanced to produce valuable ecological habitats and recreational areas. The proposed park would showcase state-of-the-art environmental reclamation techniques alongside the innovative design of park spaces. The park elements identified as part of the RWCDS would be designed around existing natural resources and habitats identified for enhancement, and phased in as the park is developed.

The landscape enhancement elements to be implemented with the park include the following

- Enhancement and expansion of the existing freshwater wetlands present within the project site, with possible creation of additional wetland habitats within several existing stormwater management basins, as compatible with the stormwater management plan developed for the park;
- Enhancement and expansion of the existing tidal wetlands through removal of invasive species such as *Phragmites* and restoration of the native intertidal and high marsh plant communities;
- Development of native grassland and meadow habitats on the landfill sections; and
- Expansion of woodlands within the project site to provide a buffer for the site perimeter and an ecological connection with woodlands adjacent to the project site.

As presently envisioned, the construction and operation of North, South, East, and West Parks and Confluence planned for the 2016 and 2036 build years would allow for substantial public access and multi-use recreation within varied aquatic and terrestrial landscapes of Fresh Kills Park. These recreational goals would be consistent with landscape enhancement elements that would improve ecological structure and complexity and biodiversity within Fresh Kills Park. The proposed recreational amenities and landscape enhancement programs that would be implemented with Fresh Kills Park would result in valuable recreational resources for residents and visitors to New York City. The potential for adverse impacts to natural resources resulting from the construction and operation of these facilities would be limited, and substantially offset by the natural resources benefits achieved through extensive landscape enhancements. These efforts would include large-scale wetland and upland enhancement and management projects that would create terrestrial and freshwater wetlands, native grassland habitats on former landfill slopes, increased biodiversity, and restored overall connectivity to a former active landfill landscape. Additionally, the stormwater management plan developed for Fresh Kills Park would minimize the potential for significant adverse impacts to water quality and aquatic biota by reducing the rate of stormwater discharge from the project site compared to existing conditions, and improving the quality of stormwater discharge through a decrease in nutrients and suspended sediments. The application of best management practices and low impact design throughout the park would decrease the rate of stormwater discharge and further improve stormwater quality. Therefore, it is concluded that the discharge of stormwater from Fresh Kills Park would not result in significant adverse impacts to water quality or aquatic biota.

Other elements of the overall design have the potential to result in significant adverse impacts to natural resources. For example, construction and operation of the proposed park roads to provide a new east-west connection between Richmond Avenue and the West Shore Expressway as well as to provide visitor access to major park facilities would result in significant adverse impacts to approximately 5.2 acres of wetlands due to filling and approximately 3.5 acres of wetlands and aquatic habitat due to shading, which requires mitigation (i.e., creation, enhancement) at ratios established by regulatory agencies to offset these impacts. The proposed wetland mitigation and enhancement project, presented in Chapter 23 "Impact Avoidance and Mitigation," would offset and mitigate these long-term adverse impacts on an area basis by a ratio of more than 20 to 1 for tidal and freshwater wetlands for the 2016 build year, and by at least 6 to 1 for tidal and freshwater wetlands for the 2036 build year. Operation of the proposed park roads also has the potential to result in indirect impacts to wildlife due to aspects of road operation such as noise and light pollution, as well as impairment of life-cycle requirements, habitat fragmentation and wildlife avoidance response, and the loss of wildlife individuals due to wildlife/vehicle collisions. Measures would be integrated into the design and operation of the park roads to

minimize the potential for adverse impacts to aquatic and terrestrial biota (e.g., monitoring of wildlife/vehicle collisions, providing safe wildlife passages, and modifying roadside landscaping and maintenance, see also Chapter 23). Increased human presence within Fresh Kills Park also has the potential to impair suitability of the habitat restoration efforts for certain wildlife species and individuals. These effects, however, can be minimized through modification of proposed pathway locations and number of pathways to create large areas of contiguous habitat in certain locations that would have minimal human presence (see Chapter 23).

Finally, the proposed operation of five commercial wind turbines to be located within the highest elevations within the park (i.e., on the tops of the mounds within the North, East and South Parks) has the potential to result in adverse impacts to migratory and resident wildlife (i.e., birds, bats, insects) due to collision with turbine blades that would require mitigation to offset these losses. Mitigation measures would include designing and implementing wildlife studies documenting use of the project site before and after installation of the proposed wind turbines, monitoring losses of individuals during operation of the wind turbines, and developing mitigation measures as necessary to minimize adverse impacts. The design of the wildlife studies, submission of monitoring reports, and mitigation measures would require approval by DEC.

Recognizing that the project has the potential to avoid natural resources impact as design progresses (e.g., habitat fragmentation) and would also mitigate the expected direct and indirect impacts of project elements such as road impacts on wetlands (e.g., filling), Chapter 23, "Impact Avoidance and Mitigation Measures," contains a comprehensive approach to avoiding or minimizing project impacts to natural resources through design and mitigating impacts where necessary. ✷

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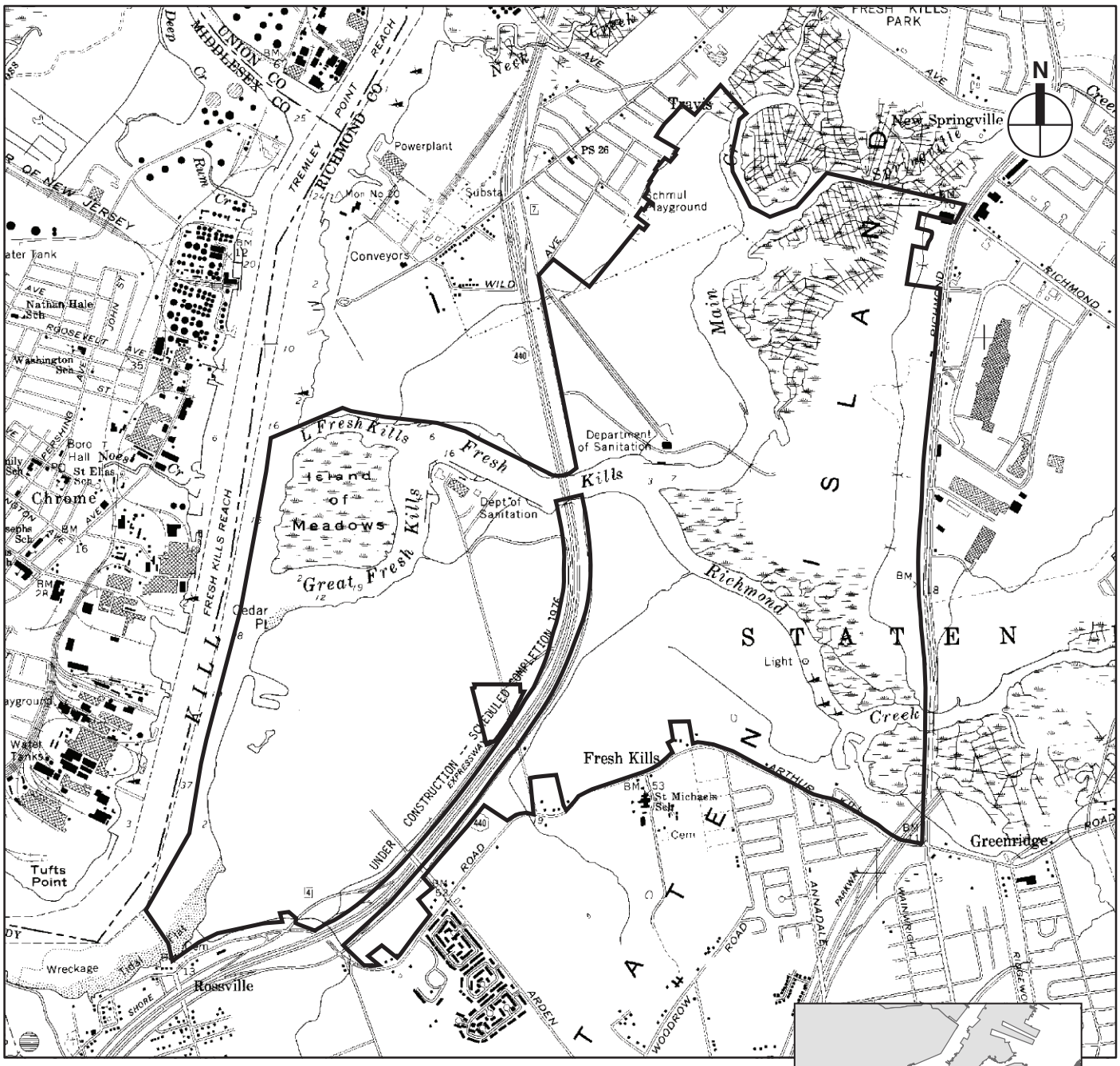
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Fresh Kills Project Boundary
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SCALE
Area of Detail
Fresh Kills Park Project Site
USGS Basemap - Arthur Kill Quad

Fresh Kills Project Site
Current Aerial (2007)
Figure 10-2

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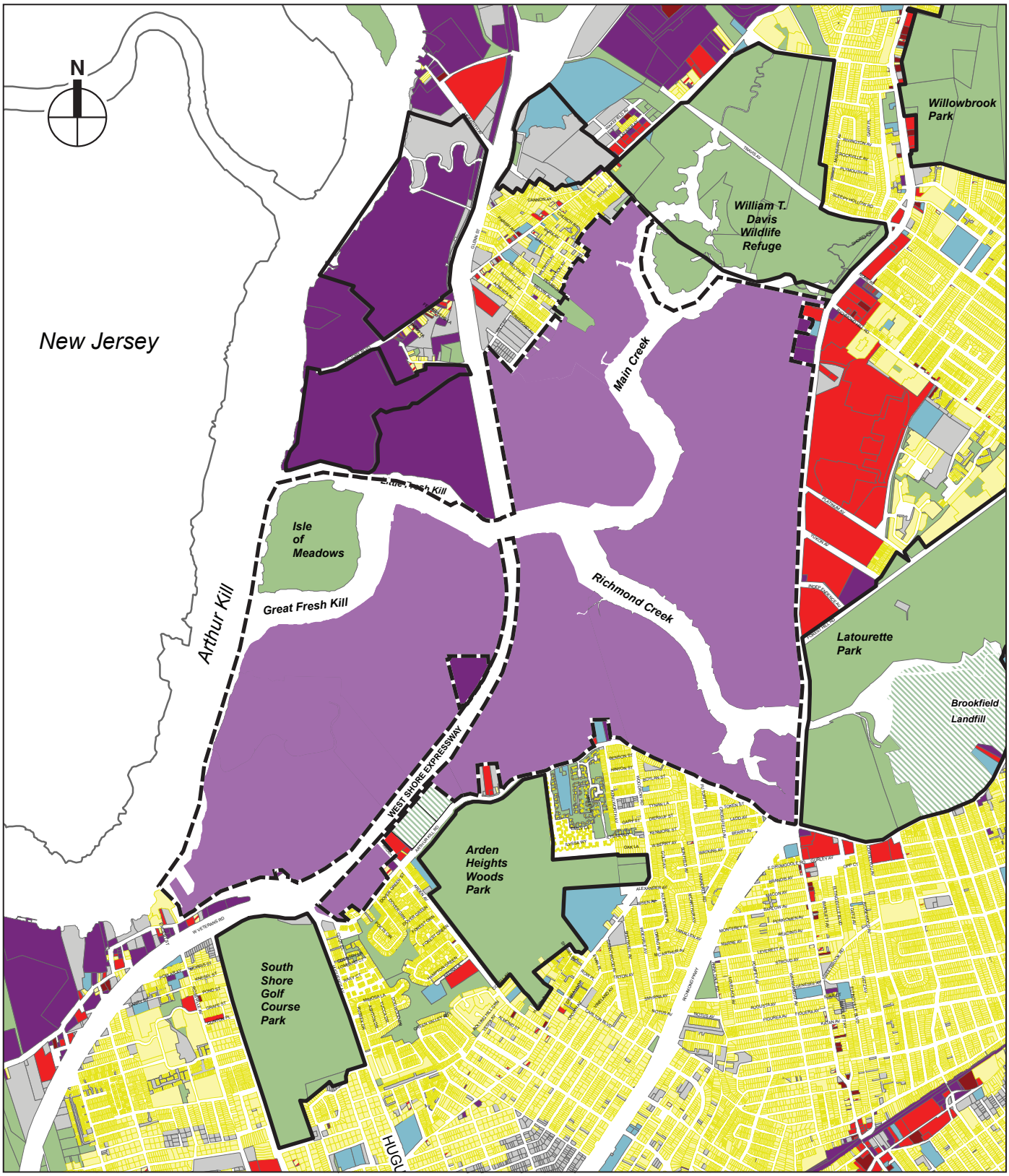
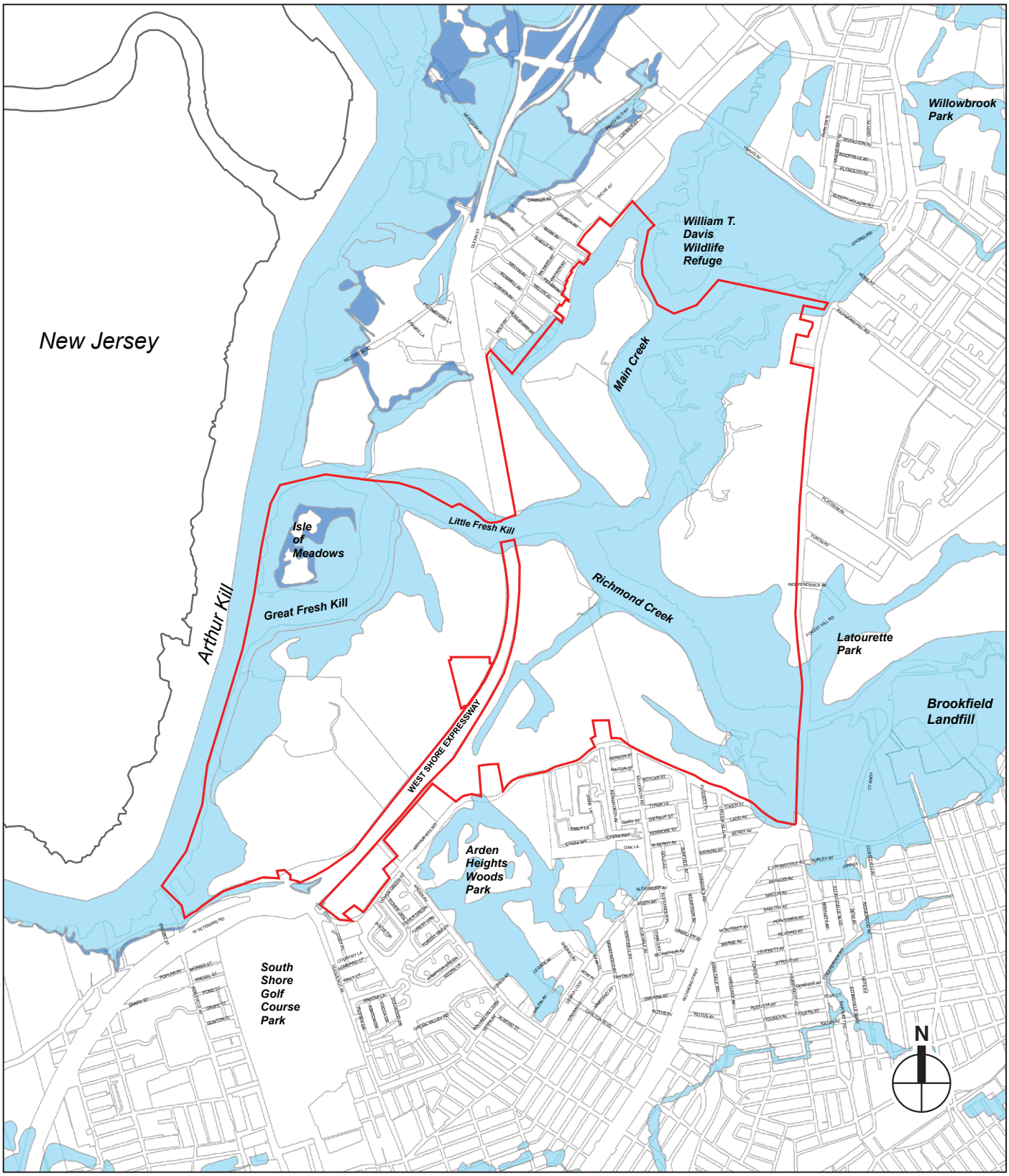


Primary and Secondary Natural Resources Study Areas

Figure 10-3



Fresh Kills Project Site

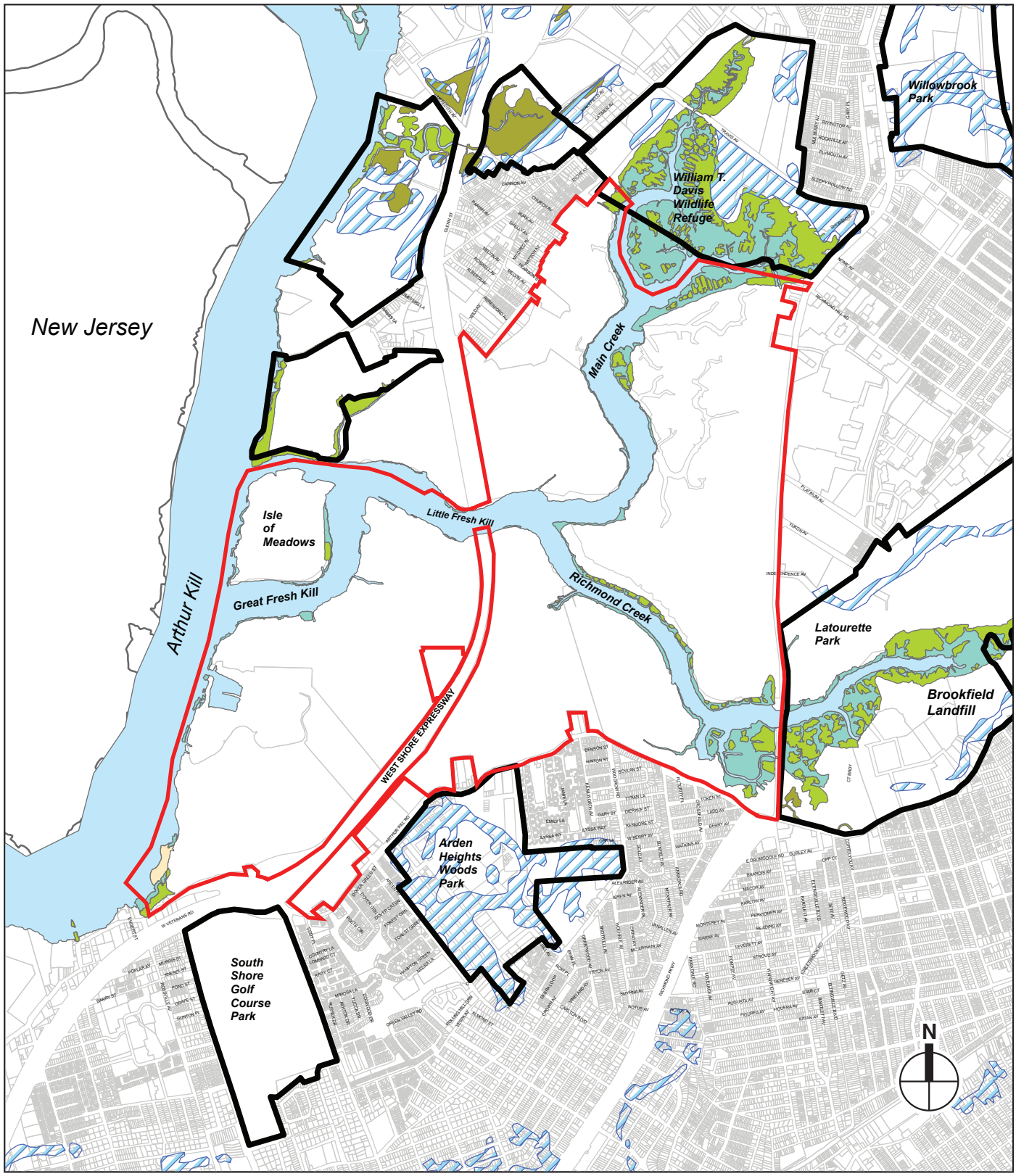
FEMA Flood Plains

Inside 100-Year Floodplain

Inside 500-Year Floodplain

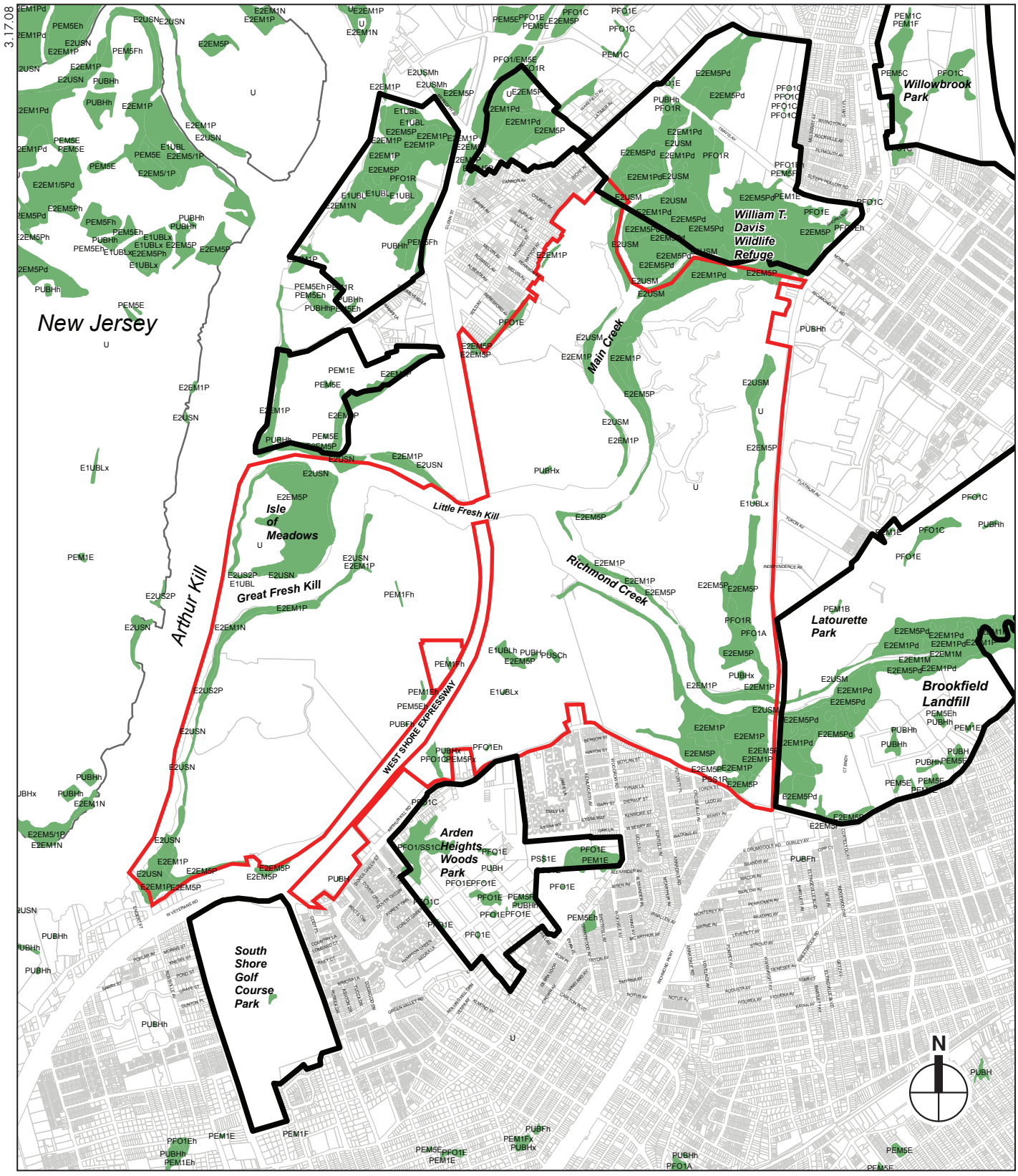
Floodplains

Figure 10-4



NYSDEC-mapped Wetlands

Figure 10-5



Fresh Kills Project Boundary

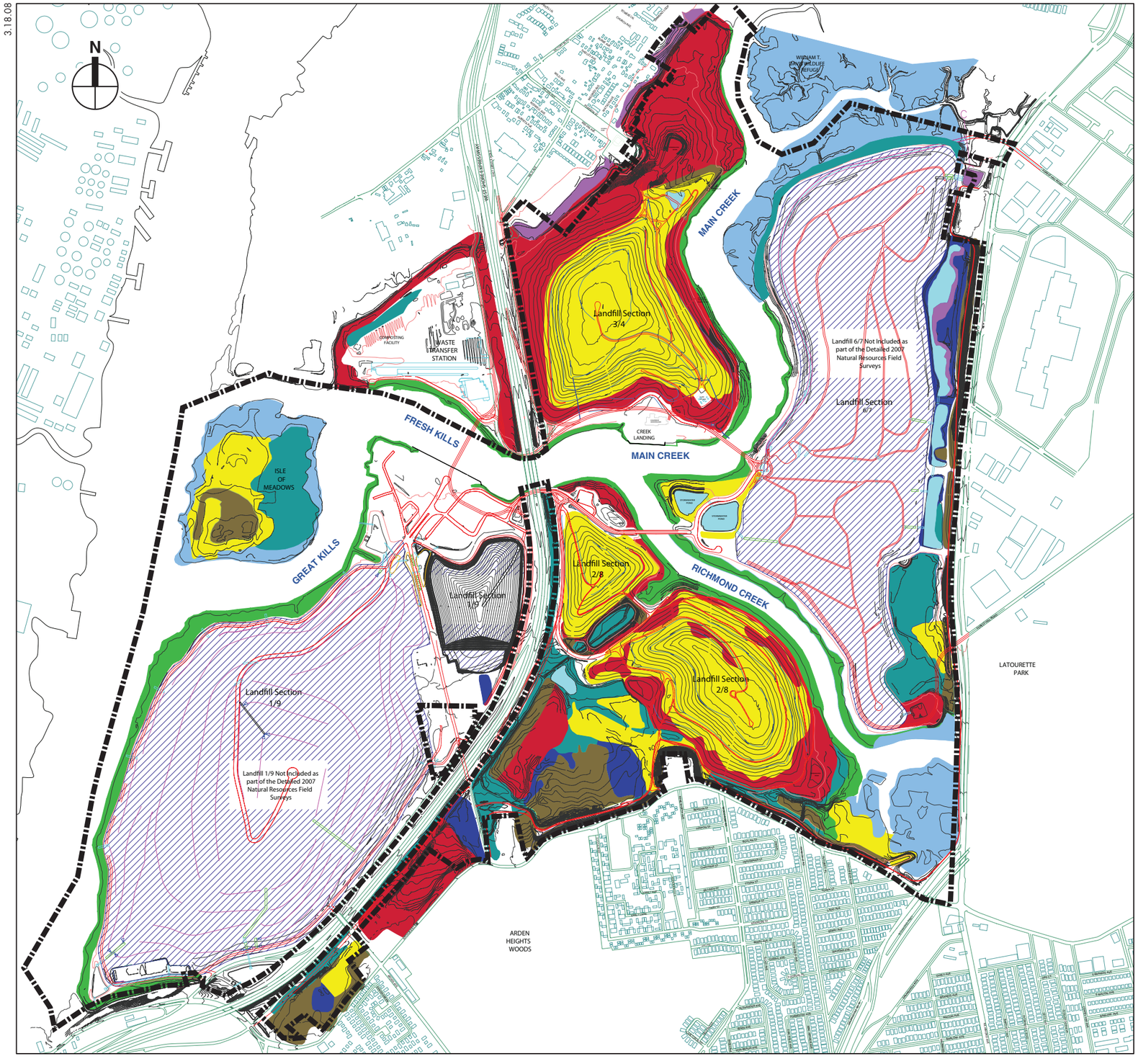
Secondary Study Area Boundary

NWI Wetlands

NWI-mapped Wetland Areas

Figure 10-6

3.18.08



Legend

Habitat Types

- Spartina -dominated
- Mixed marsh
- Phragmites -dominated Emergent/Scrub Shrub
- Palustrine emergent/forested
- Palustrine forested
- Open water/Stormwater Basins
- Phragmites /Mugwort-dominated
- Maturing Woodland
- Grass/Forb Dominated
- Areas Were Not Included as part of the Detailed 2007 Natural Resources Surveys
- Developed Areas (within the Primary Study Area)
- MAIN CREEK — Tidal Waterways

Notes:

1. Revised from AES 2003 and SCS Engineers 1991 based on field surveys performed by AKRF, Inc. (May and October 2007).

2. Field surveys were performed in May and October 2007 as outlined in the Natural Resources Field Survey Plan (AKRF 2007) and Fall 2007 Addendum, and focused on locations proposed as part of the 2016 Projects of the overall Fresh Kills Park Project.

3. In certain areas, mapped habitats contain smaller portions of other habitats. For example, the area north of Landfill Section 3/4 mapped as *Phragmites/* Mugwort-dominated contains smaller amounts of Maturing Woodlands that are not represented on this drawing. Also, the areas mapped as Palustrine Forested wetland adajacent to the eastern edge of Landfill Section 6/7 contain smaller isolated areas of *Phragmites* -dominated Emergent/Scrub-Shrub wetlands in addition to large open water areas.

4. Landfill Section 6/7 was not investigated as part of the detailed survey because of ongoing active landfill operations. However, based on areas visible from accessible roads and adjacent areas, much of the vegetated portions of Landfill Section 6/7 would be classified as Grass/Forb Dominated.

5. Landfill Section 1/9 was not included as part of the detailed Natural Resources Survey performed in May 2007; however, this area appeared to be Grass/Forb Dominated, with areas of unvegetated cover in addition to large areas of *Phragmites* /Mugwort dominated communities.

6. For additional locations of stormwater basins see Figure 13-1.

0 1200 FEET

SCALE

General Land Cover Classification
Fresh Kills Project Site

Figure 10-7

View north towards open water area located along the eastern edge of East Park (Landfill Section 6/7) **1**

View north along the wetland alongside open water area in East Park (Landfill Section 6/7) **2**

East Park Habitat:
DSNY Drainage Basin
Figure 10-8

Upland area along berm alongside Richmond Avenue **3**

Phragmites-dominated wetland area in East Park **4**

East Park Habitat:
Richmond Avenue Berm and
Adjacent Wetlands

Figure 10-9

Upper reach of Main Creek north of East Park (Landfill Section 6/7) **5**

View of *Spartina*-dominated wetland north of East Park (Landfill Section 6/7) **6**

East Park Habitat:
Main Creek Wetlands
(East Shore)

Figure 10-10

Large stormwater management basin at the Convergence of Main Creek and Richmond Creek **7**

Large stormwater management basin at the Convergence of Main Creek and Richmond Creek **8**

East Park Habitat:
West Stormwater Basins
Figure 10-11

Smaller of the two stormwater basins located at the Convergence of Main and Richmond Creeks **9**

Spartina-dominated area along Richmond Creek, southwest of stormwater management basins **10**

East Park Habitat:
Stormwater Basins and Shoreline Wetlands

Figure 10-12

Mixed marshes along the shoreline of Richmond Creek **11**

Spartina-dominated Richmond Creek shoreline at the southern tip of East Park (Landfill Section 6/7) **12**

East Park Habitat:
Richmond Creek Shoreline
Figure 10-13

Spartina-dominated marsh south East Park (Landfill Section 6/7) **13**

View of the northern shoreline of Richmond Creek, at the southern tip of East Park **14**

East Park Habitat:
Richmond Creek Shoreline
Figure 10-14

Intertidal unvegetated shoreline along the north shore of Main Creek at Creek Landing. Rip-rap and gabions being used to stabilized the shoreline **15**

Shoreline along the north shore of Main Creek at Creek Landing **16**

North Park Habitat:
Main Creek Shoreline
Figure 10-15

Spartina-dominated marsh at The Terrace along Main Creek **17**

View upland area of North Park, predominantly vegetated with *Phragmites* and mugwort **18**

North Park Habitat:
Shoreline and Uplands
Figure 10-16

Area of North Park predominately vegetated with mugwort **19**

View of the shoreline of Main Creek along the eastern edge of North Park **20**

North Park Habitat:
Uplands and Tidal Shoreline

Figure 10-17

Maturing woodland in South Park, along Arthur Kill Road **21**

Forested wetland area along Arthur Kill Road **22**

South Park Habitat:
Woodlands
Figure 10-18

Grass/forb-dominated field north of Arthur Kill Road **23**

Young woodland area in South Park **24**

South Park Habitat:
Fields and Woodlands

Figure 10-19

Grass/forb-dominated field, surrounded by young woodlands in South Park **25**

Maturing woodland north of Arthur Kill Road **26**

South Park Habitat:
Fields and Woodlands

Figure 10-20

View of *Phragmites*-dominated area adjacent to tidal tributary to Richmond Creek near Landfill Section 2/8 **27**

Tidal tributary to Richmond Creek adjacent to Landfill Section 2/8, with *Spartina alterniflora* and *Phragmites australis* growing along the shorelines **28**

South Park Habitat:
Tidal Swale at Landfill Section 2/8

Freshwater tributary to Richmond Creek located in South Park, between the landfill areas of Landfill Section 2/8 **29**

Open water area in South Park west of Landfill Section 2/8 **30**

South Park Habitat:
Freshwater Wetlands

Figure 10-22

Shoreline of Richmond Creek, in the southwest portion of South Park **31**

Stormwater discharge along Richmond Creek in the southeast portion of South Park **32**

South Park Habitat:
Richmond Creek Tidal Shoreline

Figure 10-23

Shoreline of Great Fresh Kill north of West Park (Landfill Section 1/9) **33**

Shoreline of Arthur Kill, along western edge of West Park (Landfill Section 1/9) **34**

West Park Habitat:
Tidal Shorelines
Figure 10-24

West Park (Landfill Section 1/9) view of wreckage in Arthur Kill, off of the shoreline of West Park (Landfill Section 1/9) **35**

View of shoreline and wreckage off the southwestern portion of West Park (Landfill Section 1/9) **36**

West Park Habitat:
Offshore Habitats
Figure 10-25

View of *Spartina*-dominated marsh southeast Terrace **37**

Mixed marsh at the location of the proposed Terrace, along Main Creek **38**

Central Area Habitat:
Terrace Tidal Wetlands

Figure 10-26

Impounded area within maturing woodland along Arthur Kill Road **39**

Wooded area of Arden Heights Woods Park **40**

Secondary Study Area Habitat:
Arden Heights Woods Park

Figure 10-27

Wooded area near entrance to Arden Heights Woods Park **41**

Phragmites- and mugwort-dominated field located in LaTourette Park **42**

Secondary Study Area Habitat:
Arden Heights/ LaTourette Park

Figure 10-28

Spartina-dominated Richmond Creek shoreline in the southern section of East Park **43**

View northeast across Main Creek of *Spartina*-dominated tidal wetland on the western edge of East Park **44**

East Park Habitat:
Richmond Creek and Main Creek Tidal Shorelines
Figure 10-29

View north of drainage basin located along the eastern edge of East Park. Landfill Section 6/7 is visible in the background **45**

Fish sampling point at drainage basin along the eastern edge of East Park **46**

East Park Habitat:
DSNY Drainage Basin
Figure 10-30

Setting round minnow trap in the larger stormwater management basin at the Confluence of Main Creek and Richmond Creek **47**

Benthic invertebrate sampling along the larger stormwater management basin at the Confluence of Main Creek and Richmond Creek **48**

East Park Habitat:
West Stormwater Basin
Figure 10-31

View north of forb-dominated open field in the southern section of East Park **49**

View south of forb-dominated open field in the southern section of East Park **50**

East Park Habitat:
Open Field
Figure 10-32

View northwest of maturing woodlands in the southern section of East Park **51**

View southwest of maturing woodlands in the southern section of East Park **52**

East Park Habitat:
Woodlands
Figure 10-33

View northwest of Main Creek and tidal wetlands from North Park (Landfill Section 3/4) **53**

View of North Park (Landfill Section 3/4) upland habitat dominated by grass and forb species **54**

North Park Habitat:
Landfill Section 3/4 Uplands and Main Creek

Southwestern view of freshwater wetland dominated by *Phragmites* in North Park **55**

Southwestern view of freshwater wetland dominated by *Phragmites* in North Park **56**

North Park Habitat:
Fresh Wetland
Figure 10-35

View southwest of forested wetland along the northwestern border of North Park **57**

View southwest of forested wetland along the northwestern border of North Park **58**

North Park Habitat:
Forested Wetland
Figure 10-36

View northeast of a tributary to Richmond Creek in South Park **59**

View southwest of linear wetland along a tributary to Richmond Creek in South Park **60**

South Park Habitat:
Tributary to Richmond Creek
Figure 10-37

Southwest view across Richmond Creek to the northern section of South Park (Landfill Section 2/8) **61**

Northwest view across Richmond Creek to the northern section of South Park (Landfill Section 2/8) **62**

South Park Habitat:
Richmond Creek Tidal Shoreline

View west of shallow pond and wetland in the western section of South Park **63**

View of channel and fish sampling point in the western section of South Park **64**

South Park Habitat:
Pond and Channel
Figure 10-39

Upland forest dominated by tree-of-heaven in the southern section of South Park **65**

View of area along dirt road dominated by invasive plants, mugwort, *Phragmites*, and tree-of-heaven in the southern section of South Park **66**

South Park Habitat:
Owl Hollow Uplands
Figure 10-40

Mixed marsh shoreline of Great Fresh Kill north of West Park (Landfill Section 1/9) **67**

View southwest along the shoreline of Great Fresh Kill north of West Park (Landfill Section 1/9) **68**

West Park Habitat:
Great Fresh Kill Tidal Shorelines
Figure 10-41

Upland forest dominated by tree-of-heaven in the southern section. View southeast of open mound area dominated by *Phragmites* on the western edge of West Park **69**

View of mound vegetation along the eastern edge of West Park near West Shore Expressway **70**

West Park Habitat:
Landfill Section 1/9

View south of unvegetated tidal shoreline in the southeastern corner of West Park **71**

View north of unvegetated tidal shoreline in the southeastern corner of West Park **72**

West Park Habitat:
Arthur Kill Tidal Shoreline
Figure 10-43

View south of drainage swale along the eastern edge of West Park **73**

View north of drainage swale along the eastern edge of West Park **74**

West Park Habitat:
Drainage Swale
Figure 10-44

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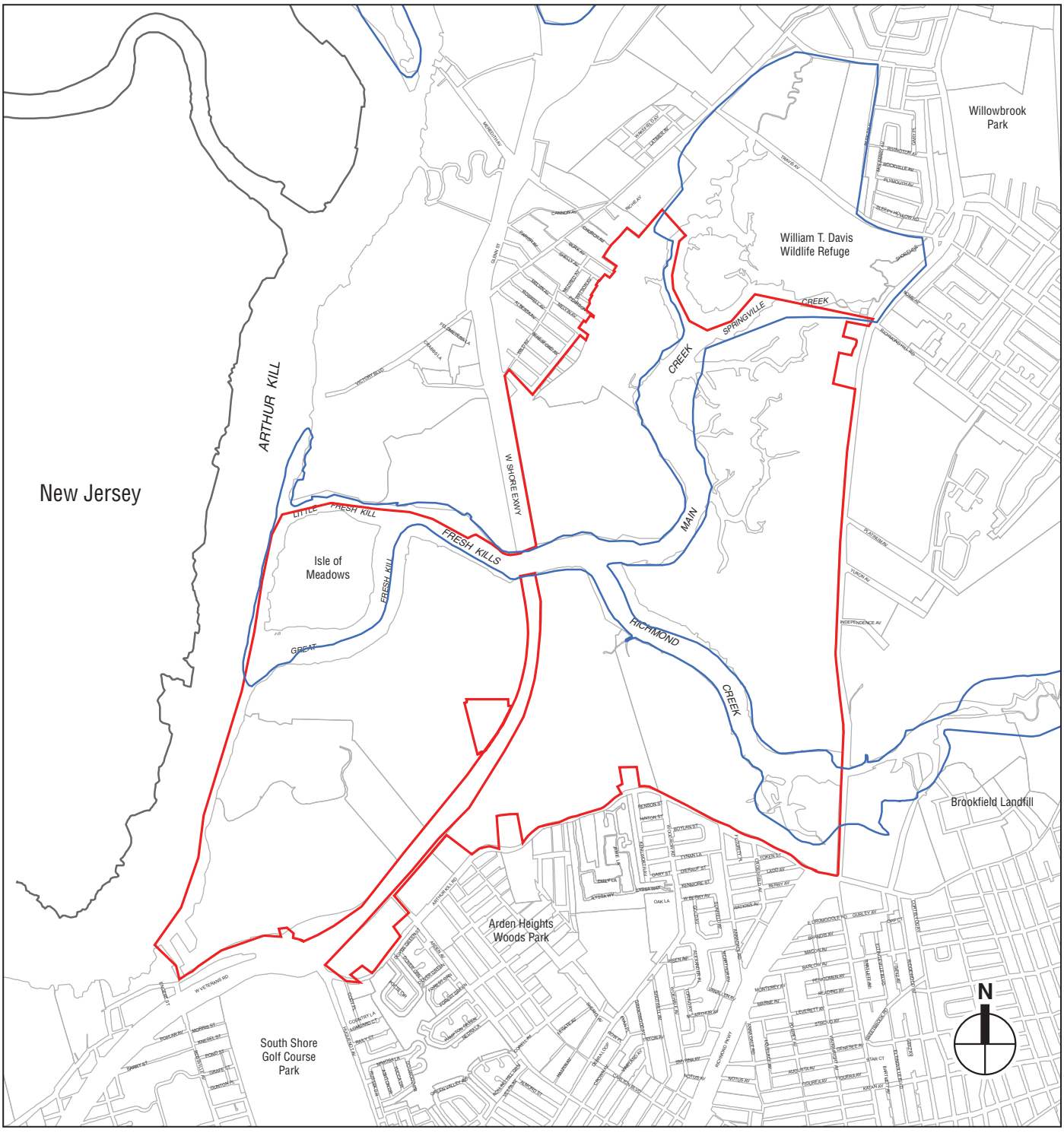
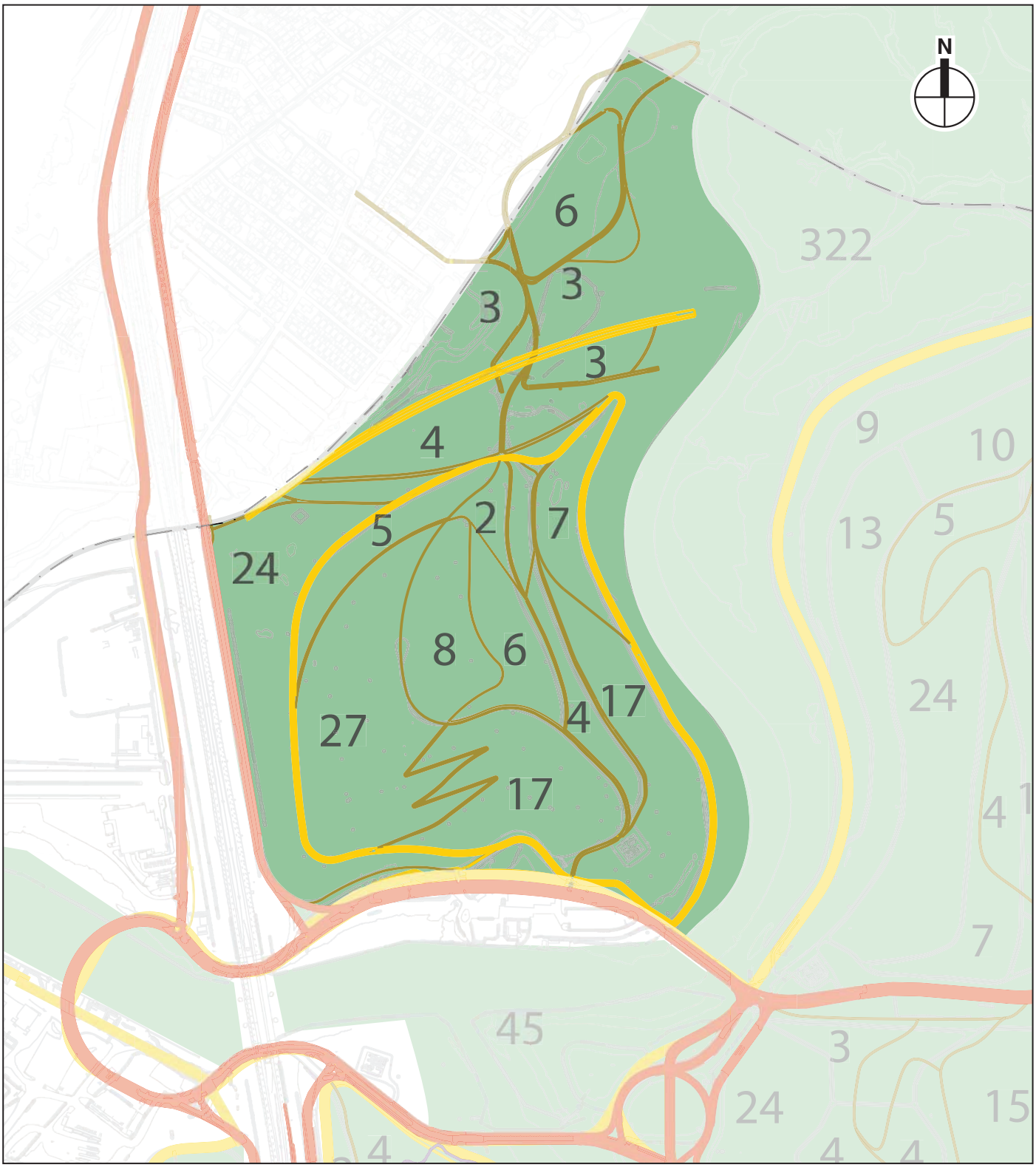


Fresh Kills Project Boundary

Fresh Kills Significant Coastal Fish and Wildlife Habitat

NYSDOS Significant Coastal Fish and Wildlife Habitat

3.12.09



8 *Contiguous Acres*

Multipurpose Path

Foot Paths/trail

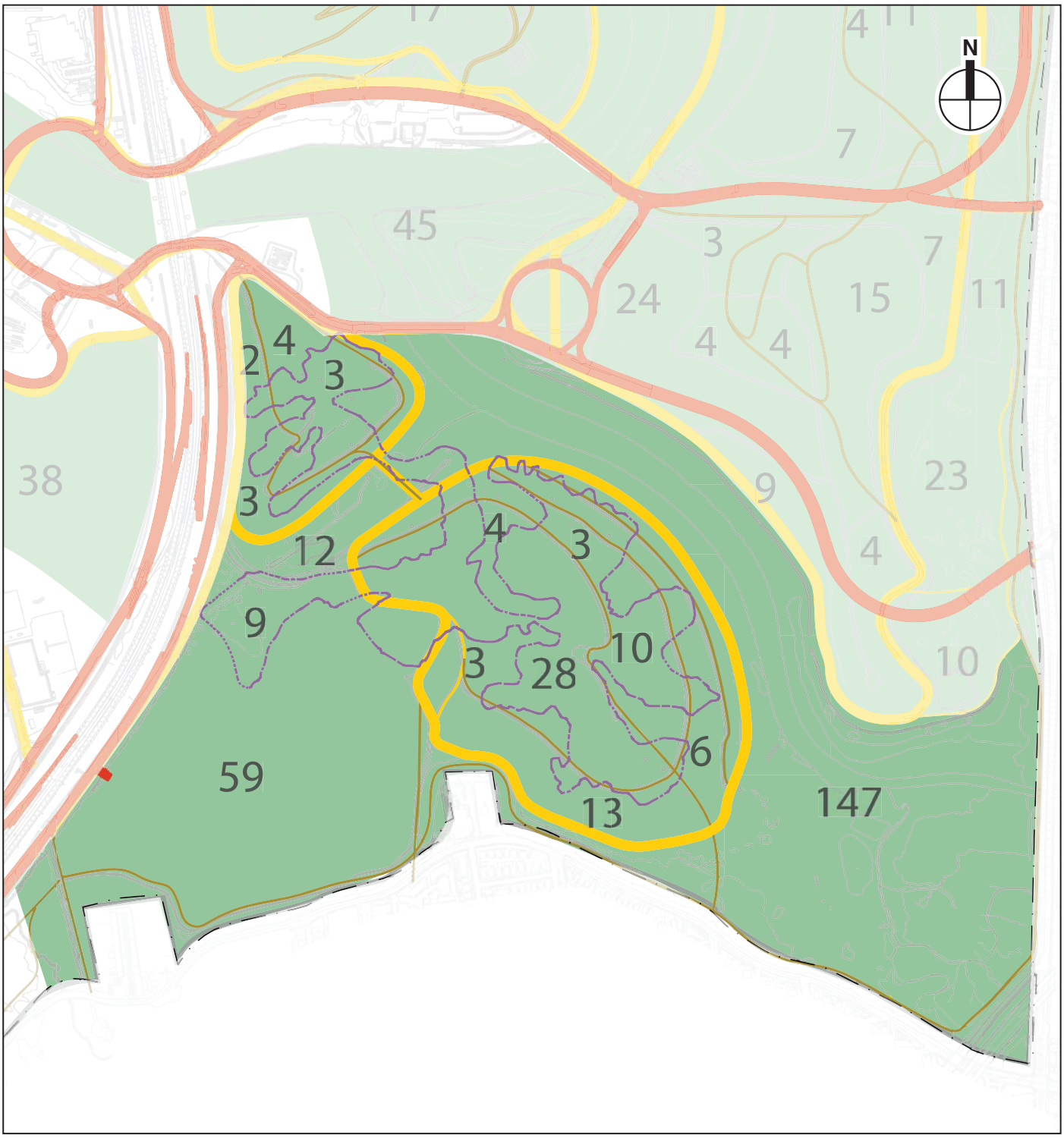
Park Roads

Mountain Bike Trail

Cohesive Habitat Areas: North Park

Figure 10-46a

3.12.09



3 *Contiguous Acres*

Multipurpose Path

Foot Paths/trail

Park Roads

Mountain Bike Trail

Cohesive Habitat Areas: South Park

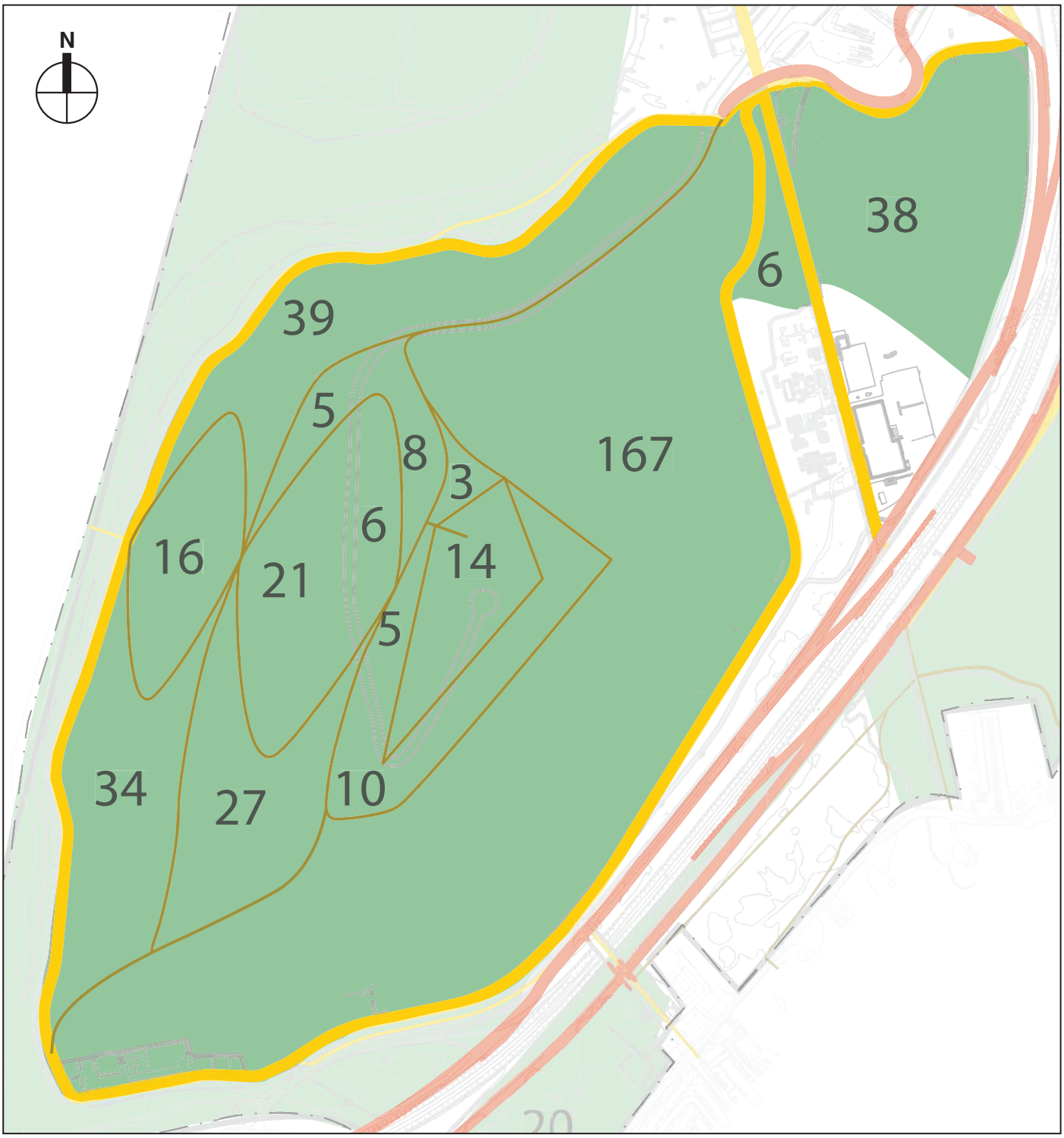
Figure 10-46b

3.12.09

Cohesive Habitat Areas: East Park

Figure 10-46c

3.12.09



3 *Contiguous Acres*

Multipurpose Path

Foot Paths/trail

Park Roads

Mountain Bike Trail

Cohesive Habitat Areas: West Park

Figure 10-46d