CHAPTER 18. NATURAL RESOURCES

18.1 INTRODUCTION

18.1.1 CONTEXT

Prior to September 11, 2001, the World Trade Center (WTC) complex (Towers 1 through 6, and the WTC PATH Terminal) relied on water withdrawn from the Hudson River for cooling. Operation of the WTC cooling water intake and outfalls began in the early 1970s. During the 1980s and early 1990s, concurrent with the operation of the WTC cooling water system, water quality in the Lower Hudson River Estuary and other waters of the New York/New Jersey Harbor Estuary improved dramatically as a result of regional water quality improvement efforts that included upgraded wastewater treatment. The withdrawal of river water to cool the WTC did result in the loss of some fish and invertebrates through impingement (individuals trapped against intake screens or other barriers at the entrance of cooling water intake structures) or entrainment (individuals drawn into a cooling water intake structure). After passing through the cooling system, the heated river water was discharged back into the Hudson River through one of two discharge outlets. The discharge of the cooling water was authorized by the New York State Department of Environmental Conservation (NYSDEC), through a State Pollutant Discharge Elimination System Discharge Permit (SPDES Number NY-0006033), which was most recently renewed in 1999. Although the cooling water intake structures were intact following September 11, 2001, use of the intake and outfalls was suspended after September 11, and the associated impingement and entrainment of aquatic organisms ceased.

The proposed World Trade Center Memorial and Redevelopment Plan (Proposed Action) contemplates using the existing WTC intake structure and outfalls as part of the cooling system for its office towers, retail uses, hotel, museum, and cultural facilities at the Memorial. The intake would also be used to supply cooling water for The Port Authority of New York and New Jersey's (the Port Authority) permanent WTC PATH Terminal. While the development of the permanent WTC PATH Terminal is independent of the Proposed Action and is undergoing a separate environmental review with the FTA as the federal lead agency, the volume of river water that would be used to cool that project (approximately 5 to 6 percent of the volume withdrawn at the intake) is included in this assessment of potential impacts to natural resources from the Proposed Action. As described in Chapter 12, "Infrastructure," the reuse of the existing cooling water intake and outfalls is the most economical and efficient method for cooling the components of the Proposed Action. It is also consistent with the overall goal of integrating sustainable development techniques into the design of the Proposed Action.

Before September 11, 2001, the approximately 16-acre WTC complex was an urban area that provided only limited habitat for wildlife. It consisted of the Twin Towers (1 WTC and 2 WTC), a hotel (3 WTC), 4 and 5 WTC office buildings, and the U.S. Customs House at 6 WTC. Open space areas included the sparsely landscaped 4-acre Austin J. Tobin Plaza at the center of the WTC complex (Figure 18-1), and landscaped areas along Church, Vesey, and Liberty Streets. To the south of the main WTC Site, additional open space areas included the approximately 1-acre plaza at 130 Liberty Street on the Southern Site, and 0.6-acre area at One Liberty Plaza. Typical of many urban areas, wildlife habitat provided by these open space areas was limited to occasional shade trees and planters with ornamental vegetation. While wildlife using these areas year-round consisted primarily of birds and small mammals tolerant of the urban conditions, songbirds used the landscaping as resting areas during spring and fall migrations. In response to bird collisions with buildings on the WTC complex, the Port Authority and WTC tenants implemented measures to reduce the number of collisions such as netting and night-time lighting modifications. On September 11, 2001, the limited habitat provided by these open space areas was lost. At the same time, the loss of the Twin Towers and other structures within the WTC complex resulted in a decrease in the number of bird collisions.

The Proposed Action would return urban wildlife habitat to the Project Site, but would also result in the potential for collision of birds with structures proposed as part of the Proposed Action.

This chapter:

- Describes regulatory programs that control intakes of and discharges to surface waters, or protection of wildlife, that may apply to the Proposed Action.
- Describes current conditions within the vicinity of the WTC intake and outfalls with respect to water quality and aquatic organisms, and the current terrestrial resources within the Project Site and the WTC Site, and the condition of these same resources prior to September 11, 2001.
- Assesses future water quality, and aquatic and terrestrial natural resources without the Proposed Action.
- Assesses the probable impacts of the Proposed Action on:
    - Water quality and aquatic organisms from the reuse of the WTC cooling water intake and outfalls; and
    - Terrestrial organisms from the construction and operation of the Proposed Action.

18.1.2 CONCLUSIONS

The Proposed Action would not be expected to result in significant adverse impacts to water quality in 2009 or 2015 under either the Pre-September 11 or Current Conditions Scenarios. While the Proposed Action would result in losses to aquatic biota in 2009 and 2015 under either the Pre-September 11 or Current Conditions Scenarios, these impacts would not be expected to be significant in 2009, but may be significant in 2015, if withdrawal volumes exceed projected flows and approach the design flow. These findings are based on conclusions summarized in the following sections.

PRE-SEPTEMBER 11 SCENARIO

The Proposed Action in 2015 is expected to withdraw cooling water from the Hudson River at volumes that would be no greater those required for the WTC complex, pre-September 11. Because many design uncertainties remain, the Proposed Action in 2015 may ultimately require less cooling water flow than pre-September 11. Pre-September 11, the average seasonal volumes of water withdrawn at the WTC intake were between 65 and 82 percent lower than the design

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Source: PANYNJ

Pre-September 11, 2001 photo showing the Austin J. Tobin Plaza

Austin J. Tobin Plaza
Pre-September 11, 2001
Figure 18-1

flow of the intake system (179 million gallons per day (mgd)). The volumes of water required for cooling the Proposed Action in 2009 would be about 60 percent less than the volumes withdrawn at the WTC complex pre-September 11, since much less space would need to be cooled (approximately 4 million square feet in 2009 compared to approximately 10 million square feet pre-September 11). Thermal discharges and water withdrawal for the Proposed Action in 2009 and 2015 would be in compliance with the terms of the 1999 SPDES permit authorizing the Port Authority to discharge thermal effluent from the WTC outfalls. Because the 1999 SPDES permitting conditions were established to protect water quality and aquatic life, significant adverse impacts would not be expected from this thermal discharge.

The assessment of potential impacts to aquatic biota evaluating the significance of adverse impacts was based, in part, upon data collected during a 1991 to 1993 impingement/entrainment study at the WTC cooling water intake (where water withdrawal volumes were similar to those reported for the two years prior to September 11, 2001). Since the volume of water withdrawn for the Proposed Action in 2015 is expected to be no greater than that withdrawn to cool the WTC complex pre-September 11, losses of invertebrates and fish for the Proposed Action in 2015 would also be expected to be similar to those recorded for the WTC complex pre-September 11. The assessment concluded that while there would be losses of aquatic organisms due to impingement or entrainment at the intake, the estimated number of fish and invertebrates lost through operation of the intake in 2015 would be expected to be an average of 65 to 82 percent lower (depending on the season) than what would be expected to occur from the operation of the intake at the design flow. The estimated low annual loss of some individuals through impingement, and higher estimated annual loss of individuals through entrainment would equate to a much smaller number of older fish that would not be added to the population, or small number of pounds that would be lost to a particular fishery because of the extremely high natural mortality of these lifestages. These losses may, however, result in significant adverse impacts to populations of these species in the Lower Hudson River under the Proposed Action in 2015 if withdrawal volumes increase and approach design flows.

As part of the SPDES permitting process for operation of the WTC intake, measures to reduce impingement losses (e.g., further flow reduction, modified screens with fish return, reduction of flow velocities, closed-cycle cooling, and fish avoidance systems such as barrier nets, light and sound) and entrainment losses (e.g., flow reduction, closed-cycle cooling, fine mesh barriers to exclude eggs and larvae such as Gunderbooms and fine mesh wedge wire screens) would be explored with respect to feasibility, effectiveness, cost, and constraints imposed by surrounding property owners and land uses such as deed restrictions or easements.

Because the area to be cooled in 2009 is as much as 60 percent less than 2015 and the pre-September 11 baseline, the volume of water withdrawn for the Proposed Action in 2009, would be similarly reduced. This lower volume of cooling water withdrawn at the WTC intake for the Proposed Action in 2009 would significantly reduce losses of fish and invertebrates through impingement and entrainment. Therefore, the operation of the WTC intake for the Proposed Action in 2009 would not be expected to result in significant adverse impacts to aquatic biota.

Significant adverse impacts would not be expected to occur to essential fish habitat (EFH) for the lifestages of the 15 managed species identified by the National Marine Fisheries Service (NMFS) as occurring in the Lower Hudson River Estuary (see Appendix I.2) in 2009, and may also not occur in 2015. This conclusion is based on the greatly reduced flow that would be expected for the Proposed Action in 2009 compared to pre-September 11 (attributed to the approximately 60 percent reduction in space that would require cooling compared to pre-September 11 and 2015), results of the assessment of potential impacts to target species from impingement and entrainment; the lack of in-water construction activities associated with the Proposed Action; the conclusion that the channel leading to the intake under the Battery Park City esplanade would be less desirable habitat for most fish species than open water or pile field habitats available within the vicinity of the intake; and the findings that significant adverse impacts would not be expected to occur to water quality, and therefore EFH, from the discharge of the heated effluent or stormwater associated with Proposed Action. As part of the permitting process for the operation of the WTC, measures to reduce potential losses of fish and invertebrates from impingement or entrainment would be explored with respect to feasibility, effectiveness, cost, effect to EFH, and other constraints such as deed or easement restrictions.

Significant adverse impacts would not be expected to occur to the five threatened or endangered species, or species of special concern to state or federal agencies that have the potential to occur in the Lower Hudson Estuary. Shortnose sturgeon would not be expected to occur in the vicinity of the intake and therefore would not be subjected to impingement or entrainment. None of the four species of sea turtles identified as having the potential to occur as transient individuals nest or reside in the lower Hudson River year round, and are only rarely observed in this portion of the estuary.

Stormwater generated during construction or operation of the Proposed Action in 2009 or 2015 would not be discharged directly to surface waters, but would be directed to the municipal combined sewer system and then to the municipal wastewater treatment facility prior to discharging to surface water bodies. (During wet weather conditions, overflow discharge from the combined sewer system is discharged into either the Hudson River or East River.) Implementation of erosion and sediment control measures and stormwater management measures during construction as part of the approved stormwater pollution prevention plan (SWPPP), and the proposed reclamation of stormwater for other uses such as irrigation of open space areas, would minimize potential impacts to the municipal combined sewer system from the introduction of stormwater due to the Proposed Action. These actions may result in less stormwater generated at the Project Site than pre-September 11. Therefore, no significant adverse impacts to water quality of the Hudson River would be expected to occur under the Pre-September 11 Scenario for either the 2009 or 2015 Proposed Actions.

In 2009, the Proposed Action is expected to result in fewer bird strikes than those realized under pre-September 11 conditions. The amount of above-ground vertical exterior surface area extending above 500 feet, which represents a strike hazard for migrating birds, would be approximately 63 percent less under the Proposed Action in 2009 than in pre-September 11 conditions (approximately 540,000 square feet versus approximately 1,469,000 square feet, respectively). In 2015, bird strikes under the Proposed Action are anticipated to be 15 percent less than those realized under pre-September 11 conditions due to a reduced amount of vertical exterior surface area extending higher than 500 feet elevation (1,246,000 square feet proposed in 2015 versus 1,469,000 square feet in pre-September 11). Peregrine falcons, designated an endangered species in New York, are accustomed to the intensely developed habitats of New York City and are not expected to experience a negative impact due to the Proposed Action. There are no records of peregrine falcons colliding with buildings in the city. Design and operating measures, such as minimization of reflective surfaces and glare created by late night lighting, would reduce potential strikes. However, consideration of such measures would also be weighed against the energy conservation benefits of reflective glass that reflects heat away from buildings.

CURRENT CONDITIONS SCENARIO

Even though the WTC cooling water intake is not withdrawing water and the WTC cooling water outfalls are not discharging thermal effluent under the Current Conditions Scenario, the existing water quality and aquatic resources are similar to the Pre-September 11 Scenario. While acknowledging the significant water quality improvements that occurred from the 1970s through early 1990s, and the considerable annual and seasonal variability in aquatic biota, studies have found that similar fish and invertebrate species have dominated the Lower Hudson River Estuary during the pre- and post-September 11, 2001 timeframes. Therefore, the potential impacts of the Proposed Action in 2009, or 2015, would be expected to be similar when compared to the baseline for either a Pre-September 11 or Current Conditions Scenario.

As discussed under the Pre-September 11 Scenario, while there would be losses of aquatic organisms due to impingement or entrainment at the intake, the estimated number of fish and invertebrates lost through operation of the intake in 2015 would be expected to be an average of 65 to 82 percent lower (depending on the season) than what would be expected to occur from the operation of the intake at the design flow. The estimated low annual loss of some individuals through impingement, and higher estimated annual loss of individuals through entrainment would equate to a much smaller number of older fish that would not be added to the population, or small number of pounds that would be lost to a particular fishery because of the extremely high natural mortality of these lifestages. These losses may, however, result in significant adverse impacts to populations of these species in the Lower Hudson River under the Proposed Action in 2015 if withdrawal volumes increase from those projected and approach design flows.

As part of the SPDES permitting process for operation of the WTC intake for the Proposed Action, measures to reduce impingement losses (e.g., further flow reduction, modified screens with fish return, reduction of flow velocities, closed-cycle cooling, and fish avoidance systems such as barrier nets, light and sound) and entrainment losses (e.g., flow reduction, closed-cycle cooling, fine mesh barriers to exclude eggs and larvae such as Gunderbooms and fine mesh wedge wire screens) would be explored with respect to feasibility, effectiveness, cost, and constraints imposed by surrounding property owners and land uses such as deed restrictions or easements.

Because approximately 60 percent less space would require cooling for the Proposed Action in 2009 compared to 2015, the volume of water withdrawn at the WTC intake would be greatly reduced. This lower volume of cooling water withdrawn at the WTC intake for the Proposed Action in 2009 would significantly reduce losses of fish and invertebrates through impingement and entrainment. Therefore, significant adverse impacts to populations of fish and invertebrates in the Hudson River Estuary would not be expected to occur from the operation of the WTC intake in 2009.

No significant adverse impacts would be expected to occur to water quality under the Current Conditions Scenario from the Proposed Action in 2009 and 2015. Thermal discharges and water withdrawal for the Proposed Action in 2009 and 2015 would be in compliance with the 1999 SPDES permit authorizing the Port Authority to discharge thermal effluent from the WTC outfalls and would not be expected to result in significant adverse impacts to water quality or aquatic organisms.

No stormwater would be discharged directly to surface waters during construction or operation of the Proposed Action in 2009 or 2015 under the Current Conditions Scenario. (During wet weather conditions, overflow discharge from the combined sewer system is discharged into either the Hudson River or East River.) As is the case for the Pre-September 11 Scenario, no significant adverse impact to Hudson River water quality is expected under the Current Conditions Scenario.

As is the case for the Pre-September 11 Scenario, significant adverse impacts would not be expected to occur to threatened or endangered species, or species of special concern to state or federal agencies under the Current Conditions Scenario.

The Proposed Action would have the potential to result in higher numbers of bird strikes under the Current Conditions Scenario in 2009 and 2015. Given the lack of vertical structure and concomitant lighting and reflective surfaces currently within the Project Site, impacts due to bird strikes are inevitable as a result of completion of construction of the Freedom Tower, which extends higher than surrounding structures, in 2009, and the remaining structures in 2015. Peregrine falcons, designated an endangered species in New York, are accustomed to the intensely developed habitats of New York City and are not expected to experience a negative impact due to the Project. There are no records of Peregrine falcons colliding with buildings in the city. Design and operating measures, such as minimization of reflective surfaces and glare from late night lighting, would reduce bird strikes.

18.2 REGULATORY CONTEXT

The following sections briefly describe the federal and state laws, and regulatory programs that may apply to the Proposed Action with respect to water quality and aquatic resources within the vicinity of the WTC cooling water intake and outfalls, and terrestrial resources within the vicinity of the Project Site. Because some of the state laws and regulatory programs were promulgated under authority of federal laws, the federal laws and regulatory programs are presented first.

18.2.1 FEDERAL

CLEAN WATER ACT (33 USC §§ 1251 TO 1387)

The objective of the Clean Water Act, also known as the Federal Water Pollution Control Act, is to restore 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, and non-point source pollution such as runoff from streets, agricultural fields, construction sites and mining that enter waterbodies, from other than the end of a pipe.

In addition, any applicant for a federal permit or license for an activity that may result in a discharge to navigable waters must provide to the federal agency issuing a permit a certificate, either from the state where the discharge will occur or from an interstate water pollution control agency, that the discharge will comply with Sections 301, 302, 303, 306, 307, and 316 (b) of the Clean Water Act. Applicants for discharges to navigable waters in New York must obtain a Water Quality Certificate from the New York State Department of Environmental Conservation (NYSDEC).

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 must be accompanied by a Coastal Zone Consistency Determination that evaluates consistency with New York'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 the NMFS and the Regional Fishery Management Councils (in this case, the Mid-Atlantic Fishery Management Council) to comment on activities proposed by federal agencies (issuing permits or funding projects) that may adversely impact areas designated as essential fish habitat (EFH). EFH is defined as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (16 USC §1802(10)).

ENDANGERED SPECIES ACT OF 1973 (16 USC §§ 1531 TO 1544)

The Endangered Species Act of 1973 recognized 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 prohibits the importation, exportation, taking, possession, and other activities involving illegally taken species covered under the Act, and interstate or foreign commercial activities. The Act also provides for the protection of critical habitats on which endangered or threatened species depend for survival.

MIGRATORY BIRD TREATY ACT (16 USC §§703-712)

The Migratory Bird Treaty Act implements the United States' commitment to four bilateral treaties, or conventions, for the protection of a shared migratory bird resource. Each of the treaties protects selected species of birds and specifies basic closed and open seasons for hunting game birds. The Act makes it illegal for anyone to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase or barter, any migratory bird, or the parts, nests, or eggs of such a bird except under the terms of a valid permit issued pursuant to federal regulations. Title 50, Section 10.13, of the Code of Federal Regulations (50 CFR 10.13) lists the bird species protected under the Act.

EXECUTIVE ORDER 13186 OF JANUARY 10, 2001, RESPONSIBILITIES OF FEDERAL AGENCIES TO PROTECT MIGRATORY BIRDS

This Executive Order directs federal agencies to take certain actions to further implement the Migratory Bird Treaty Act. Each federal agency taking actions that have, or are likely to have, a measurable negative effect on migratory bird populations is directed to develop and implement a Memorandum of Understanding (MOU) with the US Fish and Wildlife Service (USFWS) that promotes the conservation of migratory bird populations. Agencies are expected to avoid or minimize impacts to migratory bird populations, and to take reasonable steps that include restoring and enhancing habitat, preventing or abating pollution affecting birds, and incorporating migratory bird conservation into agency planning processes whenever possible.

18.2.2 NEW YORK

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 discharges to pipe (point source) that discharges 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.

SPDES addresses thermal discharges in ECL §§15-0313 and 17-0301, and the implementing regulations in 6 NYCRR Parts 704 and 750. Title 3 (Powers and Duties) of Article 15 (Water Resources), ECL, and Title 3 (Jurisdiction of the NYSDEC, Authority, Powers and Duties) of Article 17 (Water Pollution Control), ECL, authorizes the NYSDEC to establish water quality standards for thermal discharges to the waters of New York State, as implemented in 6 NYCRR Chapter X (Division of Water Resources) Part 704 (Criteria Governing Thermal Discharges) and Part 750 (SPDES). The thermal discharge criteria established in 6 NYCRR Part 704 include general criteria for waters receiving thermal discharges; special criteria specific to different types of state waters receiving thermal discharges; and mixing zone criteria.

The location, design, construction and capacity of a cooling water intake structure must minimize adverse environmental impacts, especially impingement and entrainment of aquatic organisms (6 NYCRR Part 704.5). As part of the SPDES permit renewal/modification process for continued use and operation of an intake (6 NYCRR Part 750 et seq.), measures to reduce impingement losses (e.g., further flow reduction, modified screens with fish return, reduction of flow velocities, and fish avoidance systems such as barrier nets, light and sound) and minimize entrainment losses (e.g., closed cycle cooling, flow reduction, alternate/augmented water supply, fine mesh barriers to exclude eggs and larvae) would be evaluated with respect to feasibility, effectiveness, cost, and constraints imposed by surrounding property owners and land uses such as deed restrictions or easements. Based on the evaluation during the SPDES permitting process, the NYSDEC will determine the best technology available for minimizing adverse environmental impacts at the intake structure.

WATERFRONT REVITALIZATION OF COASTAL AREAS AND INLAND WATERWAYS ACT (SECTIONS 910-921, EXECUTIVE LAW)

Under this Act, the New York State Department of State (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.

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)

The Endangered and Threatened Species of Fish and Wildlife; Species of Special Concern 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.

18.3 METHODOLOGY

The analysis of potential impacts to aquatic and terrestrial resources considered the potential effects of the Proposed Action, in years 2009 and 2015, to natural resources present under two baseline scenarios— Current Conditions and Pre-September 11. As described in greater detail in Chapter 2, "Methodology," the components that would be completed in 2009 would include the Memorial, Tower 1 (1776 Freedom Tower), retail users in the bases of the other four towers, open space areas, museums, performing arts building, and other space dedicated to cultural programs. The remaining components (Towers 2 through 5 and hotel) would be completed and operational in 2015.

18.3.1 WATER QUALITY AND AQUATIC RESOURCES

BASELINE AND FUTURE CONDITIONS WITHOUT THE PROPOSED ACTION

Baseline conditions for water quality and aquatic natural resources within the study area were summarized from:

- Existing information identified in literature and obtained from governmental and non-governmental agency sources, including the New York City Department of Environmental Protection (NYCDEP) Harbor Water Quality Survey (NYCDEP 1998, 2000, 2001, 2002, and 2003a and b); EPA National Sediment Quality Survey Database, 1980-1999 (EPA 2001); New York/New Jersey Harbor Estuary Program; EPA Regional Environmental Monitoring and Assessment Program (R-EMAP) (Adams et al. 1998), US Army Corps of Engineers (USACOE) New York District and results of numerous sampling efforts conducted by a consortium of Hudson River Utilities over the past 30 years.
- Requests for information on rare, threatened or endangered species within ½ mile surrounding the Project Site and the WTC intake/pumphouse location that were submitted to USFWS, NMFS, and the New York Natural Heritage Program (NYNHP). NYNHP, a joint venture of NYSDEC and The Nature Conservancy, maintains an ongoing, systematic, scientific inventory on rare plants and animals native to New York State. NYSDEC maintains the NYNHP files. The NYNHP database is updated continuously to incorporate new records and changes in the status of rare plants or animals. In addition to the state program, the USFWS maintains information for federally-listed threatened or endangered freshwater and terrestrial plants and animals, and NMFS for federally-listed threatened or endangered marine organisms.

The future without the Proposed Action was assessed by determining:

- Potential effects of proposed development in the vicinity of the existing WTC intake and outfall structures on the Hudson River on water quality and aquatic natural resources; and

- Potential effects of proposed or ongoing improvements on water quality and aquatic natural resources of the Lower Hudson River Estuary.

ASSESSMENT OF IMPACTS TO WATER QUALITY AND AQUATIC NATURAL RESOURCES FROM THE PROPOSED ACTION

Potential impacts to water quality and aquatic natural resources from the Proposed Action were assessed using an approach that considered the following:

- The existing water quality and aquatic natural resources within the vicinity of the WTC cooling water intake and outfall structures in the Lower Hudson River Estuary.
- Results of impingement/entrainment studies conducted during the early 1990s on behalf of the Port Authority at the WTC cooling water intake structure.
- Results of quantitative and qualitative assessments that placed impingement and entrainment losses for selected fish and invertebrate species into population contexts by using estimates of riverwide abundance, standing stock, production, or harvest size.
- Results of assessment of potential impacts to EFH.
- The SPDES permitting conditions and compliance record for the WTC cooling water system outfalls.
- The WTC intake design flow compared to the average flow record at the WTC intake pre-September 11, 2001.
- Potential effects from the discharge of stormwater during construction and operation of the Proposed Action, considering land use changes and best management practices (BMPs) to control stormwater runoff.
- Results of empirical studies conducted within or near the existing WTC intake and discharge structures on the Hudson River, or relevant studies performed in other geographic areas that relate to the Proposed Action.

Potential Effects of Impingement and/or Entrainment on Populations of Target Fish and Macroinvertebrates

The assessment of the potential for the reuse of the WTC cooling water intake structure to impact aquatic resources evaluated the potential effects to populations of target fish and invertebrate species, and EFH. As the first step of the assessment, the total number and types of fish that would be impinged or entrained were documented. These losses were then analyzed to determine if entrainment through an intake structure and into the cooling water system and/or impingement at the WTC cooling water intake had the potential to adversely affect riverwide regional populations of these species. Then the WTC intake design flow was compared to flows recorded at the intake pre-September 11.

The following sections describe the methods used to select the fish or invertebrate species (target species) to be evaluated, and various methods used to evaluate the potential effects to riverwide or regional populations from the loss of eggs, larvae, juveniles or adults at the WTC cooling water intake.

Identification of Target Species

Impingement/entrainment studies were conducted at the WTC intake on behalf of the Port Authority for a 23-month period from 1991 to 1993. The results of this study are summarized in section 18.4.5, "Probable Impacts of the Proposed Action 2015—Current Conditions Scenario," of this chapter. Numbers of fish impinged or entrained were adjusted for flow volumes withdrawn to provide monthly and annual estimates of impingement and entrainment. A subset of the total number of impinged and entrained species was identified for further analysis using the following criteria:

- The number of individuals impinged and/or entrained during the 1991 to 1993 impingement/entrainment study appeared to be large.
- The species is commercially important within New York, New Jersey and Connecticut and being managed by the Atlantic States Marine Fisheries Commission (ASMFC).
- The species is recreationally important within New York, New Jersey, and Connecticut.
- The species has been identified as of interest to state and/or federal resource agencies within the Hudson River Estuary.
- The species is representative of a particular group of fish within the Hudson River Estuary such as prey (forage), estuarine, or marine species.
- Some reasonable estimate of riverwide, regional abundance, or harvest size was available.
- Natural mortality rates were available specific to each lifestage known to be present within the Hudson River Estuary.

Table 18-1 presents the target species for which quantitative evaluations to assess potential impacts were performed. The quantitative analyses performed for the target species were judged to be sufficiently broad in covering the range of life strategies for other Hudson River species. Other fish species were evaluated qualitatively based on habitat requirements, life history information, and available information on the status of the regional population. These species include: black sea bass (*Centropristis striata)*, blueback herring (*Alosa aestivalis)*, grubby (*Myoxocephalus aenaeus)*, hogchoker (*Trinectes maculatus)*, red hake (*Urophycis chuss)*, spotted hake (*Urophycis regius),* silver hake (*Merluccius bilinearis)*, tautog (*Tautoga onitis)*, American shad (*Alosa sapidissima*), American eel (*Anguilla rostrata),* and horseshoe crab (*Limulus polyphemus).*

Methods Used to Assess the Potential Effect of Losses Due to Entrainment or Impingement at the WTC Cooling Water Intake on Populations of Target Species

Several standard quantitative methods or models were used to assess whether the potential losses of target species observed at the WTC cooling water intake during the 23-month impingement/entrainment study would affect riverwide or regional populations of these species. The first method was to simply compare the actual numbers of organisms impinged or entrained to riverwide or regional population estimates derived from literature sources. A second set of methods was used to project how impingement and entrainment losses would translate to pounds of fish and crab species lost to the fishery, and to higher trophic levels, thereby placing these losses into fishery management contexts.

Table 18-1
Aquatic Species Identified for Quantitative Evaluation of Potential Impact of the Proposed Action

Common Name	Scientific Name
Alewife	*Alosa pseudoharengus*
Atlantic menhaden	*Brevoortia tyrannus*
Atlantic tomcod	*Microgadus tomcod*
Bay anchovy	*Anchoa mitchilli*
Bluefish	*Pomatomus saltatrix*
Striped bass	*Morone saxatilis*
Weakfish	*Cynoscion regalis*
White perch	*Morone americana*
Winter flounder	*Pseudopleuronectes americanus*
Blue crab	*Callinectes sapidus*

This second set of methods used information on life stage specific natural mortality rates and durations to convert the impingement and entrainment losses of early life stages into equivalent losses of one-year-old fish. Analyses also were performed that calculated biomass (pounds) lost to the fishery. These losses were then compared to commercial landings. For fish used as prey or forage by other fish, such as bay anchovy, an assessment was made on how the loss of individual forage fish would affect the production of these fish that would be available to predatory species (production forgone).

Quantitative Methods to Estimate Fish Lost Due to Operation of WTC Intake Structure

Models used to estimate the number of 1-year old fish lost to a population, pounds lost to a fishery, or biomass (or weight) lost to predators, through the operation of the WTC cooling water intake are as follows:

- *Equivalent recruits*—Equivalent recruits, following the methodology described by Ricker (1975), is the number of impinged and entrained individuals less than 1-year old that would otherwise have survived to be 1-year old. It provides a means of converting losses of fish eggs, larvae, and juveniles less than 1-year old into units of individual 1-year old fish. Life-stage specific entrainment counts and life stage specific mortality rates from the life stage of entrainment to 1-year old are required to calculate equivalent recruits. Equivalent recruits was calculated for Atlantic menhaden, bay anchovy, striped bass, weakfish, white perch, winter flounder, and blue crab.
- *Pounds lost to the fishery*—Pounds lost to the fishery is a measure of the amount of fish (in pounds) not harvested due to fish lost to impingement or entrainment. It is based on the number of equivalent recruits (i.e., 1-year olds in this case) that were lost. Key parameters used to calculate pounds lost to the fishery include: natural mortality rate, fishing mortality rate, and weight at age (in pounds) of harvested fish. The general procedure to calculate this measure involves multiplying age-specific harvest rates by age-specific weights to calculate an age-specific expected yield (in pounds). The lifetime expected yield for a cohort (age class) of fish is the sum of all age-specific expected yields. Pounds lost to the fishery was calculated for Atlantic menhaden, striped bass, weakfish, white perch, winter flounder, and blue crab.

- *Production forgone*—Production forgone, following the methodology described by Rago (1984), is the biomass (or weight) that would have been transferred to higher trophic levels, such as predatory fish (e.g., striped bass and bluefish), through consumption of the impinged or entrained fish. It is calculated by simultaneously considering the age-specific growth increments and survival probabilities of individuals lost to impingement and entrainment. Production forgone was calculated for bay anchovy, the most abundant forage fish in the Hudson River.

Estimates of Commercial Landings, Riverwide, or Regional Population Abundance

Estimates of commercial landings, and riverwide or regional populations were used to place estimated losses from entrainment or impingement at the WTC cooling water intake into a meaningful impact assessment context, based on the following:

- Commercial landings data were compiled from the NMFS Fisheries Statistics & Economics Division. Data for landings from Connecticut, New York, and New Jersey for the same years as the 23-month impingement/entrainment study at the WTC cooling water intake, 1991 through 1993. These three states were selected to represent the regional population of a species in the New York/New Jersey Harbor Estuary and the interconnected waters of Long Island Sound.
- Estimates of the annual average number of eggs, and the average daily number of larvae and juveniles within the Hudson River for the 1991 through 1993 period, developed from the Hudson River Utilities' Hudson River Estuary Monitoring Program for Atlantic tomcod, bay anchovy, bluefish, weakfish and striped bass (ASA 2003).
- Estimates of 1-year old striped bass abundance for the Hudson River stock derived from the Hudson River Utilities' Striped Bass Mark-Recapture (SBMR) sampling program for the 1990 to 1995 year classes presented by Central Hudson Gas & Electric Corp. et al. (1999).
- Regional population estimates based on information from ASMFC, or other agencies responsible for the management of fisheries.

Qualitative Assessment of Potential Impacts to Target Species

For target species that were not assessed through the quantitative assessment methods described above, potential effects to riverwide or regional populations were assessed qualitatively, taking into consideration:

- Habitat requirements;
- Life history information;
- Information available from various sources such as NMFS, ASMFC, and other that describe the current status of the fishery or population; and
- For horseshoe crab and blue crab, comparison of the average number of individuals impinged during the 23-month impingement study with the number that could be legally collected on a daily basis in accordance with the NYSDEC Marine Recreational Fishing Laws and Regulations effective July 3, 2003.

18.3.2 TERRESTRIAL RESOURCES

Terrestrial resources within the project site were characterized using existing information. Impacts on terrestrial resources were evaluated by comparing relative habitat area present in the two baseline scenarios (Current Conditions and Pre-September 11) and two analysis years (2009 and 2015), as described in Chapter 2, "Methodology." Initial components of the Proposed Action would be completed in 2009, with full build-out completed in 2015.

In 2009, the Memorial and the related museum (southeast quadrant of the Project Site) and Tower 1, Freedom Tower (northwest corner of the Project Site), would be completed. Freedom Tower would reach a height of 1,776 feet.

By 2015, the redevelopment of the Project Site would be complete. In addition to the Memorial, museum, cultural facilities, open space, and a hotel, full development would bring the total office space to about 10 million square feet. There would be five large, modern office towers (between 56 and 70 stories of office space) ranging in area from 1.6 million to 2.6 million square feet.

Tall buildings and other structures present strike hazards for many species of birds, especially along major migration routes. New York City is situated along the East Coast Flyway, a route which millions of migratory birds fly twice a year between their tropical Central and South American overwintering grounds and North American nesting grounds. Migration is mainly south to north during spring and north to south during autumn. Collisions tend to be more common during autumn migrations when storms more frequently include low visibility conditions as a result of fog, mist, low cloud cover, and precipitation (Scott and Culter 1971).

Mirrored or reflective windows, because they reflect the surrounding environment (e.g., sky or nearby vegetation), may result in birds trying to navigate into the reflection, often resulting in collisions. Birds may be stunned, injured, or killed by striking windows in attempts to reach perceived shelter. These types of windows are fairly common in tall buildings due to architectural aesthetics and maintenance and cooling cost considerations. Among the lobbies and atriums of lower floors of buildings with indoor plants, clear windows may be seen by birds as a natural habitat, increasing the potential for birds to crash into them. In addition, lower levels of buildings are more likely to be surrounded by foliage, creating a reflection of natural habitats in mirrored windows.

Nighttime collisions with buildings and towers are more common than daytime collisions. Most species of migratory birds use the stars to navigate at night, and brightly illuminated buildings and broadcast towers can attract birds. In particular, small insectivorous (insect-eating) species such as warblers tend to fly at night to avoid predation (Schmidt-Keonig 1979). Birds drawn towards these illuminated structures may crash into them or circle them until exhaustion forces them to land. While collisions with buildings are often fatal to birds due to the speeds involved, many birds (greater than twice the number killed) are only slightly injured or temporarily stunned from the force of impact (Ogden 1996). Birds that are stunned may not survive however, if predators catch them before they can recover.

The height or altitude of migration is an important factor in the determination of the potential for collisions with structures. Migration altitudes vary depending on species, location, geographic features, season, time of day and weather (Ogden 1996). According to published reports, approximately 75 percent of neotropical migratory birds fly at altitudes between 500 and 6,000 feet during migration (e.g., Able 1999). Shorebirds generally migrate at altitudes of between 1,000 and 13,000 feet.

Evaluations of bird strike potential were made by comparing the above-ground exterior vertical surface area of the structures present between the various analysis corridors. Based on migratory altitudes published in the scientific literature and considering the existing structures surrounding the Project Site, comparisons of exterior vertical surface area were made at heights greater than 500 feet which extend into migratory bird flyways. Exterior vertical surface area was calculated by multiplying the perimeter of the building by the height extending 500 feet or higher above ground. Building dimensions of the pre-September 11 WTC structures were used and the building dimensions for the Proposed Action were taken from the conceptual designs contained in *Libeskind Studios Memory Foundations February 2003*. All sides of a structure were considered potential strike areas. Elevations below 500 feet are expected to present minor collision potential for birds as described above and were not quantified.

18.4 CURRENT CONDITIONS SCENARIO

This section provides:

- An overview of natural resources in the vicinity of the WTC cooling water intake in the Lower Hudson River Estuary (baseline condition);
- An assessment of these natural resources in the future without the Proposed Action in 2009 as described in Chapter 2, "Methodology";
- An assessment of the potential impact to the natural resources of the baseline condition in 2009 based on the elements of the Proposed Action anticipated to be completed, as presented in Chapter 2, "Methodology";
- An assessment of the natural conditions in the future without the Proposed Action in 2015; and
- An assessment of the potential impact to the natural resources of the baseline condition in 2015 when the Proposed Action is fully constructed and operational, as described in Chapter 2, "Methodology."

18.4.1 BASELINE CONDITIONS

AQUATIC RESOURCES

The WTC cooling water intake and outfalls proposed for reuse as part of the Proposed Action, are located at the Battery, in the Lower Hudson River Estuary. The Lower Hudson River Estuary is part of New York/New Jersey Harbor Estuary (region where fresh and saltwater mix), which also includes upper and lower New York Harbor, the East River, Kill van Kull, the Arthur Kill, Raritan Bay and Jamaica Bay. The Hudson River is the largest single freshwater input to this coastal plain estuary. It begins in the Adirondack Mountains of northern New York, and discharges to upper New York Harbor at the southern tip of Manhattan. The Lower Hudson River Estuary extends approximately 150 miles upriver from the southern tip of Manhattan to the Federal Dam at Troy, New York. The river gradient within the Lower Hudson River Estuary is very low, rising only 5 feet, and is tidally influenced throughout this extent (Moran and Limburg 1986).

Near the southern tip of Manhattan the Hudson River is relatively straight and approximately 1 mile wide. The USACOE maintains the channel in the river at a navigable depth (minimum depth from 30 to 36 feet) through periodic dredging. Within the vicinity of the WTC cooling water intake and outfall, the Hudson River is influenced by tides that have a range of approximately 4 to 4.5 feet (1.2 to 1.4 meters) (NOAA 1994). The shoreline within the vicinity of the WTC cooling water intake and outfalls is engineered, with concrete seawall and/or steel sheetpile installed during the development of Battery Park City.

Hydrology

Salt water and tides dominate the flows and physical characteristics of the Lower Hudson River Estuary. The estuary receives salt water from Upper New York Harbor during the flood phase of a tidal cycle, discharging less saline water to the Upper Harbor during the ebb phase (Moran and Limburg 1986). The Lower Hudson River Estuary is partially stratified; more saline waters are generally found toward the bottom and fresher waters toward the surface. On average, salinity increases 10 percent from the top of the water column to the bottom layers. However, under low freshwater flow conditions the fresh and saline waters are generally well mixed (Busby and Darmer 1970).

The estimated lower Hudson River freshwater flow is approximately 19,000 to 20,000 cubic feet per second (cfs) (Moran and Limburg 1986). Average fresh water flows are highest in the early spring (April, about 43,000 cfs) and lowest in late summer (August, about 6,000 cfs) (LMS 1992; NYSDOT 1994). Tidal flows range from 200,000 to 500,000 cfs, and are far larger than the fresh water flows in the lower Hudson River (NYSDOT 1994). Mean tidal flow near the southern tip of Manhattan has been estimated at 425,000 cfs (Moran and Limburg 1986). The Lower Hudson River Estuary has a semidiurnal tide (two high and two low tides per day) (NOAA 1994).

Tidal current velocity in midstream near downtown Manhattan is 0.98 meters per second (m/sec) (3.2 feet per second [ft/sec]) at spring tide high water, and 1.44 m/sec (4.7 ft/sec) at spring tide low water, and represent the maximums normally encountered each month at the full and new moons (AKRF et al. 1993). Tidal currents between the bulkhead and pierhead line would be less than the maximum velocities measured in the main channel. Flushing time in the Lower Hudson River Estuary ranges from 15 days during spring high river flows to 45 to 60 days during the summer low flow conditions (Brosnan and O'Shea 1995).

Water Quality

6 NYCRR Part 703 includes surface water standards for each use class of New York surface waters. The lower Hudson River is Use Class I saline surface waters. Best usages for Use Class I waters are secondary contact recreation and fishing. Water quality should be suitable for fish propagation and survival. Water quality standards for Use Class I saline surface waters include:

- Fecal coliform—Monthly geometric mean less than or equal to 2,000 colonies/100 milliliter (mL) from 5 or more samples;
- Total coliform—Monthly geometric mean from a minimum of 5 examinations shall not exceed 10,000 colonies/100 mL;
- Dissolved oxygen (DO)—Never less than 4.0 milligrams per liter (mg/L); and
- pH—The normal range shall not be extended by more than 0.1 of a pH unit.

The City of New York has monitored New York Harbor water quality with an annual survey (Harbor Survey) for over 90 years. NYCDEP conducts the survey by collecting water samples at stations in four designated regions: Inner Harbor Area, Upper East River-Western Long Island Sound, Lower New York Bay-Raritan Bay, and Jamaica Bay (NYCDEP 2002). The WTC cooling water intake and outfalls are located in the Inner Harbor Area, which includes the lower

Hudson River to the Harlem River, the East River to the Battery, Kill Van Kull and the Arthur Kill, and the Upper New York Harbor south to the Narrows.

As part of the Harbor Survey, NYCDEP collects samples to evaluate water quality, sediment characteristics, hydrology, phytoplankton, and macroinvertebrates two to four times in the summer months and once each in October, February, March and April (NYCDEP 2000, 2001). Water quality parameters include temperature, salinity, density, DO, water clarity, pH, total suspended solids (TSS), nutrients, chlorophyll a, plankton and coliforms. The results of the annual Harbor Survey are used by NYSDEC to determine use classifications for waterbodies within the Survey. The following discussion of water quality in the vicinity of the WTC cooling water intake and outfalls within the Lower Hudson River Estuary is based on Harbor Survey data from 1998 to 2002.

Water temperature and salinity affect spatial and seasonal distribution of aquatic species. Water temperature also affects oxygen solubility, respiration, and biological and chemical processes within the water column and sediment. Salinity, which fluctuates in response to tides and freshwater discharges, affects water density along with temperature, and can affect vertical stratification of the water column. Average temperatures within the Upper Bay range from about 3.7 to 23.8°C (39 to 75°F) (USACOE 1999). Within the Upper New York Harbor, higher salinity bottom waters tend to be somewhat warmer than the less saline surface waters during the winters months; with the opposite being true during the summer. Temperatures in the lower Hudson River during the 1998 through 2002 Harbor Surveys ranged from approximately 3 to 25°C (37 to 77°F).

Ristich et al. (1977) classified the Lower Hudson River Estuary, including the area in the vicinity of the WTC intake and outfalls, as polyhaline (18 to 30 parts per thousand (ppt)) in late summer and fall and mesohaline (5 to 18 ppt) in spring and early summer. Salinity measurements taken in the lower Hudson River near the southern tip of Manhattan, between 1998 and 2002, generally ranged from about 8 to 30 ppt with bottom water salinity averaging 5.6 ppt greater than surface water salinity. Periodic high freshwater flows in extremely wet years can occasionally create oligohaline conditions (salinity less than 5 ppt) for relatively short periods.

The results of recent Harbor Surveys (NYCDEP 2001, 2002) 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 the Harbor Survey station closest to the WTC intake and outfalls, mid-stream near Pier A just south of Battery Place, indicate that the water quality in this part of the lower Hudson River is generally good. All pH levels in the New York Harbor Area are in attainment. The following section provides a brief summary of the water quality conditions in the sampling region (Inner Harbor Area) of the Harbor Survey that includes the WTC cooling water intake and outfalls. Table 18-2 presents a summary of water quality measurements at the Pier A station (Station N5) from 1998 to 2002.

Table 18-2
NYCDEP Water Quality Data for the Pier A Sampling Station in the Hudson River (1998–2002)

Parameter	Top Waters			Bottom Waters		
	Low	High	Avg	Low	High	Avg
Total Fecal Coliforms (per 100 mL)	1	1,720	138.6	2	280	43.4
Dissolved Oxygen (mg/L)	42.	12.3	7.1	3.5	10.9	6.5
Secchi Transparency (ft)	1.5	8	4.3	NA	NA	NA
Chlorophyll *a* (µg/L)	0.5	39.1	4.8	NM	NM	NM
Salinity (ppt))	2.1	28.6	19.5	2.9	31.6	25.0
Temperature (°C)	3.1	25.5	17.7	3.4	25.0	17.3

Notes: NM = not measured, NA = not applicable
Source: NYCDEP 2003b.

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. According to the 1999, 2000 and 2001 New York Harbor Water Quality Regional Summaries (NYCDEP 2000, 2001, 2002), the waters of the Inner Harbor Area, meet the fecal coliform standard at most sampling locations. Temporary increases in fecal coliform concentrations may occur during wet weather due to increased fecal coliform loadings following a rain event. In years 1998 to 2002, fecal coliform concentrations near the project area ranged from 1 to 1,720 colonies/100 mL and averaged 138.6 colonies/100 mL in top waters and 43.4 colonies/100 mL in bottom waters (NYCDEP 2003b) and were well below the water quality standard.

DO in the water column is necessary for respiration by all aerobic forms of life, including fish and such invertebrates as crabs, clams, and zooplankton. The bacterial breakdown of high organic loads from various sources can deplete DO to low levels 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 above 5 mg/L in 2001, a value fully supportive of ecological productivity (NYCDEP 2002). In the period 1998 to 2002, DO concentrations near the WTC cooling water intake, Pier A station, were above the 4 mg/L standard for Use Class I waters in top waters, but fell below the standard in bottom waters in 2 of 76 measurements (NYCDEP 2003b).

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. Concentrations greater than 20 micrograms per liter (µg/L) are considered suggestive of eutrophic conditions. From 1998 to 2002 chlorophyll-a concentrations in the vicinity of the WTC cooling water intake and outfalls ranged from 0.5 to 39.1 µg/L, and averaged 4.8 µg/L. Chlorophyll-a exceeded 20 µg/L in only 1 of 78 measurements (NYCDEP 2003b).

Secchi transparency is a measure of the clarity of surface waters. Transparency greater than 5 feet 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 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. Secchi transparency near the project area between 1998 and 2002 ranged from 1.5 to 8 feet. Of the 82 measurements taken in this time period, 16 were less than 3 feet, indicating that water quality in this area is periodically impaired by reduced water transparency (NYCDEP 2003b).

Two sampling areas from the Contamination Assessment and Reduction Project (CARP) being conducted by the NYSDEC as part of the New York/New Jersey Harbor Estuary Program, are near the WTC cooling water intake: Hudson River below Harlem River (HRSHAR), and Upper New York Harbor (UPB) to the south of the southern tip of Manhattan. A trace organics platform sampler (TOPS) was used in 1998 and 1999 to sample the water column for trace organics (pesticides, dioxin, methyl mercury, polycyclic aromatic hydrocarbons (PAHs)) (Donlon et al. 1999). Samples from the HRSHAR sampling area exceeded the NY State standards for benzo(b,k)fluoranthene in 1999, but not in 1998 (Litten et al. 1999). Other trace contaminants reported in samples from the HRSHAR site include mercury, methylmercury, cadmium, polychlorinated biphenyls (PCBs), and the pesticides DDT, chlordane, and dieldrin. (Litten and Fowler 1999). Samples from the UPB sampling area contained measurable concentrations of three pesticides (DDT, chlordane, and dieldrin), methyl mercury, dissolved mercury, PCBs, and dioxin (Litten and Fowler 1999, Litten et al. 1999). The PAHs measured at the UPB area were below their respective standards both sampling years (Litten et al. 1999).

Sediment Quality

Complex flow patterns lead to widely variable sediment characteristics throughout the area. Upper New York Harbor has the most complex distribution of sediments in the area because of variable currents and a high degree of sediment input due to natural and human actions. The USACOE (1999) reports that sediments in Upper New York Harbor vary from coarse sands and gravels in high-energy areas to fine-grained silts and clays in low-energy areas. The primary constituents of Hudson River sediments are silt and clay (USACOE 1996, EEA 1988).

Typical of any urban watershed, New York Harbor Estuary sediments are contaminated due to a history of industrial uses in the area. Contaminants found throughout the New York Harbor Estuary include pesticides such as chlordane and DDT, metals such as mercury, cadmium, lead, and copper, PCBs and various polycyclic aromatic hydrocarbons (Rohmann and Lilienthal 1987). Adams et al. (1998) found the mean sediment contaminant concentration for 50 of 59 chemicals measured in sediment samples from the New York/New Jersey Harbor Estuary to be statistically higher than other coastal areas on the East Coast. Within the New York/New Jersey 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).

Aquatic Biota

The New York/New Jersey Harbor Estuary, including the Lower Hudson River Estuary, supports a diverse and productive aquatic community of over 100 species of finfish, more than

100 different invertebrates, and a variety of phytoplankton and zooplankton. The following sections provide a brief description of the aquatic biota found in the Harbor Estuary, focusing on the Lower Hudson River Estuary. While the following description is based on studies that have been conducted in this area from the 1980s through the present, the aquatic community is generally considered to have been stable over the this period, although there is considerable annual and seasonal variability, and the description of existing conditions presented below would apply to current and pre-September 11, 2001 baseline conditions.

Phytoplankton

Phytoplankton are microscopic plants whose movements within the system are largely governed by prevailing tides and currents. Several species can obtain larger sizes as chains or in colonial forms. Light penetration, turbidity and nutrient concentrations are important factors in determining phytoplankton productivity and biomass. While nutrient concentrations in most areas of New York Harbor are very high, low light penetration has often precluded the occurrence of phytoplankton blooms.

In a 1993 survey of New York Harbor, 29 taxa of phytoplankton were identified, with the diatom *Skeletonema costatum* and the green algae *Nannochloris atomus* determined to be the most abundant species at the monitored sites (Brosnan and O'Shea 1995). The average summer cell counts in that year ranged from 6,300 to 97,000 cells/mL. Residence times of phytoplankton species within New York Harbor are short and species move quickly through the system. Therefore, studies conducted at locations throughout the Harbor showing various species indicate that these same species would also likely be present within the Lower Hudson Estuary in the vicinity of the WTC intake and outfalls.

A 1990-1992 study (Lonsdale and Cosper 1994) indicated that the phytoplankton community in New York coastal waters, including the Lower Hudson Estuary, is dominated by diatoms in late winter to early spring, and then by smaller forms. Throughout most of 1991 and 1992, the diatoms *Skeletonema costatum* and *Thalassiosira* spp. were the dominant phytoplankton compared with all other species enumerated. Most notable was a bloom of *S. costatum* during March 1992. Dinoflagellates also comprised a large portion of the phytoplankton community. Among dinoflagellates, *Prorocentrum* spp. were usually most common.

Submerged Aquatic Vegetation and Benthic Algae

Submerged aquatic vegetation (SAV) are rooted aquatic plants that are often found in shallow areas of estuaries. These organisms are important because they provide nursery and refuge habitat for fish. Benthic macroalgae are large multicellular algae that are important primary producers in the aquatic environment. They occur on rocks, jetties, pilings, and sandy or muddy bottoms (Hurley 1990). Since these organisms require sunlight as their primary source of energy, the limited light penetration of New York Harbor limits their distribution to shallow areas. Light penetration, turbidity and nutrient concentrations are all important factors in determining SAV and benthic algae productivity and biomass.

Within the Hudson River, SAVs are generally restricted to shallow bays and shoal areas at the mouths of tributaries in less than 3 meters (10 feet) of water (Moran and Limburg 1986), and are rare in the Upper Bay (Dames and Moore 1983). Within the Lower Hudson River Estuary, light limitation, turbidity, frequent dredging activities, and the soft substrate make the habitat generally unsuitable for SAV colonization. Two green macroalgae and two red macroalgae were documented in an underwater recolonization study at Battery Park City (LMS 1980). Benthic macroalgae documented in the Hudson River Park include sea lettuce, green fleece, and brown algae *Fucus* spp. (PBS&J 1998).

Zooplankton

Zooplankton are an integral component of aquatic food webs—they are primary grazers on phytoplankton and detritus material, and are themselves used by organisms of higher trophic levels as food. The higher-level consumers of zooplankton typically include forage fish, such as bay anchovy, as well as commercially and recreationally important species, such as striped bass and white perch during their early life stages. Predacious zooplankton species can consume eggs and larvae, and can have a detrimental effect on certain fish species.

Zooplankton studies conducted in New York Harbor found crustacean taxa to be the most prevalent form of zooplankton in collected samples. 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, Lauer 1971, Hazen and Sawyer 1983). In the Lower Hudson River Estuary, copepods are the dominant mesozooplankton (retained on a 200 micrometer mesh (µm) sieve) group throughout the year (Stepien et al. 1981). Data collections in lower Hudson River channel and interpier habitats show that barnacle larvae are abundant in interpier areas in spring, copepods and rotifers were more abundant in channel than interpier areas in summer, and copepods continue to be less abundant in interpier areas in the fall and winter (Malcolm Pirnie, Inc. 1982). Common macrozooplankton (retained on a 505 µm sieve) include mysid shrimp (*Neomysis americana*), cumaceans, and amphipods.

Benthic Invertebrates

Invertebrate organisms that inhabit river bottom sediments as well as surfaces of submerged objects (such as rocks, pilings, or debris) are commonly referred to as benthic invertebrates. These organisms are important to an ecosystem's energy flow because they convert detrital and suspended organic material into carbon (or living material); moreover, they are also integral components of the diets of ecologically and commercially important fish and waterfowl species. In addition, benthic invertebrates are also essential in promoting the exchange of nutrients between the sediment and water column.

Benthic invertebrates include those that can be retained on a 0.5 millimeter (mm) screen (macroinvertebrates) as well as smaller forms, such as nematodes (a class of roundworm) and harpacticoid copepods (order of copepods that are primarily benthic) called meiofauna. Some of these animals live on top of the substratum (epifauna) and some within the substratum (infauna). Substrate type (rocks, pilings, sediment grain size, etc.), salinity, and dissolved oxygen levels are the primary factors influencing benthic invertebrate communities; secondary factors include currents, wave action, predation, succession, and disturbance.

A number of studies regarding the distribution and abundance of benthic invertebrates have been conducted in New York Harbor. Two studies report collections of benthic macroinvertebrate infauna collected in the lower Hudson River by grabs (EEA 1988, EA Engineering Science and Technology 1990). In addition, Coastal (1987) and PBS&J (1998) summarized benthic macroinvertebrate fauna collected from past studies from the southern tip of Manhattan to the George Washington Bridge. The major groups of organisms collected included aquatic earthworms (oligochaetes), segmented worms (polychaetes), snails (gastropods), bivalves, barnacles, cumaceans, amphipods, isopods, crabs, and shrimp.

Iocco et al. (2000) found that the dominant macroinvertebrates varied seasonally and the number of invertebrates increased from June to October. Further, they found that the number and species of benthic invertebrates was similar between shallow water habitats (7 to 18 feet deep), middle depth habitats (19 to 32 feet deep), and deep water or channel areas (33 to 40 feet deep). Ongoing sampling within the Hudson River Park—initiated to record changes to the aquatic community after the emergency dredging that occurred near Pier 25 following September 11, 2001—has collected 116 benthic macroinvertebrates. These taxa included 40 different polychaetes, 3 oligochaetes, 37 crustaceans, and 31 mollusks. From 2002 to 2003, abundance and species richness at the area dredged near Pier 25 has become more similar to non-dredged areas (Meixler et al. 2003).

Epifauna encrust pilings and other structures in the river. Divers observed rock surfaces in the vicinity of Battery City Park (LMS 1980b). The greatest amount of rock surfaces was covered by barnacles (*Balanus improvisus*) and sand-builder worms (*Sabellaria vulgaris*). Large areas of a wall were covered by a sea squirt (*Molgula manhattensis*) and the ghost anemone (*Diadumene leucolena*). Other abundant invertebrates included bryozoans, sand shrimp (*Crangon septemspinosa*), hermit crabs (*Pagurus longicarpus*), and rock crabs (*Cancer irroratus*). Many of the invertebrate species were known prey for fish inhabiting the area.

Some of the largest invertebrates are captured in fish trawls and traps rather than in grabs or on artificial substrata. These invertebrates typically include crabs, large snails, and shrimp. EA Engineering Science and Technology (1990) reported mud dog whelks (*Ilyanassa obsoleta*), sand shrimp, and blue crabs (*Callinectes sapidus*). Others included three species of mud crabs (xanthids), a rock crab, horseshoe crabs (*Limulus polyphemus*), blue mussel (*Mytilus edulis*), soft shelled clams, and a sea slug (nudibranch) as invertebrate species. Invertebrates collected on the WTC cooling water intake from 1991 to 1993 were generally representative of those known to occur in the Lower Hudson River, including blue crab, sand shrimp, grass shrimp, marine mud crab (*Rhithropanopeus harrisii*), horseshoe crab, lady crab (*Ovalipes ocellatus*), spider crab (*Libinia emarginata*), common rock crab (*Cancer irroratus*) and green crab (*Carcinus maenas*) (LMS 1994).

Two marine taxa of destructive wood borers, *Limnoria* and *Teredo* spp., have attracted recent local attention because of their reappearance in the Hudson River. The reappearance has been attributed to better water quality (higher levels of DO and lower levels of toxic substances) that allows them to grow and thrive in the lower Hudson River (WRI 1994). Piers in some parts of the lower Hudson River have severe structural problems due to borers (Berndt and Bognacki 1991).

The following sections describe life history information for the two invertebrates selected as target species: horseshoe crab and blue crab.

Horseshoe crab—Horseshoe crab is an important commercial fishery in the mid-Atlantic, and is managed by the ASMFC. Horseshoe crabs are harvested for use as bait in the American eel and conch pot fisheries, and to a lesser extent as catfish bait, and for use in the biomedical industry. Individuals collected for the biomedical industry are bled and released; mortality from biomedical use has been estimated at 20,000 to 37,500 horseshoe crabs per year. Commercial landings are only compiled for the bait fishery. Fishing effort is concentrated within the mid-Atlantic area in New Jersey, Delaware, Maryland, and Virginia waters and federal waters adjacent to these states (ASMFC 1998a). As part of the management plan for this species, the ASMFC has set harvest thresholds for crab bait landings for each state (ASMFC 2003a).

In addition to their commercial importance, horseshoe crabs are important to migrating shorebirds that feed on the eggs during the spring. Horseshoe crabs are also an important food source for finfish, and the federally-listed threatened Atlantic loggerhead turtle. The Delaware Bay is reported to be an important breeding location for horseshoe crabs and is also the second largest staging area for shorebirds in North America. Intertidal sandy beaches with porous, well oxygenated sediment provide essential spawning habitat and are considered the most critical habitat for this species. The nearshore, shallow water, intertidal, and subtidal flats within the vicinity of spawning beaches are considered essential habitat for the development of juvenile horseshoe crabs. Larger juveniles and adults use deep water areas for feeding habitat. Because this species matures slowly, and is easily harvested, populations are sensitive to harvest pressure. While data from the Delaware Bay appear to show a decreasing trend in abundance from 1990 to 1997, the ASMFC concluded that the mid-Atlantic population has remained stable. The horseshoe crab tolerates a wide range of environmental conditions in waters with salinities greater than 6 ppt, but is generally collected in waters shallower than 20 meters (66 feet). Adults migrate from deep bay waters to spawn on sandy beaches from March through July. Beaches of the Delaware and Chesapeake bays are preferred spawning locations because wave action is low; minimizing stranding. Individuals spawn multiple times, with females laying up to 4000 eggs in a cluster, buried in the sand. Eggs hatch in 14 to 30 days, and egg and larval mortality is believed to be substantial. Larvae settle in shallow water next to the spawning beach to molt, and juveniles generally spend the first and second summer on the intertidal flats near breeding beaches. Although older individuals move out of intertidal areas to a few miles offshore, some reside in coastal bays year-round. Within the New York/New Jersey Estuary, areas that support spawning include Long Island Sound (Peconic Estuary), Jamaica Bay, and Raritan Bay (ASMFC 1998a).

Blue crab—Although blue crab support a local commercial and recreational fishery, there is little published data about them in the Hudson River estuary. The Hudson River blue crab fishery is active primarily in the summer and fall. An estimated 12 out of the 705 crab permits held in New York may be for holders that fish in the Hudson River Estuary. New York has had a moratorium on crab permit holders since 1999. Blue crab is believed to be found throughout the Hudson River Estuary and has been collected from near the southern tip of Manhattan up to Albany, New York. Eggs are released in the higher salinity waters of the lower estuary in the summer, and newborn crab larvae (zoea) are carried out to the near shore ocean where they continue to develop through 10 to 12 molts. By the time they are about 10 to 20 mm (0.4 to 0.8 inches) in size they have re-entered the estuary, appearing on power plant intakes upriver from Haverstraw Bay to Newburgh Bay in August or September (Kenney 2002, Normandeau 1998 and 2000 in Kenney 2002). As water temperature drops in late fall, crabs feed less, stop molting, and are believed to head toward deeper water as they do in the Chesapeake and Delaware estuaries. In the Hudson River, female crabs become sexually mature before they are 125 mm wide (5 inches) (Kenney 2002).

<u>Fish</u>

New York City is located at the convergence of several major river systems, all of which connect to the New York Bight portion of the Atlantic Ocean. This convergence has resulted in a mixture of habitats in the Harbor Estuary and Lower Hudson River Estuary that supports 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). Table 18-3 presents the fish species that have been caught in the New York Harbor between 1982 and 2003.

Table 18-3
Finfish Species Caught in New York Harbor 1982–2003

Common Name	Scientific Name
Alewife	*Alosa pseudoharengus*
American eel	*Anguilla rostrata*
American sand lance	*Ammodytes hexapterus*
American shad	*Alosa sapidissima*
Atlantic cod	*Gadus morhua*
Atlantic croaker	*Micropogonias undulatus*
Atlantic herring	*Clupea harengus*
Atlantic mackerel	*Scomber scombrus*
Atlantic menhaden	*Brevoortia tyrannus*
Atlantic moonfish	*Selene setapinnis*
Atlantic needlefish	*Strongylura marina*
Atlantic seasnail	*Liparis atlanticus*
Atlantic silverside	*Menidia menidia*
Atlantic sturgeon	*Acipenser oxyrhynchus*
Banded killifish	*Fundulus diaphanus*
Bay anchovy	*Anchoa mitchilli*
Black sea bass	*Centropristis striata*
Blackfish	*Tautoga onitis*
Blueback herring	*Alosa aestivalis*
Bluefish	*Pomatomus saltatrix*
Butterfish	*Peprilus triacanthus*
Clearnose skate	*Raja eglanteria*
Conger eel	*Conger oceanicus*
Crevalle jack	*Caranx hippos*
Cunner	*Tautogolabrus adspersus*
Fawn cusk eel	*Lepophidium cervinum*
Feather blenny	*Hypsoblennius hentzi*
Fourbeard rockling	*Enchelypus cimbrius*
Foureye butterflyfish	*Chaetodon capistratus*
Four-spot flounder	*Paralichthys oblongus*
Gizzard shad	*Dorosoma cepedianum*
Goosefish	*Lophius americanus*
Grey snapper	*Lutjanus griseus*
Grubby	*Myoxocephalus aenaeus*
Hickory shad	*Alosa mediocris*
Hogchoker	*Trinectes maculatus*

Table 18-3 (cont'd)
Finfish Species Caught in New York Harbor 1982–2003

Common Name	Scientific Name
Inshore lizardfish	*Synodus foetens*
Lined seahorse	*Hippocampus erectus*
Little skate	*Raja erinacea*
Longhorn sculpin	*Myoxocephalus octodecimspinosus*
Lookdown	*Selene vomer*
Mummichog	*Fundulus heteroclitus*
Naked goby	*Gobiosoma bosci*
Northern kingfish	*Menticirrhus saxatilis*
Northern pipefish	*Syngnathus fuscus*
Northern puffer	*Sphoeroides maculatus*
Northern searobin	*Prionotus carolinus*
Orange filefish	*Aluterus schoepfi*
Oyster toadfish	*Opsanus tau*
Planehead filefish	*Monacanthus hispidus*
Pollock	*Pollachius virens*
Rainbow smelt	*Osmerus mordax*
Red hake	*Urophycis chuss*
Rock gunnel	*Pholis gunnellus*
Rough scad	*Trachurus lathami*
Scup	*Stenotomus chrysops*
Seaboard goby	*Gobiosoma ginsburgi*
Sheepshead	*Archosargus probatocephalus*
Short bigeye	*Pristigenys alta*
Silver hake	*Merluccius bilinearis*
Silver perch	*Bairdiella chrysoura*
Smallmouth flounder	*Etropus microstomus*
Spot	*Leiostomus xanthurus*
Spotfin butterflyfish	*Chaetodon ocellatus*
Spotted hake	*Urophycis regia*
Striped bass	*Morone saxatilis*
Striped burrfish	*Chilomycterus schoepfi*
Striped cuskeel	*Ophidion marginatum*
Striped killifish	*Fundulus majalis*
Striped mullet	*Mugil cephalus*
Striped searobin	*Prionotus evolans*
Summer flounder	*Paralichthys dentatus*

Table 18-3 (cont'd)
Finfish Species Caught in New York Harbor 1982–2003

Common Name	Scientific Name
Tautog	*Tautoga onitis*
Threespine stickleback	*Gasterosteus aculeatus*
Tomcod	*Microgadus tomcod*
Weakfish	*Cynoscion regalis*
White hake	*Urophycis tenuis*
White mullet	*Mugil curema*
White perch	*Morone americana*
Windowpane	*Scophthalmus aquosus*
Winter flounder	*Pseudopleuronectes americanus*
Yellowtail flounder	*Limanda ferruginea*
Sources: Woodhead 1990; EEA 1988; EA Engineering, Science & Technology 1990; LMS 1994, 1999, 2002, 2003a, 2003b; Able et al. 1995	

According to Woodhead (1990), populations of numerically dominant fish within the Harbor Estuary (hogchoker, Atlantic tomcod, winter flounder, white perch and striped bass) remain relatively stable from year to year. Stoeker et al. (1992) reported striped bass, summer flounder, winter flounder, American eel, alewife, American shad, Atlantic tomcod, white perch and hogchoker to be the most frequently collected fish species during sampling of interpier areas in the vicinity of Pier 79 from February 1986 to March 1988. Stoeker et al. (1992) observed that within the vicinity of Pier 79, the same four fish species (striped bass, white perch, winter flounder, and Atlantic tomcod) comprised about 88 to 90 percent of the fishes collected from December to March in 1982-1983 as part of the Westway Highway project, and from December to March in 1986 to 1987 for the Hudson River Center Project. Although there are differences in abundance of fish among years and seasons, field investigations conducted by Able et al. (1995) in the Lower Hudson River Estuary (Piers 40 and 76) in 1993 and 1994 found that the composition and distribution of fish were similar to those reported in previous studies such as Beebe and Savidge (1988). Nine species comprised nearly 95 percent of the total number of fish collected, with juvenile striped bass the most abundant followed by Atlantic tomcod, American eel, seaboard goby, cunner, northern pipefish, naked goby, winter flounder, and tautog. Sampling conducted within the Hudson River Park to track changes to the aquatic community over time following the emergency dredging that occurred near Pier 25 following September 11, 2001 (Meixler et al. 2003), recorded 41 fish species within the Park. The most abundant species were bay anchovy (87 percent), striped bass (4 percent), Atlantic herring (4 percent), and alewife (2 percent). Bay anchovy adults are known to occur in high numbers in the Lower Hudson River Estuary in the summer, and are generally absent from the estuary in the winter (Woodhead et al. 1992).

Results of sampling conducted for the Hudson River Utilities (ASA 2003) in the Lower Hudson River Estuary, has also found that the same dominant fish species have been collected in the monitoring program since the mid-1980s, although considerable variability occurs from year to year. On the basis of the long sampling record for the Hudson River Utilities studies and the results of other studies of the Hudson River Estuary, it was concluded that there was no evidence of any substantial long-term changes in composition or abundance of the fish community from the mid-1970s onward (ASA 2003). Sampling conducted by the USACOE from 2002 to 2003 (LMS 2003b) found the most common fish collected in the Upper Bay to be striped bass (December through January), winter flounder (February), windowpane flounder (February through March), spotted hake (April) and bay anchovy (May through June). Atlantic menhaden, bay anchovy, windowpane, and winter flounder, species that spawn in the Harbor, occurred in high densities during their spawning period (March through July).

Ichthyoplankton sampling conducted in the New York Harbor by the USACOE from December 2000 through June 2001 (USACOE 2002) collected 26 species, with the greatest abundance of species in May and June. Ichthyoplankton species composition and abundance was found to be similar between navigation channel sampling locations and shoal/shallow water stations. The number of eggs and larvae was greatest in June. Windowpane flounder eggs were the dominant lifestage collected, followed by tautog and cunner eggs. Other eggs collected were Atlantic menhaden, bay anchovy, hogchoker, weakfish, summer flounder and winter flounder. Yolk- sac larvae were collected from January through May, dominated by Atlantic menhaden. Post yolk-sac larvae were collected during every month, with highest densities in May and June, dominated by winter flounder, weakfish, grubby and herrings. Juveniles were collected in December, January and April through June, with Atlantic tomcod collected from April through June. Early lifestage of winter flounder were present from February through June, but density was highest in April and May, and eggs were only collected in the upper Harbor. Subsequent sampling conducted by the USACOE in 2001-2002, and 2002-2003 suggested that winter flounder eggs were laid primarily in the Lower New York Bay, followed by the Upper Bay, and to a lesser degree in other areas of the New York/New Jersey Harbor Estuary (LMS 2003b).

The results of the 2002-2003 USACOE sampling program suggest eggs to be the most abundant lifestage, with winter flounder eggs dominating the Upper Bay samples from February through March. Windowpane flounder eggs dominated catches from April through June, and bay anchovy eggs in July. Winter flounder yolk-sac larvae was the most abundant of this life-stage in the Upper Bay from March through May, and Atlantic menhaden in June. Atlantic herring was the most abundant post-yolk-sac larvae in the Upper Bay in March, and winter flounder from April through May. Atlantic menhaden and windowpane flounder post yolk-sac larvae were common in June. Bay anchovy post-yolk-sac larvae dominated Upper Bay catches in July.

Several studies have compared fish communities from interpier, underpier, and pile field areas (EEA 1988, EA Engineering, Science and Technology 1990, Able et al. 1995, Able et al. 1998, Able et al. 1999, and Duffy-Anderson and Able 1999) in the lower Hudson River (north of the WTC cooling water intake and outfalls) between Piers 32 and 49. Able et al (1998) observed that most of the fish caught in traps from May through October underpier, in pile fields and open-water shallow areas (less than 5 meters (16 feet)), were juveniles, suggesting the lower Hudson River is used as a nursery habitat for a variety of fish during this period of the year. Atlantic tomcod and winter flounder juveniles dominated the catches in the early summer, while striped bass dominated the collections in late summer and early fall. The number and variety of fish was found to be significantly lower under piers, where American eel dominated the species caught. Abundance and variety of species was greatest in the pile fields and open-water habitats. Able et al. (1998) concluded that habitat quality under platforms greater than 20,000 square meters (5 acres) appears to be poor for juvenile fish, compared to pile fields and open water habitats. In related studies, Duffy-Anderson and Able (1999) observed reduced growth rates in winter flounder and tautog held under piers (similar to starvation conditions) even though sufficient prey items appeared to be available, compared to growth rates for these same two species when held at the pier edge or open water areas. Similarly, Able et al. (1999) found growth rates under piers to be significantly reduced for winter flounder and tautog, compared to pile fields and open water habitats. Overall, the results of these studies suggest that fish movement between the interpier and underpier areas is necessary for feeding and growth.

The following sections present life history information for the marine, estuarine, anadromous, and catadromous target fish species selected for evaluation.

Winter flounder—Winter flounder is a relatively small, thick flatfish that reach lengths of 8 to 10 inches within 2 to 3 years and only rarely reach lengths of 18 inches or more (Bigelow and Schroeder 1953). This species is a popular sport and commercial fish (managed by the ASMFC), and was found between piers 76 and 81 in 23 of 25 months sampled (EEA 1988). Winter flounder spawn in mid-winter in the shallows primarily in the Lower New York Harbor and New York Bight. Larger flounder generally leave the estuary as temperatures increase in the summer, but many juveniles may remain in the harbor. Winter flounder abundance increases again in the fall as adults return and juveniles recruit to the population in November and December. Winter flounder is common throughout the Hudson River estuary south of Spuyten Duyvil (Woodhead 1990). Winter flounder is currently experiencing high fishing rates that are in excess of natural production (annual exploitation rates from 55 to 70 percent). New York winter flounder is part of the Southern New England/Mid-Atlantic stock unit, which was found to be overfished. The 2001 exploitation rate was 37 percent (ASMFC 2002a). The lifestages with the potential to occur in the vicinity of the WTC intake include adults, eggs, larvae and juveniles.

Weakfish—Weakfish, a member of the drum family, is a popular sport fish and common summer resident in the lower Hudson. This species is also commercially fished (managed by the ASMFC) in New York State waters. It has been reported as far north as Indian Point and Croton Creek (Smith 1985; Esser 1982). Weakfish winter in offshore waters, generally from the Chesapeake Bay south to Cape Fear, North Carolina. As inshore waters warm in the spring, older individuals move toward the shore and head north, followed by successively younger groups of adults. Spawning in the New York Bight generally occurs from May to mid-July. The eggs are buoyant and newly hatched larvae swim shoreward into bays and estuaries. Peak juvenile abundance in the Hudson River is mid-July, with juveniles occurring between the Battery and Indian Point, and concentrated in the Croton-Haverstraw area. They can be found in the river through about October as they gradually emigrate from the estuary (ASA 2001). NYSDEC (2003) has identified weakfish as a Hudson River species that has been declining in abundance. Commercial and recreational landings of weakfish have decreased since the 1980. Since 1994, the commercial fishery has maintained itself at around 7 to 8 million pounds, in response to harvest restrictions. Since 1990, recreational landings have fluctuated between 1 and 2 million pounds, in response to harvest restrictions (ASMFC 2002b). Management measures implemented since 1996 have resulted in positive trends for the weakfish population. In 2002, weakfish stock was found to be at a high level of abundance and subject to low fishing mortality (ASMFC 2002b). The lifestages with the potential to occur in the vicinity of the WTC intake include eggs, larvae, juveniles, and adults.

Bay anchovy—Bay anchovy is found in salinities ranging from fresh to seawater. This species is common in its range and may be the most abundant species in the western north Atlantic (McHugh 1967 in Vougilitois et al. 1987). Bay anchovy uses the Lower Hudson River Estuary extensively for spawning, embryonic development, and hatching. Spawning in the New York Bight occurs from about May through September and females spawn many times per year (Houde and Zastrow 1991). Within the Hudson River, bay anchovy eggs are most abundant from Tappan Zee to the southern tip of Manhattan. The yolk sac stage typically lasts less than one day, and few are caught in ichthyoplankton samples. The peak abundance of post-yolk sac larvae bay anchovy in the Hudson River is in June and July and occurs slightly upstream compared to that of eggs. Juveniles occur from mid-August through October, primarily downstream of the Hyde Park region. Trawl data indicate that north of Delaware Bay, bay anchovy move out of estuaries and southward during the fall and are virtually absent from the inshore continental shelf of New York during the winter months. Peak abundance of juveniles is in the Tappan Zee region (ASA 2001). All lifestages have the potential to occur in the vicinity of the WTC intake and outfalls from spring though fall.

Atlantic menhaden—Atlantic menhaden is a member of the herring family. It has been a commercially important fish for oil, fertilizer, bait, and other purposes, and is managed by the ASMFC. Although menhaden is not considered a desirable food by people, it is prey for a wide variety of predators (Bigelow and Schroeder 1953; Smith 1985) that include fish, seabirds and marine mammals. This species undergoes extensive north-south seasonal migrations and inshore-offshore movements along the Atlantic coast. During the northward migration in the spring, spawning occurs progressively closer inshore. There are spring and autumn spawning peaks in the middle and north Atlantic regions. Larvae move into estuaries to feed from October through June in the mid-Atlantic region. Juveniles leave the estuaries from August to November as temperatures decline (Rogers and Van Den Avyle 1989). The Atlantic menhaden stock, which consists of a single population on the east coast of the US, is considered healthy and not overfished. Overfishing is not occurring on a coastwide basis (ASMFC 2003b). Lifestages with the potential to occur in the vicinity of the WTC intake and outfalls from spring through fall include adults, eggs, larvae and juveniles.

Black sea bass—Black sea bass is a commercially and recreationally valuable marine species (managed by the ASMFC). In the mid-Atlantic region, recreational landings have fluctuated between 6.5 and 19.6 million pounds from 1990 to 2000, and were about 3.41 million pounds in 2001. Commercial landings in 2001 (2.8 million pounds) were below the average for 1981 through 2001 (Lewis 2002a). The northern population of this species migrates seasonally: inshore and north in the spring and offshore and south in the autumn (Mercer 1989). They typically move inshore around Long Island in the first or second week of May, returning offshore in late October or early November. When inshore, they prefer hard bottoms and are often plentiful around wrecks, wharves, and pilings (Bigelow and Schroeder 1953). Larvae are rarely reported in estuaries, and most likely settle in nearshore marine waters (Steimle et al. 1999b). Juveniles are found in estuaries and coastal areas in the summer, usually near structured habitat. Adults also seek structured habitat but are often found slightly deeper than juveniles (Mercer 1989). This species is a protogynous hermaphrodite: most fish mature as females and change to males as they get larger. Therefore, most large individuals are males (Steimle et al. 1999b). When reviewed by the ASMFC in 1998, the black sea bass stock was found to be over-exploited and at a low biomass level. For 2002, the NMFS (2003) determined that the mid-Atlantic stock was overfished (fish biomass is below a threshold value set for the fishery) and that overfishing (fishing mortality is above a threshold value set for the fishery) was occurring. However, recent data indicate that management efforts have been successful in rebuilding the stock and it is no longer considered overfished. Consequently, the ASMFC and MAFMC have recommended increasing the total allowable landing limit for black sea bass from 6.8 million pounds in 2003 to 8.0 million pounds in 2004 (ASMFC 2003c). The current management plan for this species has an annual quota divided between recreational and commercial fishery (Lewis 2002a). Lifestages with the potential to occur in the vicinity of the WTC intake and outfalls from include adults and juveniles.

Tautog—Tautog is a commercial and recreational marine species of wrasse that is managed by the ASMFC. Along the east coast the fishery is primarily recreational. It has been reported up to 70 km (45 miles) upstream from the mouth of the Hudson River. Spawning occurs in the spring, primarily at or near the mouths of estuaries and in inshore waters. Young tautog inhabit shallow areas and prefer vegetated habitats. Adults also prefer shelter and are found in vegetation, rocks, natural and artificial reefs, pilings, mussel and oyster beds, etc. Adults are found inshore in summer and offshore in the winter (Steimle and Shaheen 1999). Recreational and commercial landings declined from 1987 to 2001 (19,902,223 pounds to 2,745,2000 pounds recreational, and 1,157,100 pounds to 245,661 pounds commercial). Most estimates suggest that tautog stocks have declined since the mid-1980s, although abundance indices through 2000 show a slight increase in biomass and recruitment in recent years as a result of management measures (Stirratt 2002). Lifestages with the potential to occur in the vicinity of the WTC intake and outfalls include larvae, juveniles and adults in the spring, and juveniles and adults in the summer through fall.

Spotted, Red, and Silver Hake—Spotted, red, and silver hake are three marine cod species that occur in the Hudson River estuary. They are not important as commercial or recreational species. Spotted hake is a coastal species that occurs primarily in the channel and not among pilings or in interpier areas (Woodhead 1990). Red hake make seasonal migrations to follow preferred temperature ranges. They are most common in depths less than 100 meters (328 feet) in warmer months and deeper than 100 meters in colder months. Recently metamorphosed juveniles are pelagic, gathering around floating debris and patches of sargassum, and gradually descend to the bottom as they grow. They require shelter and can be found associated with scallops, clam shells, and polychaete tube shells. Adults are most often found over soft sediments. Red hake is occasionally found in the Hudson River as far upstream as Indian Point. However, this marine species would only occasionally occur in deeper channel areas beyond the WTC cooling water intake and outfalls (Steimle et al. 1999a). Only two silver hake were captured in the Hudson River Park area, in January, during 14 months of sampling in 2002 and 2003 (Meixler et al. 2003). A few individual red hake were captured in January, April and June 2003 and small numbers of spotted hake were collected in late spring and summer. Lifestages with the greatest potential to occur in the vicinity of the WTC cooling water intake and outfalls include adults and juveniles. In 2002, red hake and silver hake were not considered overfished (biomass was not below a threshold set for the stock) (NMFS 2003).

Bluefish—Bluefish is another commercial and recreational marine fish species found in the Hudson River estuary, and is managed by the ASMFC. There are two major spawning aggregations in the mid-Atlantic, a spring spawning stock and a summer spawning stock. The New York Bight bluefish population probably originates primarily from the spring spawning stock. Bluefish spawn as they migrate northward and in the autumn they migrate back to wintering areas off south Florida and the south Atlantic. Eggs and larvae are oceanic. Juveniles enter the shallow nursery areas of the New York Bight in two groups: the spring spawned individuals arrive in June or early July and the summer spawned individuals arrive in September. Juveniles are most common in the shallow, saline areas of the estuary, with the majority collected between the Tappan Zee and Croton-Haverstraw regions (ASA 2001). NYSDEC (2003) has identified bluefish as a Hudson River species that has been declining in abundance. Recreational catch of bluefish in the mid-Atlantic have declined from 93 million pounds in 1986 to 10 million pounds in 2000. However, management measures resulted in an increase in total stock biomass from 32 million pounds in 1995 to 86 million pounds in 2001. In 2001, the fishing mortality rate was below the target set for 2002 and 2003 (Lewis 2002b). The most recent estimates of fishing mortality suggest that the rebuilding program, state-by-state quota system, and recreational harvest limit have been successful and that overfishing is no longer occurring (fishing mortality was not above the threshold set for the stock), although the stock was considered overfished (biomass was below the threshold set for the stock) (NMFS 2003). Lifestages with the potential to occur in the vicinity of the WTC cooling water intake and outfalls include juveniles and adults from summer through fall.

Grubby—Grubby, a small sculpin that grows to a size of about 5 to 6 inches, is a resident of the lower estuary and has no recreational or commercial value. This fish spawns primarily in February when most other species have left the Harbor (Woodhead 1990), although spawning can occur through spring (Bigelow and Schroeder 1953). The eggs sink and attach to structures on the bottom (Woodhead 1990). All lifestages have the potential to occur in the vicinity of the WTC cooling water intake and outfalls.

Hogchoker—Hogchoker has no commercial or recreational value. It is a small flatfish (maximum size about 8 inches) that spawns in the summer (May through September) in the lower estuary (Dovel et al. 1969, Koski 1978). Eggs are more commonly collected from the end of May thorough July in the more saline areas of the Lower Hudson Estuary such as near the southern tip of Manhattan (ASA 2001). After hatching, the larvae move upstream. When winter begins, juveniles are found in upper estuary nursery areas. Many hogchokers repeat this migratory cycle—movement to the saline portion of the estuary in spring and to the freshwater portion in autumn—throughout life (Bigelow and Schroeder 1953). Yearling and adult hogchoker are found throughout the river but are most abundant in the lower and middle estuary (ASA 2001). Lifestages with the potential to occur in the vicinity of the WTC cooling water intake and outfalls include adults and eggs in the summer, and adults in the fall and winter.

White perch—White perch is a commercially and recreationally important species (Stanley and Danie 1983). Adult white perch resemble the closely related striped bass but are much smaller, averaging less than ten inches in length and less than 3 lbs in weight (ASA 2001). In the Hudson River, most spawning occurs from May to early June north of Croton Bay. White perch eggs sink to the bottom and are very adhesive, sticking to each other and to the substrate (Stanley and Danie 1983). After spawning, many adults move downriver to Haverstraw Bay and the Tappan Zee region where salinities are higher (ASA 2001). In winter, they may move to deeper parts of the estuary, where they pass the winter in a sluggish condition. Juveniles inhabit creeks and inshore areas until they are about a year old (Heimbuch et al. 1994). In the Hudson River estuary, juveniles are generally found in the middle estuary between the Hyde Park and West Point regions (ASA 2001). NYSDEC (2003) has identified white perch as a Hudson River species that has been declining in abundance. Adults have the potential to occur in the vicinity of the WTC cooling water intake and outfalls.

Atlantic tomcod—Atlantic tomcod was a locally important commercial fish species in northern estuaries during the 1800s and is now the target of a winter sport fishery along the New England coast (Stewart and Auster 1987). The Hudson River is the southernmost estuary in which Atlantic tomcod have been reported to spawn, although their geographic range extends from southern Labrador and northern Newfoundland to Virginia (Stewart and Auster 1987). One-year old fish constitute most of the Hudson River spawning stock. The spawning period is generally from late December to early January. The eggs are non-adhesive and take at least a month to hatch. The largest concentrations of spawning tomcod in the Hudson River are in the middle estuary between West Point and Poughkeepsie. Atlantic tomcod return to coastal waters after spawning. Yolk sac larvae are found throughout the lower half of the estuary while post-yolk sac larvae are concentrated in the Yonkers to Tappan Zee region. Juveniles are generally found in the middle estuary while yearling and older Atlantic tomcod are primarily found in the lower estuary (ASA 2001). NYSDEC (2003) has identified Atlantic tomcod as a Hudson River species that has been declining in abundance. Lifestages with the greatest potential to occur in the vicinity of the WTC cooling water intake and outfalls include adults, larvae, and juveniles.

Striped bass—Historically, striped bass was a recreationally and commercially important species in the New York area, and is managed by the ASMFC. Due to high levels of PCBs in their flesh, however, commercial fishers may no longer take striped bass from the Hudson River, and recreational fishers are allowed to keep only one fish 18 inches in length or longer per day, and are advised to eat no more than one meal of Hudson River striped bass per month. Striped bass enter the estuary in spring to spawn and spawning typically occurs in mid-May through mid-June farther up the Hudson, from below Kingston to above Haverstraw Bay. The eggs are semi-buoyant, are suspended by the river currents, and are most abundant in the mid-river. Post-yolk sac larvae can occur throughout the estuary but are primarily located in the middle-estuary. Toward the end of the post-yolk sac stage, young striped bass move into the lower estuary. Adult striped bass may visit the study area again during their return trip to the sea. Many juveniles move to the southern extreme of the estuary at the end of their first summer (ASA 2001). Young striped bass have been reported to use the interpier areas within the Hudson River Park and other portions of the Hudson River as overwintering habitats (USACOE 1984). Some may remain in the river year-round (Clark 1968). NYSDEC (2003) has identified striped bass as a Hudson River species that has been declining in abundance. However, coastwide stock abundance was at its highest levels in 2000 (53 million fish) and 2001 (59.6 million fish), for the period from 1982 to 2001. Overall, the stock appears to be abundant, trending upward slightly, and is not considered overfished, nor is overfishing occurring. Total coastwide landings from recreational and commercial fisheries was estimated at 4,343,798 striped bass in 2001 (Beal and Gamble 2002). Lifestages with the potential to occur in the vicinity of the WTC cooling water intake and outfalls include adults during the spring spawning migration, late stage larvae occasionally in summer, adults and juveniles in the fall, and juveniles and some adults in the winter.

Alewife and American shad—Alewife and American shad are common anadromous species that are members of the herring family. Both of these species are important commercial and recreational fish species. These species live in the sea as adults and move into estuaries in spring on their spawning migrations. Both spawn in fresh water, with American shad spawning as far north as the dam at Troy in May. Individuals of these species may return to the Hudson River many times to spawn (Talbot 1954). Juveniles are found throughout the river (ASA 2001). NYSDEC (2003) has identified American shad as a Hudson River species that has been declining in abundance. Commercial landings for American shad and alewife have declined since 1985 (ASMFC 1998c). Declines in American shad have been attributed to overfishing (ASMFC 1998b). However, a 1998 stock assessment of American shad stocks in 7 river systems (Connecticut River, Hudson River, Delaware River, Upper Chesapeake Bay Maryland, Edisto River, Santee River, and Altamaha River) did not detect overfishing of these stocks (ASMFC 2002c). Stock declines in the Hudson River appear to have occurred from 1988 to 1996, although it was still below the estimated overfishing definition. The ASMFC determined the Hudson River stock to be fully exploited in 1998 (ASMFC 1998b). Management measures are underway to limit recreational catch of American shad to 10 fish per day, and monitor landings to better ascertain the status of the stocks (ASMFC 2002c). Adult alewives also migrate upriver to spawn in the spring, returning to the ocean in the fall. Juveniles migrate from the estuaries in their first year, migrating out of the estuary in the fall. These species primarily eat crustaceans and other invertebrates (Bigelow and Schroeder 1953). Commercial landings of alewife may not accurately represent stock abundance (ASMFC 1998c). Lifestages of American shad with the potential to occur within the vicinity of the WTC cooling water intake include adults during the spring migration, juveniles and adults in the fall. Lifestages of alewife with the potential to occur in the vicinity of the WTC intake include adults during the spring migration, and adults and juveniles in the fall.

Blueback herring—Blueback herring, another herring found in the Lower Hudson River Estuary, is very similar in appearance to the alewife. Often, eggs and larvae of alewife and blueback herring cannot be discerned from each other due to the similarity of appearance. The blueback herring is an important commercially fished species in the Hudson, is managed by the ASMFC, and is often taken for use as bait by recreational anglers. Of the three anadromous herrings that spawn in the Hudson River, blueback herring is the last to begin the spring spawning run. Peak activity usually occurs near the end of May. Blueback herring prefer fast-flowing tributaries, and spawn in the Mohawk River and upper Hudson River. The eggs are initially adhesive but may be dislodged and become pelagic. Most eggs occur in the Catskill and Albany regions and larvae disperse gradually down the river to the middle estuary regions. Juveniles are generally most abundant in the upper estuary (ASA 2001). Commercial and recreational harvest of blueback herring have declined since 1985 (ASMFC 2002c). However, commercial landings of blueback herring may not accurately represent stock abundance (ASMFC 1998c). Lifestages of blueback herring with the potential to occur in the vicinity of the WTC cooling water intake and outfalls include adults during the spring spawning migration, and juveniles and adults in the fall.

American eel—The single catadromous species common to the Lower Hudson River Estuary is American eel. American eel is a commercially important species and is managed by the ASMFC. Eels spawn in the Sargasso Sea, in the western Atlantic Ocean. The young move into the estuary as elvers in the spring (February through March) (Fahay 1978). They are known to occur in the vicinity of the WTC cooling water intake from February through June (EEA 1988). Some move up the estuaries in summer, while others stay in higher salinity water. American eels are opportunistic feeders and juveniles eat crustaceans, polychaetes, bivalves, and fish (Ogden, 1970; Wenner and Musick, 1975). Eels grow slowly, and at sexual maturity, move down the estuary in the fall and out to sea (Bigelow and Schroeder, 1953). The current stock status of American eel is poorly understood because stock assessment efforts have been limited and have not been applied across the distribution range for this species. Within the mid-Atlantic region, commercial landings for American eel have declined from a high of 1.8 million pounds in 1985 to 886 thousand pounds in 2001. However, because fishing effort data are unavailable, it is difficult to correlate landings data with population numbers. Harvest data are often a poor indicator of abundance, because harvest is dependent on demand, and may consist of annually changing mixes or year classes. (ASMFC 2002d). Management measures focus on instituting consistent monitoring programs through-out the mid-Atlantic and reversing any local or regional declines in abundance.

<u>Essential Fish Habitat</u>

Appendix I.2, "Essential Fish Habitat Assessment," provides a detailed discussion of EFH designations for the Lower Hudson River Estuary in the vicinity of the WTC intake and outfalls, and potential impacts to these designations from the operation of the intake and outfalls for the Proposed Action. The NMFS designates EFH within 10' by 10' squares identified by latitude and longitude coordinates. The location of the WTC intake and outfalls on the lower Hudson River is within a portion of the Hudson River estuary EFH that is situated in the NMFS 10' x 10' square with coordinates (North) 40°50.0' N, (East) 74°00.0' W, (South) 40°40.0' N, (West) 74°00.0' W. This square includes the following waters: the Hudson River and Bay from Guttenberg, NJ south to Jersey City, NJ, including the Global Marine Terminal and the Military Ocean Terminal, Bayonne, NJ, Hoboken, NJ, Weehawken, NJ, Union City, NJ, Ellis Island, Liberty Island, Governors Island, the tip of Red Hook Point on the west tip of Brooklyn, NY, and Newark Bay. This area has been identified as EFH for 15 species of fish: red hake (larvae, juveniles and adults), winter flounder (eggs, larvae, juveniles, adults, and spawning), windowpane (eggs, larvae, juveniles, adults, and spawning), Atlantic herring (larvae, juveniles, and adults), bluefish (juveniles and adults), Atlantic butterfish (larvae, juveniles, and adults), Atlantic mackerel (juveniles and adults), summer flounder (larvae, juveniles, and adults), scup (eggs, larvae, and juveniles), black sea bass (juveniles and adults), king mackerel (*Scomberomorus cavalla) (*eggs, larvae, juveniles, and adults), Spanish mackerel (*Scomberomorus maculatus*) (eggs, larvae, juveniles, and adults), cobia (*Rachycentron canadum)* (eggs, larvae, juveniles, and adults), sand tiger shark (*Odontaspis taurus*) (larvae), and sandbar shark (*Carcharinus plumbeus)* (larvae and adults). As described in the previous section, winter flounder, bluefish, black sea bass, and red hake are also target species identified for evaluation of potential impacts from impingement and entrainment in this GEIS.

Marine Mammals

Marine mammals use the waters of the New York Bight, and occasionally come into New York Harbor, but are not commonly observed in the Lower Hudson River Estuary. The most commonly observed marine mammal in the Bight is the harbor seal (*Phoca vitulina*) which winters in the Harbor and hauls out onto islands in Jamaica Bay, Sandy Hook, Staten Island, and the Westchester and Connecticut shorelines of the Long Island Sound. Less frequently, but seen in similar locations, is the grey seal (*Halichoerus grypus*). The occasional sighting of cetaceans in the Harbor is generally of individuals that are likely to be unhealthy and/or lost. Historic records indicate the harbor porpoise (*Phocoena phocoena*) may have once been a regular visitor to the Harbor (USFWS 1997).

Endangered, Threatened, and Special Concern Species

Requests for information on rare, threatened or endangered species within the immediate vicinity of the WTC cooling water intake and outfalls on the Lower Hudson River were submitted to USFWS, NMFS, and the NYSDEC New York Natural Heritage Program (NYNHP). The NMFS indicated that four species of marine turtle (loggerhead, green, Kemp's ridley, and leatherback), may be present in the project area as seasonal transients (Rusanowsky 2003). No threatened or endangered species, or species of special concern under the authority of the NYSDEC or the USFWS were identified in the vicinity of the WTC cooling water intake and discharge in the Lower Hudson River Estuary (Houle 2003, Stilwell 2003).

While not identified as occurring in the vicinity of the WTC cooling water intake and outfalls in the Lower Hudson River Estuary, shortnose sturgeon (New York State and federally listed endangered) have the potential to occur within the Lower Hudson River Estuary. However, these fish spawn, develop, and overwinter well upriver, and prefer colder, deeper waters. Individuals are only expected to use the lower Hudson River when traveling to or from the upriver spawning, nursery and overwintering areas. Out of the more than 1,000 trawls taken in the Westway study in both the Hudson and East River, only one shortnose sturgeon was collected, in the deep water habitat, near the Peekskill-Haverstraw section of the Hudson River. Long-term Hudson River monitoring data, collected by the New York Utilities and others since the 1970s, have also indicated that shortnose sturgeon inhabit deep-water habitats, and occur in greatest abundance north of the Tappan Zee Bridge.

Four species of marine turtles, all state and federally listed, can occur in New York Harbor. Juvenile Kemp's ridley and large loggerhead turtles enter the New York Harbor and bays in the summer and fall. The other two species, green sea turtle and leatherback sea turtle, are usually restricted to the higher salinity areas of the Harbor (USFWS 1997). In general, however, these four turtle species mostly inhabit Long Island Sound and Peconic and Southern Bays. They neither nest in the New York Harbor Estuary, nor reside there year-round (Morreale and Standora 1995). Turtles leaving Long Island Sound for the winter usually do so by heading east to the Atlantic Ocean before turning south (Standora et al. 1990). It is unlikely that these turtle species would occur in the lower Hudson River except as occasional transients.

TERRESTRIAL RESOURCES

Under its current conditions, the Project Site provides only very limited and highly disturbed habitat for wildlife species tolerant of urban conditions such as squirrels and rats. In addition, Lower Manhattan and the lower Hudson River provide habitat for many species of birds. Resident and overwintering birds, as well as short- and long-distance migratory species, occur throughout the area. New York City is within an important migration corridor and provides stopover habitat for Neotropical migrant landbirds (migratory bird species that nest in North America north of the U.S.-Mexico border and Caribbean and winter in the Neotropical region south of the continental U.S.) in the New York Bight watershed. Surveys of migrating birds in open spaces in the New York City metropolitan area have revealed a high abundance and diversity of such birds. A large number of migratory birds are funneled through the city by the coastline orientation as well as other geographic features (USFWS 1997).

Based on USFWS (1997) data for the Lower Hudson River region, and New York City Audubon Society (NYCAS) bird strike data collected from within the WTC Site, common species (exclusive of pigeons and mourning doves) that may be present within the project area during migratory periods include: house wren (*Troglodytes aedon*), yellow warbler (*Dendroica petechia*), song sparrow (*Melospiza melodia*), American robin (*Turdus migratorius*), gray catbird (*Dumetella carolinensis*), black-throated blue warbler (*Dendroica caerulescens*), ovenbird (*Seiurus aurocapillus*), white-throated sparrow (*Zonotrichia albicollis*), dark-eyed junco (*Junco hyemalis*), black-and-white warbler (*Mniotilta varia*), common yellowthroat (*Geothlypis trichas*), and blackpoll warbler (*Dendroica striata*). The majority of the birds reported in collisions with the pre-September 11 WTC complex were migratory songbirds. In addition, according to October 6, 2003 correspondence from the USFWS and September 30, 2003 correspondence from the NYSDEC, the peregrine falcon (*Falco peregrinus*) which is listed by the State of New York as endangered is known to occur in the vicinity of the Project Site.

Bird strike data for structures in the Project Site are unavailable post-September 11, since the WTC complex was mostly destroyed. Currently, there are few reflective or mirrored windows to reflect the surroundings, and no natural habitat such as interior or exterior shrubs and trees that might attract birds. The use of bright lighting associated with nighttime construction has the potential to attract some birds and may result in collisions with construction equipment. The above-grade portion of the temporary WTC PATH station is the only structure on the Project Site above street level. The temporary terminal, however, does not contain walls or reflective glass surfaces, and is not expected to cause bird strikes. The lack of reflective surfaces, vegetation, and tall illuminated structures at the Project Site that might attract birds make it unlikely that bird collisions would occur under the Current Conditions Scenario.

18.4.2 FUTURE WITHOUT THE PROPOSED ACTION 2009—CURRENT CONDITIONS SCENARIO

WATER QUALITY AND AQUATIC BIOTA

Under the Current Conditions Scenario, future natural resource conditions without the Proposed Action in 2009 would not have withdrawal of Hudson River water through the WTC cooling water intake, or discharge of heated effluent through the WTC outfalls. There are, however, several proposed and ongoing projects aimed at improving water quality and aquatic resources in the New York/New Jersey Harbor Estuary, that have the potential to result in water quality and aquatic resource improvements in the Lower Hudson River Estuary. These improvements would occur without the Proposed Action and are expected to continue through 2009.

NY/NJ HEP Projects

Several of the future water quality improvement efforts in the Lower Hudson River Estuary will be coordinated by the New York/New Jersey Harbor Estuary Program (HEP). The Final Comprehensive Conservation and Management Plan (CCMP) (NY/NJ HEP 1996) for the HEP included a number of goals to improve water quality and aquatic resources in the area. 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 has developed watershed-based priorities for identifying acquisition, protection, and restoration sites 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.

NY/NJ HEP Acquisition and Restoration Sites in closest proximity to the lower Hudson River:

- *Liberty State Park*—Located in the Upper New York Bay it has been identified for restoration, including permanent protection of natural areas, enhancement of emergent habitat, and restoration of oyster beds;
- *Western Manhattan Island Parks*—Several parks on the western shore of Manhattan (Riverdale Park, Inwood Park, Fort Tryon, Fort Washington Park, and Riverside Park) have been selected as priority restoration sites and are targeted for non-point source pollution reduction measures in addition to habitat restoration;
- *Spuyten Duyvil*—Located on the Harlem River near its confluence with the Hudson River, this park was chosen as a priority restoration site for salt marsh restoration; and
- *Bush Terminal*—Located in Upper New York Bay on the Brooklyn shoreline, it was chosen as a priority restoration site for salt marsh restoration.

The floatables action plan of the HEP aims to reduce the amount of debris in New York and New Jersey waters. It includes marine debris survey collection programs, improved street cleaning, combined sewer overflow (CSO) and stormwater abatement, enforcement of solid waste transfer regulations, shoreline cleanup programs, and public education. Under the federal

Clean Water Act, New York and New Jersey are responsible for developing non-point source pollution management plans for the Harbor Estuary (NY/NJ HEP undated).

CARP is a component of HEP focused on understanding the fate and transport of contaminants discharged to the estuary, and using this information to develop measures that may be necessary to reduce sediment contamination. Continued research and monitoring programs are anticipated to play a role in the development of future management strategies for Harbor sediments (NY/NJ HEP undated, USACOE 1999). Working with New Jersey and the CARP Work Group (a group of government, academic, and consultant experts), NYSDEC is tracking down contaminant sources in the surface water, groundwater, and wastewater of the Harbor. The overall goal of the initiative is to reduce the flow of contaminants to the Port of New York and New Jersey. The principle chemicals of concern include: dioxins/furans, polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs), metals (mercury, cadmium, and lead), and pesticides (dieldrin and chlordane).

Public education efforts are underway at agencies such as NYSDEC, NJDEP, NY/NJ HEP and the Interstate Environmental Commission (IEC) to provide opportunities for teachers and schoolchildren to learn about the ecology of the Harbor and about methods to reduce inputs of pollutants into the Harbor.

Hudson-Raritan Estuary Ecosystem Restoration Project

The Hudson-Raritan Estuary Ecosystem Restoration Project is a cooperative project being led by the USACOE that was funded by a House of Representatives Resolution on April 15, 1999. Other agencies involved in this project include: EPA, USFWS, NOAA, National Resource Conservation Service, New Jersey Department of Environmental Protection (NJDEP), New Jersey Department of Transportation - Office of Maritime Resources, NYSDEC, NYSDOS, NYCDEP, New York City Parks and Recreation, the Port Authority, 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 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 will identify measures and plans to restore natural areas within the estuary and enhance their ecological value, and address habitat fragmentation, and past restoration and mitigation efforts that were piecemeal in nature. The Proposed Action will recommend site-specific restoration projects for feasibility level analysis and provide a Project Management Plan and Feasibility Cost Sharing Agreement for projects.

Thirteen initial representative restoration sites in New York and New Jersey have been targeted as the first sites for inclusion as potential restoration projects for feasibility level analysis. It is anticipated that expedited restoration of these representative restoration sites will provide substantial immediate value to the ecosystem.

The New York sites include:

- Alley Pond Park (bordering western Long Island Sound),
- Old Place Creek (a tributary to the Arthur Kill),
- Newtown Creek (a tributary to the lower East River),
- Brookville Creek (a tributary to Jamaica Bay),
- Dreier Offerman Park (bordering Coney Island Creek near The Narrows),

- Sherman Creek (a tributary to the Harlem River),
- Pelham Lagoon and Turtle Cove (a tributary to western Long Island Sound), and
- Tallapoosa (a tributary to western Long Island Sound).

The New Jersey sites include:

- Leonardo (bordering Raritan Bay),
- Rahway River (a tributary to Raritan Bay),
- Marquis Creek (a tributary to Raritan Bay),
- Liberty State Park (on western Upper New York Bay), and
- Kearny Marsh (with tributaries that drain to Newark Bay).

In addition to the 13 representative sites, 3 spin-off sites have been identified. These are restoration sites being evaluated in parallel to the representative sites. They include the Lower Passaic River and Hackensack Meadowlands in New Jersey, and Gowanus Canal in New York (a tributary to the Upper New York Bay).

Newtown Creek, Liberty State Park, and Gowanus Canal are the three sites closest to the WTC cooling water intake and outfalls in the lower Hudson River, and therefore with the greatest potential to influence water and sediment quality in this area.

State and Regional Projects

NYSDEC and NJDEP, in coordination with the IEC, will continue to develop total maximum daily loads (TMDLs) and to identify priority waterbodies in bi-annual Section 305(b) reports to EPA. TMDLs, once implemented, will reduce the daily inputs of various contaminants in an effort to improve water quality. New York State provided $255 million to implement wastewater improvements, nonpoint source abatement and aquatic habitat restoration projects in 1998. The State intends to continue water quality improvement projects in the Harbor for the foreseeable future.

New York City Projects

EPA's National Combined Sewer Overflow (CSO) Strategy of 1989 requires states to eliminate dry weather overflows of sewers, meet federal and state water quality standards for wastewater discharges, and minimize impacts on water quality, plant and animal life, and human health. CSOs are the largest single source of pollutants and pathogens to the New York Harbor (NYCDEP 2003a).

NYCDEP has taken several steps in recent years to mitigate discharges from CSOs, which, in combination with improvements that have been made to water pollution control plants (WPCP), are expected to result in future improvement in coliform, DO and floatables levels in the New York Harbor area. Since 1989, wet weather capture and treatment at WPCPs has increased from 18 percent to 62 percent. The Multi-Year Intended Use Plan of the NYC Municipal Water Financing Authority has identified several CSO improvement and abatement projects, totaling over $500 million, which will be completed between 2003 and 2010. In the past 12 years, the pollution prevention control program has expanded from 1,000 regulated firms to 30,000 regulated firms. NYCDEP plans to increase the track-down and control of pollutants of concern including mercury, polychlorinated biphenyls, and solvents. This could potentially involve thousands of NYC commercial and industrial firms. Other New York City water quality improvement measures already in practice or in development include the following:

- Elimination of CSOs—storm and sewer systems are physically separated.

- Expansion of WPCP capacity.
- Adoption of "Best Management Practices" to expand treatment of wet-weather flows.
- Creation of storage—stored water is pumped to the treatment plant after the storm event has subsided.
- Installation of a telemetry system of 92 pumping stations to enable more rapid response to malfunctions, breakdowns, and other system disruptions, thereby reducing dry weather discharges.
- Upgrades of plant equipment to modernize the WPCP facilities and install additional controls.
- Implementation of more stringent effluent limits for nutrients.
- Shoreline Survey/Sentinel Monitoring Programs—Initiated in 1998, the objective of the Shoreline Survey Program is to investigate and eliminate dry weather discharges from CSOs. Through this program, over 3,000 outfalls were investigated and samples were collected from those found to be discharging in dry weather. The initial survey found that over 3 million gallons of untreated sewage was being discharged during dry weather daily. As of 2002, NYCDEP had eliminated approximately 96 percent of these discharges. Remaining discharges will be abated through construction of new sewers and enforcement actions to correct illegal connections to storm sewers. NYCDEP also established a Sentinel Monitoring Program to monitor fecal coliform concentrations at 80 stations within the NY Harbor and its tributaries to establish a fecal coliform ambient baseline. These stations are now sampled quarterly. Exceedances of the baseline at any of the stations trigger shoreline surveys to identify potential sources.
- Enhanced Beach Protection Program—Initiated in 1997, the program increased levels of surveillance and improved preventative maintenance procedures for critical pumping stations and regulations to minimize beach closures (NYCDEP 2003a).

Other Projects

A portion of Route 9A (West Thames Street to Warren Street) bordering the western side of the Project Site would be reconstructed in the future with or without the Proposed Action. This project includes upgrades to the existing stormwater drainage system that partially separate stormwater flows, repair or replace regulators, and install grit traps, among other improvements. Potential Impacts from this project are being addressed in a separate FEIS.

As detailed in Chapter 2, "Methodology," and Chapter 3, "Land Use and Public Policy," several development projects were planned or were under construction in the vicinity of the project area before September 11, 2001. Some of these projects are continuing forward, others have been modified or cancelled as a result of the damage to the WTC Site.

TERRESTRIAL RESOURCES

Under this scenario in 2009, the permanent PATH Terminal would be the only above grade structure on the WTC Site. On the Southern Site, it is anticipated that the 130 Liberty Street would be rebuilt with a commercial office building containing approximately 1.4 million square feet with a height of approximately 550 feet and approximately 40 floors. The adjacent 140 Liberty Street site would also contain a commercial office building containing 500,000 square feet with a height of approximately 400 feet or 25 floors.

Without the Proposed Action, there would be no other tall structures with the potential to result in bird strikes, or lighting to interfere with migratory patterns. The 130 Liberty and 140 Liberty Street buildings would be lower than the 500 foot elevation. As a result, minimal bird strike impacts are anticipated to occur from activities on the Project Site.

18.4.3 PROBABLE IMPACTS OF THE PROPOSED ACTION 2009—CURRENT CONDITIONS SCENARIO

WATER QUALITY AND AQUATIC RESOURCES

Existing WTC Cooling Water System

Prior to September 11, 2001, the WTC air conditioning and computer cooling system withdrew water from the Hudson River to cool the towers, the concourse, and the WTC PATH Terminal. River water was pumped from the sub-grade pump station, through the condenser water pipeline that was in service (only one of the two pipelines, 60"or 66" in service at a given time), to the central refrigeration plant for each tower and to the heat exchangers. After passing through the chillers to remove heat, the condenser water was discharged back into the Hudson River through one of two discharge outlets.

The sub-grade pump station intakes and condenser pipelines used to supply cooling water to the WTC are intact and functional. River water would be withdrawn through a pair of 7 by 10-foot submerged intake tunnels, the bottom of which are at the same elevation as the floor of the pumphouse. The inlet channel is lined with riprap that is covered with a concrete slab. The inlets have monel bar screens with 5-inch spacing between bars. From the intake tunnels, river water passes through two groups of parallel chambers (one for each intake) within the pumphouse that consist of a settling chamber with a group of small capacity metering pumps and storage tanks for handling hypochlorite solutions (originally used as an anti-biofouling agent to deter the growth of organisms on the heat exchangers but discontinued prior to September 11, 2001), sluiceway with a 3/8-inch mesh traveling screen, sluice gate, pump suction chamber, and pumps (four 18,000 gallon per minute (gpm) capacity pumps, four 13,000 gpm capacity pumps, and two 3,500 gpm capacity emergency pumps). The two traveling screens are rinsed with river water periodically to remove accumulated material. Material washed from the screens drops into a trough and then flows into a pair of trash baskets. The trash baskets are removed by hand and emptied outside the pump station. Timers associated with each traveling screen can initiate the cleaning cycle as often as ten times per day, and control the duration of the cleaning cycle (typically 10 minutes). Prior to September 11, the traveling screens were cleaned about once every 24 hours.

The 60-inch condenser water pipeline and a 34-inch stormwater pipeline, discharge through one outfall (001), while the 66-inch condenser water pipeline discharges through a separate outfall (002), located just south of outfall 001.

Water Quality

No in-water construction activities would occur in the Hudson River for the Proposed Action in 2009. Construction of the components of the Proposed Action expected to be completed by 2009 have the potential to result in temporary water quality impacts in the vicinity of where stormwater is discharged to the Hudson River. However, stormwater generated within the Project Site would not be discharged directly to these surface waters, but would be directed to the municipal stormwater system. (During wet weather conditions, overflow discharge from the combined sewer system goes directly into the Hudson River.) Implementation of erosion and sediment control measures, and stormwater management measures during construction, implementation of the approved stormwater pollution prevention plan (SWPPP), and the proposed reclamation of stormwater for other uses such as irrigation of open space areas, would minimize potential impacts to the municipal combined sewer system from the introduction of stormwater due to the Proposed Action. Therefore, no significant adverse impacts to water quality would be expected to occur from construction or operation of the components expected to be completed prior to 2009 on the Project Site.

The potential thermal impacts from the operation of the cooling system using Hudson River water would be associated with the discharge of the heated water back into the Hudson River through the two existing WTC outfalls. Under the Current Conditions Scenario, no thermal effluent is being discharged to the Hudson River through the WTC cooling water outfalls. The assessment of potential impacts to water quality presented in this GEIS evaluates the potential impact to existing water quality from discharging heated effluent that is in compliance with the 1999 SPDES permit authorizing the Port Authority to discharge the heated cooling water into the North Cove on the Hudson River through one of two outfalls. Cooling water needs for 2009 will likely be considerably less than the cooling water withdrawals authorized under the 1999 SPDES permit. Approximately 4 million square feet of commercial office and retail space would be cooled in 2009, less than the approximately 10 million square feet of commercial office and retail space cooled pre-September 11, 2001. As described in Chapter 2, "Methodology," only Freedom Tower would be completed by 2009, in addition to the bases of the four remaining towers, open space areas, museums, performing arts building, and other space dedicated to cultural programs. The permanent WTC PATH Terminal, which would be completed by 2009, would also be cooled by the same system.

6 NYCRR Part 704 specifies the criteria governing thermal discharges to New York surface waters. NYSDEC has established general criteria that apply to all thermal discharges to waters of the State, and special criteria that apply to the different types of surface waters found within New York. The Lower Hudson River Estuary where the WTC cooling water intake and outfalls are located is a Use Class I saline surface water (best usages of Class I are secondary contact recreation and fishing, and must be suitable for fish propagation and survival). The special thermal discharge criteria that apply to the estuarine waters are designed to protect the designated use of these waters, particularly with respect to protecting fish from lethal temperatures and thermal shock, and to ensure that the river is conducive for fish passage. The special criteria that apply to estuarine waters such as the lower Hudson River are as follows:

- The water temperature at the surface of an estuary shall not be raised to more than 90°F at any point.
- At least 50 percent of the cross-sectional area and/or volume of the flow of the estuary, including a minimum of one-third of the surface as measured from water edge to water edge at any stage of tide, shall not be raised to more than 4°F over the temperature that existed before the addition of heat of artificial origin or a maximum of 83°F, whichever is less.
- From July through September, if the water temperature at the surface of an estuary before the addition of heat of artificial origin is more than 83°F, an increase in temperature not to exceed 1.5°F at any point of the estuarine passageway as delineated above, may be permitted.

- At least 50 percent of the cross sectional area and/or volume of the flow of the estuary, including a minimum of one-third of the surface as measured from water edge to water edge at any stage of tide, shall not be lowered more than 4°F from the temperature that existed immediately prior to such lowering.

The SPDES permit issued to the Port Authority for the WTC outfalls (NY-0006033) that was in effect and suspended on September 11, 2001, authorized the Port Authority to discharge cooling water that met the effluent limitations and monitoring requirements presented in Table 18-4. NYSDEC is required to include terms and conditions in a valid SPDES permit that would assure compliance with applicable surface water standards, including those for heat and temperature, for the designated use of each surface water. Compliance with the temperature and other water quality criteria and monitoring requirements issued with the SPDES permit for this facility (Table 18-4) would therefore be considered protective of the designated use of the Lower Hudson River Estuary, including fish survival and reproduction.

Table 18-4
World Trade Center Cooling Water Outfall Discharge Limitations

Parameter	Discharge Limitations			Minimum Monitoring Frequency
	Daily Average	Daily Max	Units	
Flow	Monitor	Monitor	MGD	continuous
Discharge Temperature	Monitor	91	°F	continuous
Intake-Discharge Temperature Difference	Monitor	17	°F	daily
Total Residual Chlorine[a]	Monitor	0.2	mg/L	3 times per week
pH[b]	Monitor	Monitor	SU	2 times per month

Notes:

[a] Total residual chlorine shall not be discharged more than two hours per unit per day. There shall not be simultaneous chlorination of separable portions of a single unit more than one unit at one time.

[b] The intake pH range shall not be extended more than 0.1 pH unit.

[c] Intake velocity at each fixed and/or traveling screen and at the first set of bar racks shall not exceed 1.8 fps.

[d] Only one outfall may be operated at a time. Simultaneous use of Outfalls 001 and 002 is not allowed.

Sources: NYSDEC State Pollution Discharge Elimination System Discharge Permit effective 05/01/99.

The Port Authority applied for the SPDES permit for the WTC cooling water outfall in 1971. The SPDES permit was issued in 1974, modified in 1987, and then issued again in 1999 for two outfalls. For the two-year period that the WTC intake and outfalls were operating after the SPDES permit was issued in May 1999 (until September 11, 2001), the cooling water discharge met effluent limitations and monitoring requirements (EPA 2003), and, therefore, did not result in significant adverse impacts to water quality in terms of water temperature, pH and chlorine (chlorination was discontinued prior to September 11). Additionally, modeling of the thermal effluent conducted as part of the 1987 permit modification (AKRF 1987) concluded that thermal effluent discharged to the surface of the North Cove would meet all of the special thermal criteria for estuarine waters, and would not re-circulate at the intake.

Because the Proposed Action would meet the effluent limitations and monitoring requirements issued with the 1999 SPDES for the WTC cooling water system, significant adverse impacts to water quality present under current conditions (without operation of the WTC intake and outfalls) would not be expected to occur as a result of the reuse of the WTC cooling water intake, pumphouse and outfalls in 2009.

Aquatic Biota

The evaluation of potential impacts to aquatic biota from the Proposed Action in 2009, assesses the potential effects to the aquatic community compared to the current condition in which the WTC cooling water system is not operating. The heated effluent discharged through the existing WTC cooling water system outfalls would meet the thermal criteria specified in the 1999 SPDES permit. Because these criteria were established to be protective of aquatic life, the proposed discharge of cooling water would not be expected to have a significant thermal impact to Hudson River biota. The surface plume would not affect bottom dwelling invertebrates and the limited extent of the plume would also not be expected to adversely affect phytoplankton, zooplankton and fish resources. Additionally, no stormwater would be discharged directly to surface waters during construction of the Proposed Action for the 2009 evaluation year.

The potential impacts to aquatic biota in the Lower Hudson River Estuary that could occur from the operation of the WTC cooling water intake were evaluated using impingement/entrainment data collected on behalf of the Port Authority at the WTC intake from 1991 to 1993. A report summarizing the results of this study was submitted to the NYSDEC as part of the application for the SPDES permit.

Because the 1991 to 1993 impingement/entrainment study was performed under full build out conditions for pre-September 11, 2001, the detailed assessment of potential impacts to aquatic biota is presented in section 18.4.5, “Probable Impacts of the Proposed Action 2015—Current Conditions Scenario,” when the cooling water needs are projected to be similar to those present during the 1991 to 1993 study period. The results of the 2015 impact assessment suggest that withdrawal of Hudson River water through the existing WTC cooling water intake may not be expected to result in significant adverse impacts to aquatic biota. While the existing SPDES permit already offers protection for aquatic resources by placing a restriction on flow velocities at the intake, the Proposed Action in 2015 would reduce the volume of water withdrawn from the design flow by 65 to 82 percent. The estimated low annual loss of some individuals through impingement, and higher estimated annual loss of individuals through entrainment would equate to a much smaller number of older fish that would not be added to the population, or small number of pounds that would be lost to a particular fishery because of the extremely high natural mortality of these lifestages. These losses may, however, result in significant adverse impacts to populations of these species in the Lower Hudson River under the Proposed Action in 2015 if withdrawal volumes increase from those projected and approach design flows.

Because approximately 60 percent less space would require cooling for the Proposed Action in 2009 compared to pre-September 11 conditions or in 2015, the volume of water withdrawn at the WTC intake would be greatly reduced. This lower volume of cooling water withdrawn at the WTC intake for the Proposed Action in 2009 would reduce losses of fish and invertebrates through impingement and entrainment. Therefore, significant adverse impacts to populations of fish and invertebrates in the Hudson River Estuary would not be expected to occur from the operation of the WTC intake in 2009.

Endangered, Threatened, and Special Concern Species

No threatened or endangered aquatic species, or species of special concern under the authority of the NYSDEC or USFWS were identified in the vicinity of the WTC cooling water intake and discharge in the lower Hudson River. While the endangered shortnose sturgeon has the potential to occur within the Lower Hudson River Estuary as adults, this species would only occur in this portion of the river when traveling to or from the upriver spawning, nursery and overwintering areas. Since shortnose sturgeon prefer deep water habitat, found in the channel, it is unlikely that it would occur in the vicinity of the intake. Additionally, no shortnose sturgeon were collected during the intake study. Therefore, shortnose sturgeon are not expected to be adversely impacted by the operation of the WTC cooling water intake.

The NMFS (Rusanowsky 2003) identified four species of threatened or endangered sea turtles as having the potential to occur in the project area as seasonal transients: Kemp's ridley, loggerhead, green, and leatherback. Because they neither nest, nor reside in the area year-round, and are only rarely observed in this portion of the estuary, they would not be expected to be impacted by the operation of the WTC cooling water intake.

TERRESTRIAL NATURAL RESOURCES

Under this scenario, the 1,776 foot Freedom Tower would have useable floor space up to an approximate height of 1,150 feet and broadcast antennae that reach 2,000 feet. The tower would comprise approximately 540,000 square feet of vertical, exterior surface area extending over 500 feet in elevation. Based on the projected amount of vertical, exterior surface area, and previously recorded bird strikes for the WTC Site (1,016 dead and 524 injured birds between April 1997 and September 10, 2001, according to data collected by NYCAS), it is anticipated that the structure would potentially result in several hundred more bird strikes than under the current conditions. Large construction equipment such as cranes and nighttime lighting for construction may also result in additional bird strikes. The greatest potential for bird strikes would occur in the spring (March – May) and fall (August – October) migration seasons.

Development under the Proposed Action would result in increased collisions of migrating birds over those realized under current conditions. The number of collisions and resulting bird mortality is expected to be insignificant when compared to the total number of birds migrating along the Atlantic Flyway. During migration, over 50 million birds have been documented via radar passing over the southern U.S. over the course of a few hours (Ogden 1996) and hundreds of thousands of nocturnal migrants fly over New York City during the spring and fall migration season.

With the Proposed Action, there would be potential beneficial impacts to the limited terrestrial resources within the project area with the development of landscaping and open space associated with the Memorial, museum, and Freedom Tower.

The use of bright lighting associated with nighttime construction has the potential to attract some birds and may result in collisions with construction equipment. While peregrine falcons that may occur in the vicinity of the Project Site would be expected to tolerate activities associated with the construction of the structures that are part of the Proposed Action, mitigation measures would be developed, as necessary depending on nesting activity in the vicinity of the Project Site, in coordination with NYSDEC and the New York City Department of Environmental Protection (NYCDEP). These measures would focus on minimizing potential impacts to falcons, nesting activity, and juvenile falcons. Potential measures could include the following:

- Bird control devices on the tops of cranes or other tall construction equipment to keep young falcons from landing on them and slipping off.

- Safety precautions for workers such as head and face protection, as necessary, during the nesting season, when falcons can be aggressive. Nesting season in New York starts in February and March.

Potential measures that may reduce bird strikes include reduction in reflective glass surfaces and interior lights visible from the outside, and reduction in the duration of nighttime decorative lighting, especially during the spring and fall migration periods. Peregrine falcons are accustomed to the intensely developed habitats of New York City and are not expected to experience a negative impact due to the Proposed Action. There are no records of peregrine falcons colliding with buildings in the city. The selection of exterior building materials would have to balance reduction of bird strikes with the goal of integrating the conservation and optimization of energy use into the design of the structures of the Proposed Action.

The Proposed Action includes over five additional acres of open space compared with pre-September 11 conditions. While no detailed designs have been completed at this point, the open space is anticipated to include approximately two acres of landscaped acres comprising Liberty Park on the southern portion of the WTC Site and on the Southern Site. Landscaping measures are anticipated to include shade trees and other vegetation including grass. The inclusion of such elements would offer resting/stopover habitats for migrating songbirds as well as habitats for resident birds.

18.4.4 FUTURE WITHOUT THE PROPOSED ACTION 2015—CURRENT CONDITIONS SCENARIO

WATER QUALITY AND AQUATIC RESOURCES

Under the Current Conditions Scenario, future natural resource conditions without the Proposed Action in 2015 would not have withdrawal of Hudson River water through the WTC cooling water intake, or discharge of heated effluent through the WTC outfalls. However, many of the ongoing projects described in section 18.4.2, "Future Conditions Without the Proposed Action 2009—Current Conditions Scenario," would be expected to continue to 2015, resulting in additional improvements to water quality and aquatic habitat conditions in the New York/New Jersey Harbor Estuary, including the area in the vicinity of the WTC cooling water intake on the Lower Hudson River Estuary. Habitat restoration projects completed by 2015, such as those proposed by the HEP or the Hudson Raritan Estuary Ecosystem Restoration Project would be expected to have resulted in improved aquatic habitat, and improved resting, feeding and nesting habitat for terrestrial wildlife that use these areas, such as waterfowl and wading birds. Many of the improvements to the New York City water treatment plants and CSOs that are planned or currently in progress would be completed by this time, resulting in improved water quality from the 2009 analysis year. Reconstruction of Route 9A/West Street with improvements to stormwater drainage and other improvements is scheduled for completion in 2008. All of these actions should lead to improved water quality and habitats for aquatic resources in the Harbor Estuary.

TERRESTRIAL RESOURCES

Under this 2015 scenario, the permanent WTC PATH Terminal would be the only structure on the WTC Site. Without the Proposed Action, there would be no impact on birds on the WTC Site, as there would be no other tall structures with the potential to result in bird strikes, and there would be no lighting to interfere with migratory patterns.

18.4.5 PROBABLE IMPACTS OF THE PROPOSED ACTION 2015—CURRENT CONDITIONS SCENARIO

WATER QUALITY AND AQUATIC RESOURCES

Existing WTC Cooling Water System

The cooling water intake would be the same as described previously in section 18.4.3, "Probable Impacts of the Proposed Action 2009—Current Conditions Scenario."

Water Quality

No in-water construction activities would occur in the Hudson River for the Proposed Action in 2015. Construction of the components of the Proposed Action expected to be completed by 2015, such as Towers 2, 3, 4, and 5, and the other components discussed in Chapter 2, "Methodology," have the potential to result in temporary water quality impacts in the vicinity of where stormwater is discharged to the Hudson River. However, as discussed in section 18.4.3, "Probable Impacts of the Proposed Action 2009—Current Conditions Scenario," stormwater generated within the Project Site during construction of the remaining project components through 2015, and during operation of the Proposed Action, would not be discharged directly to surface waters, but would be directed to the municipal combined sewer system. Implementation of erosion and sediment control measures, and stormwater management measures during construction, including the approved stormwater pollution prevention plan (SWPPP), and the proposed reclamation of stormwater for other uses such as irrigation of open space areas, would minimize potential impacts to the municipal combined sewer system from the introduction of stormwater due to the Proposed Action. Therefore, no significant adverse impacts to water quality would be expected to occur from construction or operation of the components expected to be completed by 2015 on the Project Site.

The potential water quality impacts from the operation of the cooling system using Hudson River water would be associated with the discharge of the heated water back into the Hudson River through the two existing WTC outfalls. The assessment of potential effects to water quality in 2015 evaluates the impacts to the current condition where no thermal effluent is being discharged to the Hudson River through the WTC cooling water outfalls, even though water would have been withdrawn and heated effluent discharged, starting in 2009. The assessment of potential impacts to water quality from the Proposed Action in 2015 assumes that the amount of space that will need to be cooled with the river water system would be similar to that being cooled pre-September 11, 2001. In 2015, approximately 11,829,105 square feet of space would be cooled, just slightly more than the approximately 10.1 million square feet that was present pre-September 11, 2001. Because the design of the buildings and the cooling system would be more energy efficient than what was present pre-September 11, 2001, the cooling needs and amount of water required to meet these needs would be expected to be similar to pre-September 11, 2001. Therefore, water withdrawal and discharge would be in compliance with the water quality criteria and monitoring requirements issued with the 1999 SPDES permit for this facility (Table 18-4), which were established to be protective of the designated use of the Lower Hudson River Estuary. Because operation of the WTC cooling water intake and outfalls for the Proposed Action in 2015 would be in compliance with the 1999 SPDES permit, significant adverse impacts to water quality would not be expected to occur as a result of the reuse of the WTC cooling water intake, pumphouse and outfalls in 2015.

Aquatic Biota

As discussed previously, the heated effluent discharged through the existing WTC cooling water system outfalls would meet the thermal criteria specified in the 1999 SPDES permit. Therefore, thermal impacts to Hudson River biota would not be expected to occur from the operation of the WTC cooling water intake for the Proposed Action in 2015. The surface plume would not affect bottom dwelling invertebrates and the limited extent of the plume would also not be expected to adversely affect phytoplankton, zooplankton and fish resources. No stormwater would be discharged directly to surface waters from the Project Site for the Proposed Action for the 2015 evaluation year.

The evaluation of potential impacts to aquatic biota from the Proposed Action in 2015, assesses the potential effects to the aquatic community and EFH present under the current condition in which the WTC cooling water system is not operating, even though water would have been withdrawn and heated effluent discharged, starting in 2009. As presented in section 18.3, “Methodology,” the assessment of potential impacts to aquatic biota from the Proposed Action in 2015 is based, in part, upon the impingement/entrainment data collected on behalf of the Port Authority at the WTC intake from 1991 to 1993. A report summarizing these data was submitted to the NYSDEC as part of the application for the 1999 SPDES permit. As discussed previously in section 18.4.1, “Baseline Conditions,” the dominant fish species within the Lower Hudson River Estuary have remained relatively stable since the 1980s. However, populations of the target species tautog, white perch, Atlantic tomcod, and American shad, appear to have declined during this period. Furthermore, the average water withdrawal volumes that occurred from 1991 1993 were comparable to the withdrawal volumes reported for the 1999 SPDES permit for the WTC cooling water system (EPA 2003) for the period from 1999 to 2001. Therefore, it was judged reasonable to use the 1991 to 1993 impingement and entrainment data to project potential impacts to aquatic biota for the full build-out of the Proposed Action in 2015.

Water Intake System Impingement/Entrainment Study

A study of the water intake system was conducted between March 1991 and February 1993 to examine entrainment and impingement of fish and macroinvertebrates (LMS 1994). This study detailed the following:

- Abundance, biomass, and species composition of fish impinged on the intake traveling screens;
- Abundance and species composition of ichthyoplankton entrained through the traveling screens; and
- Abundance, biomass, and species composition of invertebrates impinged on the intake traveling screens.

A total of 46 fish species were collected during 23 months of sampling, and include those species expected to occur in the Lower Hudson River Estuary, as described in section 18.4.1, “Baseline Conditions.” Table 18-5 provides estimates of the average numbers of fish impinged and entrained annually for the 23-month study period extending from 1991 to 1993. Most of these (38) were marine species.

The most common species impinged were grubby, striped bass, white perch, lined seahorse, and Atlantic tomcod. These species accounted for 69 percent of the total catch. A total of 144 fish were collected over the 23-month period, and were used to estimate the number of fish impinged when adjusted for intake flow.

Table 18-5
Estimated Annual Impingement and Entrainment of Fish by World Trade Center Hudson River Water Intake 1991-1993

Species	Assemblage	Number Impinged (Annual)[a]	Number Entrained (Annual)[a]			
			Eggs	Yolk Sac Larvae	Post-Yolk Sac	Juveniles <1
Alewife	Anadromous	13				
American eel	Catadromous	36				
American sand lance[b]	Marine	--			88,171	
American shad	Anadromous	3				
Atlantic herring	Anadromous	8				
Atlantic menhaden	Marine	39	1,374,125		5,975	
Atlantic seasnail	Marine	4				
Atlantic silverside	Marine	26			10,082	
Atlantic tomcod	Anadromous	345				
Bay anchovy	Marine	158	48,153,417		961,700	17,793
Black sea bass	Marine	55				
Blueback herring	Anadromous	95				
Bluefish	Marine	16				
Bothidae (lefteye flounders)	Marine	--	64,603			
Butterfish	Marine	31				
Clupidae (herrings)		9				
Conger eel	Marine	20				
Cunner	Marine	160				
Cyprinidae (minnows)					9,677	
Feather blenny	Marine	26				
Fourbeard rockling	Marine	--	22,800			
Foureye butterflyfish	Marine	52				
Four-spot flounder	Marine	--	286,235			
Gadidae (cods)		--	42,724			
Gobiidae (gobies)		--			1,935,049	
Grubby[b]	Marine	1,351		275,950	398,224	
Hogchoker	Estuarine	82	724,011			
Lined seahorse	Estuarine	384				
Myoxocephalus spp. (sculpins)		--		160,926	236,234	
Naked goby	Marine	4				30,818

Table 18-5 (cont'd)
Estimated Annual Impingement and Entrainment of Fish by World Trade Center Hudson River Water Intake 1991-1993

Species	Assemblage	Number Impinged (Annual)[a]	Number Entrained (Annual)[a]			
			Eggs	Yolk Sac Larvae	Post-Yolk Sac	Juveniles <1
Northern pipefish	Estuarine	97				72,439
Northern puffer	Marine	4			69,183	
Northern searobin	Marine	24				
Orange filefish	Marine	6				
Oyster toadfish	Marine	9				
Red hake	Marine	3				
Rock gunnel	Marine	25				
Sciaenidae (drums)		--			16,369	
Scup	Marine	18				
Seaboard goby	Marine	43				
Searobin spp.		--	1,570,558			
Sheepshead	Marine	10				
Silver hake	Marine	25	1,974,407			
Smallmouth flounder	Marine	27				
Spotfin butterflyfish	Marine	24				
Spotted hake	Marine	27				
Striped bass	Anadromous	884				
Striped burrfish	Marine	4				
Striped cuskeel	Marine	16				
Striped searobin	Marine	29				
Summer flounder	Marine	20			22,983	
Tautog	Marine	195			67,642	31,705
Threespine stickleback	Estuarine	18				
Weakfish	Marine	29	482,905			
White perch	Estuarine	606				
Windowpane	Marine	4	68,609		46,771	
Winter flounder	Marine	116	8,395,103		1,679,436	

Notes: a Sum of the monthly average.
b An estimated 4,817 American sand lance and 532,656 grubby of unidentified life stage, and 13,893 unidentified fish were entrained annually.
Source: LMS 1994.

A total of 4,960 entrained fish eggs and larvae were collected during the 23-month study period, and were used to estimate the number of eggs and larvae entrained when adjusted for flow (Table 18-5). Bay anchovy and winter flounder had the highest number of entrained lifestage individuals, accounting for over 80 percent of the total number of individuals entrained, followed by much lower numbers of silver hake, gobies, and grubby (between 2 and 3 percent each). The highest rate of egg and larval entrainment occurred from late spring through the summer, similar to the peak period of ichthyoplankton abundance observed by the USACOE in the Upper Harbor (USACOE 2002). For the 1991 through 1993 study period, average daily plant volumes withdrawn through the WTC intake were calculated as approximately 33 mgd-spring, 62 mgd-summer, 39 mgd-fall, and 22.0 mgd-winter. These average daily flows are similar to those estimated for the 2-year period prior to September 11, 2001 (as presented in EPA 2003): 33 mgd-spring, 63 mgd-summer, 46 mgd-fall, and 35 mgd-winter. Entrainment rates corresponded closely to the bay anchovy spawning season in the New York Bight area (May through August). Winter flounder ichthyoplankton occurred from March through May, with peak entrainment of eggs and post-yolk-sac larvae occurring in May. This is similar to the peak months for winter flounder early lifestages reported by the USACOE for the Upper Bay in 2001 (LMS 2003b). Large yearly differences were seen in abundance of entrained fish eggs and larvae for certain species.

Table 18-6 presents the estimated annual number of invertebrates impinged at the WTC cooling water intake from 1991 to 1993. Blue crab comprise the majority of the estimated annual number of invertebrates impinged. During the 1991 to 1993 study at the WTC cooling water intake, blue crab generally occurred from late spring through late fall, with the highest numbers from May through October. No crabs were impinged in January or February. Horseshoe crab was the fifth most abundant invertebrate impinged during the 1991 to 1993 study, when they were generally collected from May to September, with the highest numbers in June and July.

Table 18-6
Estimated Annual Number of Invertebrates Impinged by the World Trade Center Hudson River Water Intake 1991-1993

Common Name	Scientific Name	Number Impinged
Blue crab	*Callinectes sapidus*	15,003
Sand shrimp	*Crangon septemspinosa*	1,689
Grass shrimps	*Palaeomonetes* spp.	1,312
Marine mud crab	*Rhithropanopeus harrisii*	915
Horseshoe crab	*Limulus polyphemus*	670
Lady crab	*Ovalipes ocellatus*	108
Mud crab	not specified	29
Spider crab	*Libinia emarginata*	19
Common rock crab	*Cancer irroratus*	16
Green crab	*Carcinus maenus*	8

Note: Sum of average monthly estimates.
Source: LMS 1994.

Results of Quantitative Analysis

Tables 18-7 and 18-8 present the results of the quantitative analysis to assess entrainment and impingement impacts to Atlantic menhaden, bay anchovy, striped bass, weakfish, white perch, winter flounder, Atlantic tomcod, bluefish, and blue crab. The analysis calculates losses of equivalent recruits (i.e., 1-year old fish), pounds lost to the fishery, pounds lost to predators (i.e., production forgone) due to impingement and entrainment, and relates these losses to riverwide or regional population estimates. For Atlantic menhaden, striped bass, weakfish, white perch, winter flounder and blue crab, this section also compares the projected weight of individuals lost due to impingement and entrainment to annual average commercial landings for the region (New York, New Jersey, and Connecticut).

Atlantic menhaden—Results indicated that more than 1.3 million individuals in the early lifestages less than 1-year old (mostly eggs) were entrained annually at the WTC intake during the 1991 to 1993 period (Table 18-5). This loss would equate to an annual loss of 278 age-1 fish that would have been added to the regional population and about 69 pounds that would have been added to the fishery in New Jersey, New York and Connecticut. The estimated annual loss of 69 pounds that would have been added to the Atlantic menhaden fishery is less than 0.0003 percent of the average annual commercial landings (greater than 25 million pounds) reported for the tri-state area for the same time frame. An annual average of 39 menhaden were impinged. These results suggest that the annual loss of Atlantic menhaden through impingement and/or entrainment at the WTC cooling water intake system would not result in a significant adverse impact to the regional Atlantic menhaden fishery.

Bay anchovy—Bay anchovy was the most abundant species entrained during the 1991 to 1993 study, primarily as eggs (Table 18-5). An estimated average of 158 fish were also impinged annually during this same time period. The results indicated that more than 49 million individuals in the early lifestages less than 1-year old (eggs, larvae and juveniles) were estimated to be entrained annually during the 1991 to 1993 study. This loss would equate to an annual loss of 24,393 age-1 fish that would have been added to the regional bay anchovy population in New Jersey, New York and Connecticut. The estimated number of adult (age-1 and older) bay anchovy lost to the regional fishery through impingement was calculated at 142 fish, or 0.58 pounds. Approximately 104 pounds of bay anchovy would be lost as potential prey on an annual basis, which would equate to about 21 pounds of potential predator biomass (assuming a 20 percent trophic transfer efficiency (Odum 1971)). These results suggest that although the estimated annual average entrainment of individuals in the early lifestages appears high, the estimated annual loss of 1-year old fish that would have been added to the regional population is small. The weight of older fish lost to the population through impingement is insignificant. Predatory fish that rely on bay anchovy for food would not be expected to be adversely impacted from this small loss of prey.

The estimated annual average number of bay anchovy eggs entrained at the WTC intake for the 1991 to 1993 period (48,153,417) is also extremely small compared to the more than 1 trillion estimated average yearly production of bay anchovy eggs within the Hudson River system (less than 0.005 percent) (Table 18-8). No bay anchovy yolk sac larvae were reported during the impingement/entrainment study. The yolk sac larval stage has a duration of about 2 days, compared to a duration of about 30 days for the post-yolk sac stage. The estimated annual average number of post-yolk sac bay anchovy larvae entrained at the intake (961,700) is also miniscule compared to just the average daily number of bay anchovy post-yolk sac larvae

Table 18-7
Impingement and Entrainment Losses (1991–1993) Expressed as Potential Pounds Lost to the Fishery or Potential Reduction in Pounds of Bay Anchovy Available to Predators

Species	Early Life Stage Losses[1]		1-Year Old and Older Losses[2]		Production Forgone[3] (lbs)	Commercial Landings[4] (lbs)
	Equivalent Recruits[1]	Pounds Lost to Fishery	Number Lost	Total Weight (lbs)		
Atlantic Menhaden	278	69.1				25,194,328
Bay Anchovy	24,393		142	0.58	104	
Blue Crab	1,503	72.8	13,290	1,564.7		7,134,799
Striped Bass	55	70.0	497	482.6		147,079
Weakfish	5	4.8	1	0.2		1,114,565
White Perch	14	0.007	584	140.4		78,499
Winter Flounder	782	184.6				1,823,288

Notes: [1] Based on impingement and entrainment collections of eggs, yolk-sac larvae, post-yolk-sac larvae, and juvenile data modeled to predict losses of 1-year old fish (i.e., equivalent recruits).
[2] Based on impingement and entrainment collections of 1-year old and older fish and shellfish.
[3] Reduction in fish biomass available to higher trophic levels.
[4] Average annual value based on New York, New Jersey, and Connecticut data collected from 1991 through 1993.
Sources: LMS 1996a, 1996b, 1997; National Marine Fisheries Service Commercial Landings Database (http://www.st.nmfs.gov/st1/commercial/index.html).

Table 18-8
Hudson River Riverwide Population Estimates

Species	Type of Estimate	Estimate
Atlantic Tomcod	Average daily number of juveniles	1,052,902
Bay Anchovy	Total annual production of eggs	1,310,855,588,933
Bay Anchovy	Average daily number of yolk sac larvae	874,201
Bay Anchovy	Average daily number of post-yolk sac larvae	898,099,901
Bay Anchovy	Average daily number of juveniles	61,343,294
Bluefish	Average daily number of juveniles	12,655
Striped Bass	Average daily number of juveniles	655,463
Weakfish	Average daily number of juveniles	582,231
White Perch	Average daily number of juveniles	234,716

Notes: Eggs, yolk sac larvae, and post yolk sac larvae are based on Long River Survey data; Juveniles are based on Fall Shoals Survey data.
Sources: LMS 1996a, 1996b, 1997.

estimated to be present on a given day (0.001 percent). The estimated annual average number of juvenile bay anchovy entrained at the WTC intake (17,793) is also miniscule compared to just the average daily number of bay anchovy juveniles estimated to be present in the river on a given day during the same period (0.0003 percent).

This apparent discrepancy between the high annual average number of eggs entrained and the low loss of one-year-old fish can be explained by the 99.99 percent natural mortality of early life stages up to age-1 of bay anchovy. These results suggest that the annual loss of bay anchovy through impingement and/or entrainment at the WTC cooling water intake system would not result in a significant adverse impact to the regional bay anchovy fishery or regional population, or to fish such as striped bass that use them as forage.

Striped bass—As discussed previously, striped bass is an important commercial and recreational fish in the mid-Atlantic region, and is an important predatory fish in the New York/New Jersey Harbor Estuary, and Hudson River Estuary. During the 1991 to 1993 impingement/entrainment study at the WTC cooling water intake, approximately 884 striped bass were impinged annually, some of which were juveniles (less than 1 year). No striped bass lifestages were entrained, as would be expected because spawning occurs far upriver. The results of the analyses suggest that the average number of juveniles impinged at the intake annually would equate to an annual loss of 55 one-year-olds that would have been added to the New York, New Jersey and Connecticut fishery, or an average loss of just 70 pounds that would have been added to the fishery. This loss is less than 0.1 percent of the annual commercial landings recorded during the 1991 to 1993 period. Approximately 497 striped bass one-year-old and 2-year old fish were impinged on an annual basis during the 1991 to 1993 study period, for an estimated weight of about 483 pounds. This annual average loss is about 0.33 percent of the annual average commercial landings in New York, New Jersey and Connecticut during this time period.

The estimated annual average number of juvenile striped bass impinged during the WTC intake study (384 fish) is only 0.0006 percent of the average number of juveniles estimated to be present in the river on a given day (Table 18-8). The average annual riverwide abundance of 1-year old striped bass in the Hudson River estimated from the Hudson River Utilities' SBMR program for the 1990 to 1994 year classes (Central Hudson Gas & Electric Corporation et al. 1999) is 1.8 million fish. The estimated annual average number of one-year-old striped bass impinged during the 1991 to 1993 intake study (279) plus the estimated annual number of equivalent recruits lost (Table 18-7) is an extremely small compared to this estimate of the one-year-old population present within the Hudson River. These results suggest that the operation of the WTC intake would not be expected to result in significant adverse impacts to the regional striped bass fishery or population.

Weakfish—Weakfish is an important recreational fish and a common resident in the lower Hudson River during the summer, and is commercially fished in New York, New Jersey and Connecticut. NYSDEC (2003) has identified weakfish as a Hudson River species that is declining in abundance, and commercial and recreational landings have decreased since 1980. However, management measures implemented since 1996 have resulted in positive trends for the weakfish population. During the 1991 to 1993 impingement/entrainment study at the WTC cooling water intake, an average of approximately 482,905 weakfish eggs were entrained and about 28 juveniles impinged each year. The results of the analysis suggest that the average number of eggs entrained and juveniles impinged at the intake annually would equate to an annual loss of only five one-year-old fish that would have been added to the New York, New Jersey and Connecticut fishery, or an average loss of about 4.8 pounds that would have been added to the regional fishery. This loss is about 0.0004 percent of the annual commercial landings recorded for the tri-state region during the 1991 to 1993 period. For weakfish, natural mortality of early lifestages less than one year old is high (99.9997 percent). An average of one weakfish, 1-year old and older, was impinged annually at the WTC intake during the 1991 to 1993 study period, of a weight of 0.2 pounds. This annual average loss is miniscule compared to the average annual landings reported in the tri-state area during this same time period. The estimated annual average number of juvenile weakfish impinged at the WTC intake from 1991 to 1993 (28) is extremely small (0.00005 percent) when compared to the estimated average number of juvenile weakfish present in the Hudson River on a given day (Table 18-8). These results suggest that the operation of the WTC cooling water intake would not be expected to result in significant adverse impacts to the regional weakfish fishery or population, or affect the current positive trend in the population.

White perch—White perch is a commercially and recreationally important species in the Hudson River estuary. NYSDEC (2003) has identified white perch as a Hudson River species that has been declining in abundance. During the 1991 to 1993 impingement/entrainment study at the WTC cooling water intake, an average of approximately 606 white perch were impinged annually, some of which were juveniles. The results of the analysis suggest that the average number of juveniles impinged at the intake annually would equate to an annual loss of about 14 1-year old fish that would have been added to the New York, New Jersey, and Connecticut fishery, or an average loss of about 0.007 pounds to the regional fishery. This loss to the fishery is extremely small, about 0.00001 percent of the annual commercial landings recorded for the tri-state region during the 1991 to 1993 time period. An average of 584 fish, 1-year old and older, were impinged annually at the WTC intake during the 1991 to 1993 study period, with an estimated weight of about 140 pounds. This annual average loss is small compared to the annual average commercial landings during this period (about 0.18 percent). The estimated annual average number of juvenile white perch impinged during the WTC intake study (15) is only 0.00006 percent of the average number of juveniles estimated to be present in the river on a given day (Table 18-8). These results suggest that operation of the WTC cooling water intake would not be expected to result in significant adverse impacts to the regional white perch fishery or population.

Winter flounder—Winter flounder is a popular sport and commercial fish in the New York/New Jersey Harbor Estuary and is managed by the ASMFC. Winter flounder are currently experiencing high fishing rates in excess of natural production and the Southern New England/Mid-Atlantic stock is considered overfished. Individual winter flounder in the early lifestages (less than 1-year old) were the second most abundant species entrained at the WTC intake during the 1991 to 1993 impingement/entrainment study. An average of 10,074,539 individuals less than 1-year old (most of which were eggs) were entrained annually. An average of approximately 116 winter flounder was impinged annually at the intake during the study period, all of which were juveniles (less than 1-year old). The results of the analysis suggest that this average annual number of early lifestages entrained, and impinged each year would equate to an annual loss of about 782 1-year old fish that would have been added to the New York, New Jersey, and Connecticut fishery, or an average loss of about 185 pounds that would have been added to the regional fishery. This loss to the fishery is small when compared to commercial landings for the same period (about 0.01 percent of the commercial landings). The estimated annual loss of 782 1-year old winter flounder would represent 0.00005 percent of an estimated annual coastwide population of 1-year old winter flounder (developed from 1995 through 2001 ASMFC data). The estimated loss of age-1 fish individuals that would have been recruited to the population is very small, primarily due to the extremely high natural mortality rate for early winter flounder lifestages (99.9983 percent), and the approximately 3-week duration of the egg lifestage. These results suggest that the annual average loss of winter flounder early life stage individuals through entrainment and impingement at the WTC intake would not result in a significant adverse impact to the regional winter flounder population.

Atlantic tomcod—Atlantic tomcod is an anadromous species that is common in the Lower Hudson River Estuary, as adults, larvae and juveniles. NYSDEC (2003) has identified Atlantic tomcod as a Hudson River species that has been declining in abundance. The estimated annual average number of Atlantic tomcod impinged during the 1991 to 1993 period is 345 individuals. If all of these individuals are assumed to be juveniles, the annual average number of juveniles lost due to impingement is extremely small when compared to the average daily number of juveniles present in the river on a given day (Table 18-8), about 0.00033 percent. These results do not suggest that operation of the WTC intake has the potential to result in a significant adverse impact to the regional Atlantic tomcod population.

Bluefish—Bluefish has a commercial and recreational fishery and is managed by the ASMFC. NYSDEC (2003) has identified bluefish as a Hudson River species that has been declining in abundance. However, the total stock biomass rose between 1995 and 2001, during the period when the WTC intake was operating, and overfishing of the stock was not occurring in 2002. The estimated annual average number of individuals impinged during the 1991 to 1993 WTC intake study is 16 fish per year, all of which are projected to be juveniles. This number is small without comparing it to a population estimate. When compared to the average daily number of juvenile bluefish estimated to be present within the Hudson River on a given day during the 1991 to 1993 period (Table 18-8), it is only 0.0013 percent of the number of juveniles estimated to be present on one day. These results suggest that operation of the WTC intake would not result in a significant adverse impact to the regional bluefish population.

Blue crab—Blue crab was the most abundant invertebrate species impinged (Table 18-6). The results of the analyses suggest that the annual average number of smaller crabs impinged during the 1991 to 1993 period, would equate to an annual loss of 1,503 juveniles (less than 50 mm, 2 inches) that would have been added to the regional population and about 73 pounds that would have been added to the fishery in New Jersey, New York and Connecticut. This annual loss is about 0.001 percent of the annual commercial landings (7.1 million pounds) recorded during the 1991 to 1993 period. An estimated annual average of approximately 13,290 adult blue crab were impinged at the WTC cooling water intake during the 1991 to 1993 study period, or a weight of 1,565 pounds. This annual average loss of adult blue crab is about 0.02 percent of the annual average commercial landings in New York, New Jersey and Connecticut.

The estimated number of blue crab losses projected during the 1991 to 1993 impingement study was compared to the blue crab possession limit for recreational saltwater fish set by NYSDEC as of July 3, 2003 (no size limit; daily possession limit of 50; year-round open season). For the 12-month period from March 1991 to February 1992, an estimated total of 2,907 blue crab were impinged. For the period from March 1992 to February 1993, an estimated total of 27,099 blue crabs were impinged at the WTC intake. Impingement occurred from April to December for 1991-92 and March through October for 1992-93, with the highest numbers from May to October. Assuming recreational fishing would occur over a 6-month period from May through October, two days a week (52 days) and 4 holidays days (the documented blue crab fishing period in the Hudson River estuary is summer and fall, Kenney 2002), the total number of crabs that could potentially be collected by one recreational fisherman would be 2,800 crabs. Therefore, the estimated total impinged during the 1991 to 1992 period would be about the same as that collected by one recreational saltwater fisherman. For the 1992 to 1993 period, the estimated number impinged would about the same as the number collected by 10 recreational saltwater fishermen. The estimated annual average number of crabs would be the same as that collected by about 5 saltwater fishermen.

These results suggest that the annual average loss of blue crab through impingement at the WTC cooling water intake system would not be expected to result in a significant adverse impact to the regional blue crab fishery, and hence, the population.

Results of Qualitative Assessment

Target species that were not addressed in the quantitative analysis, but for which a qualitative assessment was made based on habitat requirements, life history and other information include: black sea bass, blueback herring, grubby, hogchoker, red hake, silver hake, spotted hake, and horseshoe crab.

Black sea bass—Black sea bass is a commercially and recreationally valuable marine fish. The ASMFC found the black sea bass stock to be over-exploited and at a low biomass level in 1998. The current management plan for this species sets an annual quota for this species that is divided between the recreational and commercial fishery. No early life stages were entrained during the 1991 to 1993 study. The estimated annual number of black sea bass impinged at the WTC cooling water intake during the 1991 to 1993 period is low (55 individuals), and would not be expected to adversely affect the regional black sea bass population. Assuming all of the individuals impinged were 1-year old or younger (individuals impinged were all less than 90 mm), the estimated annual number impinged would be about 0.000004 percent of an estimated annual coastwide population of black sea bass older than 1 year, based on available population data for 1998.

Blueback herring—Blueback herring is an anadromous fish that is commercially fished in the Hudson River and managed by the ASMFC. Commercial and recreational harvest of blueback herring have declined since 1985. No early life states were entrained during the 1991 to 1993 study. The estimated annual number of blueback herring impinged at the WTC cooling water intake is low (95), and would not be expected to adversely affect the regional blueback herring population. Assuming all of the individuals impinged were juveniles (all were less than 110 mm), the annual number impinged would represent an extremely small fraction of an estimated average juvenile blueback herring population in the Hudson River (23.2 million individuals) based on density estimates for juvenile average blueback herring for the years 1979 through 1997, as reported in Central Hudson Gas and Electric Corp et al. (1999).

Grubby—Grubby is a small marine fish that is common in the Lower Hudson River Estuary and has no recreational or commercial value. All lifestages have the potential to occur in the vicinity of the WTC cooling water intake, and the impingement/entrainment study reported entrainment of yolk sac and post-yolk sac larvae (estimated annual average of 275,950 and 398,224 respectively), and impingement of individuals (estimated annual average of 1,351). While these numbers may appear large, the quantitative analysis presented earlier of other species found in larger numbers in the impingement/entrainment study, such as winter flounder and bay anchovy, suggest that the annual estimated losses through impingement and entrainment would not be expected to result in significant adverse impacts to the regional population of grubby.

Hogchoker—Hogchoker is an estuarine species that has no commercial or recreational value. It is considered abundant in the Harbor Estuary (Woodhead 1990). Eggs were the only early lifestage entrained during the WTC cooling water intake impingement/entrainment study (annual average number of eggs was 724,011). The annual average number of individuals impinged during the intake study is 82. After consideration of the high natural mortality of early lifestages for fish (greater than 99 percent), and the quantitative analysis for other target species with high egg entrainment, significant adverse impacts to the regional hogchoker population would not be expected to occur from the estimated annual entrainment of 724,011 eggs. Additionally, the loss of individuals from impingement is small and would not be expected to adversely affect the regional population.

Red, spotted, and silver hake—Red hake, spotted hake, and silver hake are marine fish that are not important commercial or recreational species. The estimated annual number of red, spotted, and silver hake impinged during the 1991 to 1993 WTC intake study is low (3, 27, and 25, respectively), and would not be expected to adversely affect the regional populations for these two species. Entrainment of early lifestages was only reported for silver hake during the 1991 to 1993 entrainment study; the estimated annual average number of silver hake eggs entrained is 1,974,407. After consideration of the extremely high natural mortality for early lifestages of fish and the results of the quantitative analyses for other target species with high numbers of entrained early lifestages, this annual average loss of eggs would not be expected to result in significant adverse impacts to the regional silver hake population.

Tautog—Tautog is a valuable commercial and recreational marine fish that spawns near the mouths of estuaries. It is managed by the ASMFC. On the east coast, tautog is primarily a recreational fishery. An annual average of 195 individuals were impinged at the intake during the 1991 to 1993 study. An annual average of 67,642 post yolk-sac larvae, and 31,705 juveniles were entrained at the WTC intake. Given the high natural mortality rates for early lifestages, these numbers of entrained fish would be indicative of a much lower number of equivalent 1-year olds. These estimated losses would be small compared to an estimated annual average 1-year old Long Island Sound population of 1,366,000 (based on CTDEP data from 1995 to 2001, CTDEP 2002), and would not be expected to result in significant adverse impacts to the regional tautog population, or to affect the slight increase in biomass and recruitment observed in recent years.

American shad—American shad is an anadromous fish that has commercial and recreational fisheries. It spawns upriver, and juveniles migrate down the river and out of the estuary in the fall. NYSDEC (2003) identified American shad as a species declining in abundance in the Hudson River estuary. The estimated annual number of American shad impinged at the WTC intake is extremely low, 3 individuals. Therefore, operation of the WTC intake would not be expected to result in significant adverse impacts to this species.

American eel—American eel is a catadromous species that is commercially important, and managed by the ASMFC. The estimated annual average number of eel impinged during the 1991 to 1993 study is 36 individuals. Because the impinged count was low, significant adverse impacts to American eel would not be expected to occur from the operation of the WTC intake.

Horseshoe crab—The estimated number of horseshoe crab and blue crab projected during the 1991 to 1993 impingement study was compared to the horseshoe crab possession limits for recreational saltwater fish set by NYSDEC as of July 3, 2003 (no size limit, daily possession limit is 5, season is open year round). For the 12-month period from March 1991 to February 1992, an estimated total of 1000 horseshoe crabs were impinged. For the period from March 1992 to February 1993, an estimated total of 339 horseshoe crabs were impinged by the WTC intake. Impingement occurred from May to November the first year and May to August the second year. The estimated annual average number of horseshoe crabs impinged is 670 per year. Assuming recreational fishing would occur over a 6 month period from May through October, two days a week (52 days) and 4 holidays days, the total number of horseshoe crabs that could be collected by one recreational fisherman would be 280 horseshoe crabs. Therefore, the estimated total collected during the 1991 to 1992 period would be the same as approximately 4 people collecting the daily limit of horseshoe crabs on weekends and a few holidays during the warmer weather months. For the 1992 to 1993 period, the estimated number impinged would be slightly more than 1 person collecting the daily limit under the same assumptions. The annual average number of 670 crabs would be the same as the total amount collected by about 2 recreational fishermen under the same assumptions.

The ASMFC issued the Fishery Management Plan for the Horseshoe Crab in 1998. Addendum 1 to the plan established reference period landings and set state-by-state quotas on bait landings at 25 percent below the reference period landings. A state must close its horseshoe crab bait fishery once that state's cap is reached. The current quota for Horseshoe crab bait landings for New York is 366,272 crabs per year (ASMFC 2003a). The estimated annual number of horseshoe crabs impinged during the WTC intake study is less than 0.002 percent of the current bait landings quota. Additionally, this estimated number impinged is far less than the 0.02 to 0.03 percent of the estimated annual horseshoe crab mortality from the biomedical industry. These analyses, combined with the fact that the WTC intake is not located within the vicinity of any horseshoe crab spawning habitat, suggest that adverse impacts to the regional and coastal population of horseshoe crabs would not be expected to occur from the operation of the WTC cooling water intake.

EFH—Appendix I.2, "Essential Fish Habitat Assessment," presents a detailed assessment of potential impacts to EFH for the life stages of the 15 managed fish that the NMFS has identified as occurring in the Lower Hudson River Estuary. Potential loss of EFH habitat is not expected to occur as a result of the operation of the WTC cooling water intake. Because the intake structure is in place and operational, no in-water construction activities would be required as part of the Proposed Action. Therefore, no physical alteration would occur to EFH in the vicinity of the WTC intake. Furthermore, there would be no need for dredging or any extensive bottom disturbing actions that could negatively affect fish habitat. The operation of the intake would result in an increase in flow velocities from current conditions, but such velocities would be expected to be no greater than those that existed at the intake channel prior to September 11, 2001, and would meet the intake velocity limitation issued with the SPDES permit. Studies comparing the fish communities of underpier habitats to those found in interpier, pile field and channel habitats within the lower Hudson River have found that the number and variety of fish to be significantly lower under piers (EEA 1988, EEA 1990, Able et al. 1995, Able et al. 1998, Able et al. 1999, and Duffy-Anderson and Able 1999). Able et al. (1998) concluded that habitat quality under platforms greater than 20,000 square meters (5 acres) appears to be poor for juvenile fish, compared to pile fields and open water habitats. These studies suggest that the habitat quality in the WTC intake channel under the Battery Park City esplanade would generally be less desirable habitat for most fish species than open water or pile field habitats available within the vicinity of the intakes. Any modification in flow regime that would occur from the operation of the WTC would not be expected to significantly adversely effect EFH.

During sampling conducted at the WTC intake from March 1991 through February 1993, only three EFH species were entrained at the intake: winter flounder (8.4 million eggs and 1.7 million larvae), summer flounder (22,983 larvae), and windowpane (68,609 eggs and 46,771 larvae). Of these three species, winter flounder had the largest estimated annual number of eggs and post-yolk sac larvae entrained during the 1991 to 1993 period. While the estimated annual number of winter flounder eggs and post-yolk sac larvae appears high, the results of the analyses presented in the previous section show that these losses, combined with the estimated annual average number of juveniles impinged on the intake (116), would equate to an extremely small loss to the fishery and would not result in a significant adverse impact to the regional winter flounder population. Numbers of early life stages entrained for summer flounder and windowpane flounder were low (over 100 times lower than the winter flounder numbers) and as such, significant adverse impacts to summer flounder and windowpane flounder populations would not be expected to occur from the operation of the WTC intake.

EFH species impinged included: red hake, winter flounder, windowpane, Atlantic herring, bluefish, Atlantic butterfish, summer flounder, scup, and black sea bass. Estimates of annual impingement for these species ranged from 3 (red hake) to 116 (winter flounder, juveniles only), with most averaging 20 or fewer individuals impinged annually. The results of the evaluation of selected fish species presented in the previous section, including the EFH species winter flounder, bluefish, black sea bass, and red hake, show that significant adverse impacts to fish populations, including prey species for EFH such as bay anchovy and Atlantic menhaden, would not be expected to occur from the loss of some individuals through impingement and entrainment. Therefore, the operation of the WTC intake would not be expected to result in significant adverse impacts to EFH species resources.

Because the heated effluent that would be discharged through the existing WTC outfalls from cooling the various components of the Proposed Action would meet the thermal limitations specified in the 1999 SPDES permit, adverse impacts would not be expected to occur to EFH. Stormwater generated within the Project Site during construction of the project components and during operation of the Proposed Action would not be discharged directly to surface waters, but would be directed to the municipal combined sewer system. (During wet weather conditions, overflow discharge from the combined sewer system is discharged into either the Hudson River or East River.) Implementation of erosion and sediment control measures, and stormwater management measures during construction, including the approved stormwater pollution prevention plan (SWPPP), and the proposed reclamation of stormwater for other uses such as irrigation of open space areas, would minimize potential impacts to the municipal stormwater system from the introduction of stormwater due to the Proposed Action. Therefore, no significant adverse impacts to EFH would be expected to occur from stormwater discharges generated on the Project Site during construction or operation of the Proposed Action.

Endangered, Threatened, and Special Concern Species

Potential impacts to endangered, threatened or species of special concern as a result of the operation of the WTC cooling water intake were evaluated in section 18.4.3, "Probable Impacts of the Proposed Action 2009—Current Conditions Scenario." The additional volume of riverwater volume required to cool the Proposed Action at full build-out in 2015 would not change the conclusion reached in section 18.4.3, "Probable Impacts of the Proposed Action 2009—Current Conditions Scenario," that significant adverse impacts would not be expected to occur to endangered or threatened species or other species of concern.

TERRESTRIAL RESOURCES

By 2015, the completion of the other four towers would have the potential to result in more bird strikes than under the Current Conditions Scenario or the 2009 analysis year. Potential impacts to peregrine falcons during construction of the components to be completed by 2015 would be minimized by implementing the measures presented previously for 2009. Peregrine falcons are accustomed to the intensely developed habitats of New York City and are not expected to experience a negative impact due to the Proposed Action. There are no records of peregrine falcons colliding with buildings in the city. Bird strikes could be reduced through the implementation of mitigation measures such as those described previously.

In addition, the cessation of all construction activity on the Project Site by 2015 would result in the removal of potential bird strikes to construction equipment and related activity.

CONCLUSIONS

The results of the analyses of potential effects to natural resources from the Proposed Action in 2009 and 2015 under the Current Conditions Scenario led to the following conclusions.

- The water quality and biological resources of the lower Hudson River were not substantially different between the pre-September 11, 2001 and post September 11 time periods.
- According to the Port Authority, the intake structure, pumphouse, water pipelines and outfalls are largely intact and functional. The reuse of these structures is the most economical and efficient method for cooling components of the Proposed Action.
- As discussed in Chapter 12, "Infrastructure," the water withdrawal requirements under full build-out condition in 2015 (required to cool approximately 11.8 million square feet of space) are expected to be no greater than they were prior to September 11, 2001 (approximately 10 million square feet of space) because of greater efficiencies of the systems and compliance with sustainability guidelines established for the Proposed Action. Cooling water needs for the approximately 4 million square feet of space expected to be completed in 2009 would be considerably less.
- Heated effluent discharged through the WTC cooling water outfalls would meet the thermal criteria specified in the 1999 SDPES permit. Therefore, thermal impacts to biota would not be expected as a result of the Proposed Action in 2009 or 2015.
- No stormwater would be discharged directly to the Hudson River during construction or operation of the Proposed Action in 2009 or 2015.
- While there would be losses of aquatic organisms due to impingement or entrainment at the intake, the estimated number of fish and invertebrates lost through operation of the intake in 2015 would be expected to be an average of 65 to 82 percent lower (depending on the season) than what would be expected to occur from the operation of the intake at the design flow (179 mgd). The estimated low annual loss of some individuals through impingement, and higher estimated annual loss of individuals through entrainment would equate to a much smaller number of older fish that would not be added to the population, or small number of pounds that would be lost to a particular fishery because of the extremely high natural mortality of these lifestages. These losses may, however, result in significant adverse impacts to populations of these species in the Lower Hudson River under the Proposed Action in 2015 if withdrawal volumes increase from those projected and approach design flows.
- As part of the SPDES permitting process for operation of the WTC intake, measures to reduce impingement losses (e.g., further flow reduction, modified screens with fish return, reduction of flow velocities, closed-cycle cooling, and fish avoidance systems such as barrier nets, light and sound) and entrainment losses (e.g., flow reduction, closed-cycle cooling, fine mesh barriers to exclude eggs and larvae such as Gunderbooms and fine mesh wedge wire screens) would be explored with respect to feasibility, effectiveness, cost, and constraints imposed by surrounding property owners and land uses such as deed restrictions or easements.

- Because the area to be cooled in 2009 is as much as 60 percent less than in 2015 and the pre-September 11 baseline, the volume of water withdrawn for the Proposed Action in 2009, would be similarly reduced. This lower volume of cooling water withdrawn at the WTC intake for the Proposed Action in 2009 would significantly reduce losses of fish and invertebrates through impingement and entrainment. Therefore, the operation of the WTC intake for the Proposed Action in 2009 would not be expected to result in significant adverse impacts to aquatic biota.
- Significant adverse impacts would not be expected to occur to EFH for the lifestages of the 15 managed species identified by the NMFS as occurring in the Lower Hudson River Estuary in 2009, and may also not occur in 2015. This conclusion is based upon: the results of the quantitative and qualitative assessment of potential impacts to target species from impingement and entrainment); the lack of in-water construction activities associated with the Proposed Action; the conclusion that the channel leading to the intake under the Battery Park City esplanade would be a less desirable habitat for most fish species than open water or pile field habitats available within the vicinity of the intake; and the findings that significant adverse impacts would not be expected to occur to water quality, and therefore EFH, from the discharge of the heated effluent or stormwater from the Proposed Action.
- Significant adverse impacts would not be expected to occur to threatened or endangered species, or species of special concern to state or federal agencies. None of the four species of sea turtles identified as having the potential to occur as transient individuals nest or reside in the lower Hudson River year round. Sea turtles are rarely observed in these portions of the estuary.
- In 2009, the 1776 foot Freedom Tower, at the northwest corner of the WTC Site, would be taller than existing adjacent structures, with useable floor space up to an approximate height of 1,150 feet, and broadcast antennae that reach 2,000 feet. The tower would have approximately 540,000 square feet of vertical, exterior surface area over 500 feet in elevation, all of which would be additional exterior surface over current conditions. The greatest potential for bird strikes would occur in the spring (March–May) and fall (August–October) migration seasons.
- By 2015, the completion of the other four towers would result in a total of approximately 1,246,000 square feet of vertical, exterior, surface area extending over 500 feet in elevation, that would have the potential to result in more bird strikes than under the Current Conditions baseline, or the 2009 analysis year.
- Large construction equipment such as cranes and nighttime lighting for construction may also result in additional bird strikes. Measures would be implemented as necessary to minimize potential impacts to peregrine falcons within the vicinity of the Project Site. These measures may include bird control devices on the tops of cranes or other tall construction equipment to keep young falcons from landing on them and slipping off, and safety precautions for construction workers.
- Potential measures that may reduce bird strikes include reduction in reflective glass surfaces and interior lights visible from the outside, and reduction in the duration of nighttime decorative lighting, especially during the spring and fall migration periods. The selection of exterior building materials would have to balance reduction of bird strikes with the goal of integrating the conservation and optimization of energy use into the design of the structures of the Proposed Action.

- Peregrine falcons, which are endangered in New York, are accustomed to the intensely developed habitats of New York City and are not expected to experience a negative impact due to the Proposed Action. There are no records of peregrine falcons colliding with buildings in the city.
- The Proposed Action would result in additional open space areas with vegetation in both 2009 and 2015, as compared with current conditions.

18.5 PRE-SEPTEMBER 11 SCENARIO

18.5.1 BASELINE CONDITIONS

WATER QUALITY

Major improvements to water quality of the Lower Hudson River Estuary, indicated by lower fecal coliform bacteria concentrations and higher dissolved oxygen concentrations, occurred in the mid- to late-1980s. These improvements were primarily due to regional decreases in municipal and industrial discharges that occurred through the construction and upgrading of water pollution control plants (NYCDEP 1998 and 2003). After being closed to swimming for at least 40 years, the Coney Island Beach was reopened for swimming in 1988, and Staten Island beaches were reopened in 1992 for the first time in 20 years (NYCDEP 1998). While water quality continued to improve until the early 1990s, since that time, improvements have been relatively small (NYCDEP 2003). Therefore, the water quality conditions for the five years pre-September 11, 2001 would be expected to be similar to that described for the current conditions described earlier in this chapter in section18.4.1, "Baseline Conditions." Additionally, because the operation of the WTC cooling water intake and outfalls was in compliance with the 1999 SPDES permit conditions, it is not expected that the outfall would have influenced the existing water quality conditions during this time period. Therefore the 1998-2002 data presented in section 18.4.1, "Baseline Conditions," for the current condition represent both the pre- and post-September 11 water quality conditions. Prior to September 11, 2001, stormwater was collected in sumps within the WTC complex and discharged through WTC outfall 001.

AQUATIC BIOTA

Because the fish community in the Lower Hudson River and the New York/New Jersey Harbor Estuary has remained fairly stable since the late 1980s with respect to the dominant species, when the majority of the significant infrastructure improvements occurred in New York City (Woodhead 1990, ASA 2003), the aquatic biota for the lower Hudson River described under the Current Conditions Scenario in section 18.4.1, "Baseline Conditions," would also represent the pre-September 11 baseline conditions for aquatic biota, including EFH. As described in section 18.4.1, the target species that appear to be in decline were declining prior to September 11. The Pre-September 11 Scenario assumes that the WTC cooling water intake and outfalls are operating—withdrawing river water at volumes similar to that recorded during the 1991 to 1993 impingement/entrainment study and as recorded by EPA (2003) from 1999 to 2001, and discharging thermal effluent in accordance with the 1999 SPDES permit.

Endangered, Threatened, and Special Concern Species

The endangered, threatened and species of special concern described for the Current Conditions Scenario in section 18.4.1, "Baseline Conditions," would also represent the pre-September 11 baseline conditions for these resources.

TERRESTRIAL RESOURCES

Before September 11, 2001, the 110-story Twin Towers rose over 1,350 feet high. 1 WTC also had a 351.5-foot mast supporting television and FM radio antennae. Other structures at the WTC included two nine-story buildings (4 and 5 WTC), the eight-story U.S. Customs House (6 WTC), and a 22-story hotel (3 WTC), surrounding the Austin J. Tobin Plaza.

The WTC Site was completely paved, providing very limited habitat for wildlife in the form of 26,000 square feet of planters located primarily on the northern portion of the WTC Site away from Towers 1 and 2. Approximately 6,000 square feet of the planters were located indoors within the pedestrian connection between 6 WTC and 7 WTC. Another set of five planters were located on the eastern portion of the WTC Site between the retail area located in 4 WTC and 5 WTC; these planters were also located away from Towers 1 and 2. The planters consisted of ornamental vegetation and minimal shade trees. Wildlife consisted primarily of birds and small mammals tolerant of the urban conditions such as squirrels, chipmunks and rats. Songbirds, however, used the landscaping as resting areas during spring and fall migrations.

The New York City Audubon Society (NYCAS) Project Safe Flight has been documenting bird collisions with buildings in Manhattan since 1997 (NYCAS 2003). Volunteers conduct early dawn patrols around city buildings to monitor for injured and dead birds. Between April 1997 and May 2001, over 75 species of passerine (or birds of the Order Passeriformes) birds, nearly all of which are migratory, were reported in collisions with buildings at the WTC complex. During this period, approximately 250 bird fatalities and 125 injuries were recorded annually by the NYCAS Project Safe Flight at the WTC Site complex (NYCAS 2003). While none of these bird species are state or federally threatened or endangered, among the collisions were six species of warblers with low occurrences in the state of New York (NYNHP 2003). Because of the removal of birds by cleaning crews and scavengers, collisions reported by the NYCAS monitoring program may not represent the total number of bird collisions.

Project Safe Flight's data indicated that a considerable number of collisions occurred at the lower floors of the east face of 2 WTC (the South Tower), and were attributed to the close proximity of a large tree that offered resting habitat. In August 2000, the Port Authority covered these windows with nets, which resulted in birds contacting the nets and bouncing off unharmed instead of contacting the glass. Project Safe Flight's volunteers subsequently reported a reduction in the number of bird collisions at this location (NYCAS 2003).

Beginning in November 2000, the Port Authority turned off the floodlights that illuminate the TV masts on the roof of 1 WTC at night to avoid the disorientation of migrating birds (Port Authority 2000). Additionally, tenants in the WTC complex were asked to turn off non-essential lights at night or to close their blinds whenever possible to reduce the attraction to birds.

18.5.2 FUTURE WITHOUT THE PROPOSED ACTION 2009—PRE-SEPTEMBER 11 SCENARIO

WATER QUALITY AND AQUATIC BIOTA

Under the Pre-September 11 Scenario, future natural resource conditions without the Proposed Action in 2009 would not have withdrawal of cooling water through the WTC intake or discharge of thermal effluent through the WTC outfalls for the Proposed Action, but would have withdrawals and discharges for the WTC complex cooling system. As presented in section 18.4.2, "Future Conditions Without the Proposed Action 2009—Current Conditions Scenario," there are several proposed and ongoing projects aimed at improving water quality and aquatic resources in the New York/New Jersey Harbor Estuary that have the potential to result in water quality and aquatic resource improvements in the vicinity of the WTC cooling water intake on the Lower Hudson River Estuary. Many of the projects had been implemented prior to September 11, particularly those coordinated by HEP and the IEC and being implemented by New York City. These improvements would occur without the Proposed Action and are expected to continue through 2009.

TERRESTRIAL RESOURCES

Under the Pre-September 11 Scenario, terrestrial resources without the Proposed Action would continue to have very limited habitat in the form of landscaping with wildlife continuing to be comprised primarily of birds and small mammals tolerant of the urban conditions. The NYCAS Project Safe Flight at the WTC Site complex would likely have been in place for 12 years. The bird collisions would be comparable to pre-September 11, based on the methodology described earlier in this chapter. The floodlights on the roof of 1 WTC would remain off at night, and the same measures to reduce bird collisions (turning off non-essential lights and closing blinds) would still be implemented.

18.5.3 PROBABLE IMPACTS OF THE PROPOSED ACTION 2009—PRE-SEPTEMBER 11 SCENARIO

WATER QUALITY

Under the Pre-September 11 Scenario, river water is being withdrawn through the WTC intake and heated effluent is being discharged to the Hudson River through the WTC cooling water outfalls. The assessment of potential impacts to water quality presented in this GEIS evaluates the potential impact to existing water quality from continuing to discharge heated effluent that is in compliance with the 1999 SPDES permit authorizing the Port Authority to discharge the heated cooling water into the North Cove through one of two outfalls. As discussed previously, because the thermal effluent would meet the 1999 SPDES permit conditions, significant thermal impacts would not be expected to occur. In general, water quality impacts would be similar to those described for the Current Conditions Scenario in section 18.4.3, "Probable Impacts of the Proposed Action 2009—Current Conditions Scenario." Because the Proposed Action in 2009 would have less developed space to cool than prior to September 11, and because the equipment installed as part of the cooling system would be more efficient than that installed pre-September 11 (see Chapter 12, "Infrastructure"), the amount of water withdrawn to cool the various project components would be less than was required pre-September 11.

Stormwater generated within the Project Site during construction of the project components through 2009 and during operation of the Proposed Action would not be discharged directly to surface waters, but would be directed to the municipal combined sewer system. (During wet weather conditions, overflow discharge from the combined sewer system is discharged into either the Hudson River or East River.) Implementation of erosion and sediment control measures, and stormwater management measures during construction, including the approved stormwater pollution prevention plan (SWPPP), and the proposed reclamation of stormwater for other uses such as irrigation of open space areas, would minimize potential impacts to the municipal stormwater system. Pre-September 11, stormwater was collected in sumps and then discharged to the Hudson River through WTC outfall 001. Because the Proposed Action would result in improved stormwater management measures and would no longer discharge stormwater directly to the river, potential impacts associated with stormwater generated on the Project Site would be less than pre-September 11. Therefore, no significant adverse impacts to water quality would be expected to occur from construction or operation of the components expected to be completed by 2009 on the Project Site.

AQUATIC BIOTA

The evaluation of potential impacts to aquatic biota from the Proposed Action in 2009 assesses the potential effects to the aquatic community present under the pre-September 11 baseline condition in which the WTC cooling water system is operating. The potential impacts from the Proposed Action in 2009 under the Pre-September 11 Scenario would be the same as under the Current Conditions Scenario, presented in section 18.4.3, "Probable Impacts of the Proposed Action 2009—Current Conditions Scenario," since the aquatic biota baseline conditions are the same for the two scenarios. No significant adverse impacts to aquatic biota, including EFH, would be expected to occur as a result of the Proposed Action in 2009 under pre-September 11 conditions. Because the amount of space that needed to be cooled would be less than pre-September 11, less Hudson River water would be withdrawn. Therefore, the number of fish and invertebrates impinged or entrained at the intake would be expected to be lower under the Proposed Action in 2009 compared to pre-September 11 and the Proposed Action in 2015.

The results of the 2015 impact assessment presented in section 18.4.5, "Probable Impacts of the Proposed Action 2015—Current Conditions Scenario," suggest that withdrawal of Hudson River water through the existing WTC cooling water intake may not be expected to result in significant adverse impacts to aquatic biota. While the existing SPDES permit already offers protection for aquatic resources by placing a restriction on flow velocities at the intake. The Proposed Action in 2015 would reduce the volume of water withdrawn from the design flow by 65 to 82 percent. The estimated low annual loss of some individuals through impingement, and higher estimated annual loss of individuals through entrainment, would equate to a much smaller number of older fish that would not be added to the population, or small number of pounds that would be lost to a particular fishery because of the extremely high natural mortality of these lifestages. These losses may, however, result in significant adverse impacts to populations of these species in the Lower Hudson River under the Proposed Action in 2015 if withdrawal volumes increase from those projected and approach design flows.

Because approximately 60 percent less space would require cooling for the Proposed Action in 2009 compared to 2015, the volume of water withdrawn at the WTC intake would be greatly reduced from the pre-September 11 baseline. This lower volume of cooling water withdrawn at the WTC intake for the Proposed Action in 2009 would reduce losses of fish and invertebrates through impingement and entrainment from what occurred pre-September 11. Therefore, significant adverse impacts to populations of fish and invertebrates in the Hudson River Estuary would not be expected to occur from the operation of the WTC intake in 2009.

ENDANGERED, THREATENED, AND SPECIAL CONCERN SPECIES

As was assessed under the Current Conditions Scenario (see section 18.4.3, "Probable Impacts of the Proposed Action 2009—Current Conditions Scenario"), no significant adverse impacts would occur to threatened or endangered species, or species of special concern. No threatened or endangered aquatic species or species of special concern under the authority of the NYSDEC or USFWS were present within the vicinity of the WTC intake pre- or post-September 11. Shortnose sturgeon would be most likely to use the deep river in the portion of the Hudson River at the Battery, and would not use the portion of the river near the intake. Threatened or endangered sea turtles would be no more likely to use the lower Hudson River before September 11 than after September 11.

TERRESTRIAL RESOURCES

The Proposed Action includes over five additional acres of open space compared with pre-September 11 conditions. While no detailed designs have been completed at this point, the open space is anticipated to include approximately 2 acres of landscaped area comprising Liberty Park on the southern portion of the WTC Site and the Southern Site. Landscaping measures are anticipated to include shade trees and other vegetation including grass. The inclusion of such elements would offer resting/stopover habitats for migrating song birds as well as habitats for resident birds.

The 1,776-foot tall Freedom Tower, at the northwest corner of the WTC Site, would have useable floor space up to a height of 1,150 feet and broadcast antennae that would reach 2,000 feet. These heights are higher than pre-September 11 structures at the WTC Site. 1 WTC and 2 WTC were 110-story buildings that rose over 1,350 feet high. 1 WTC also had a 351.5-foot mast supporting television and FM radio antennae. Other structures at the WTC included two 9-story buildings (4 and 5 WTC), the 8-story United States Customs House (6 WTC), and a 22-story hotel (3 WTC), surrounding the Austin J. Tobin Plaza. The proposed Freedom Tower will also contain less reflective glass and likely emit less nighttime light than under pre-September 11 conditions.

Reflective glass and lighting at night would have the potential to result in bird strikes, especially during the spring and fall migratory seasons. However, considering that the Freedom Tower will be the only significant tall structure completed in 2009 and that its vertical surface area extending over 500 feet in elevation (approximately 540,000 square feet) is approximately 63 percent less than that present under pre-September 11 conditions (approximately 1,469,000 square feet), bird strikes in 2009 would be expected to be lower (approximately 63 percent) than under pre-September 11 conditions. Based on migratory altitudes published in the scientific literature and considering the existing structures surrounding the Project Site, comparisons of exterior vertical surface area were made at heights greater than 500 feet that extend into migratory bird flyways. Exterior vertical surface area was calculated by multiplying the perimeter of the building by height extending 500 feet or higher above ground. For purposes of this analysis, the likelihood of bird strike is expected to change proportionally with vertical surface area.

Ongoing construction may also result in additional bird strikes. Large vertical cranes, associated wires, and nighttime lighting would provide physical obstacles to birds. While any peregrine falcons that may occur in the vicinity of the Project Site would be expected to tolerate activities associated with the construction of the structures that are part of the Proposed Action, mitigation measures would be developed as necessary, depending on nesting activity in the vicinity of the Project Site, in coordination with NYSDEC and the NYCDEP. These measures would focus on minimizing potential impacts to falcons, nesting activity, and juvenile falcons. Potential measures could include the following:

- Bird control devices on the tops of cranes or other tall construction equipment to keep young falcons from landing on them and slipping off.
- Safety precautions for workers such as head and face protection, as necessary, during the nesting season when falcons can be aggressive. Nesting season in New York starts in February and March.

Options to be considered for reducing the potential for bird strikes include reduction in reflective glass surfaces and interior lights visible from the outside, and reductions in the duration of nighttime decorative lighting, especially during the spring and fall migratory periods. In addition, in 2003 the NYCAS adopted Conservation Resolutions which included: working with building managers to adopt a policy of reduced lighting in tall buildings; to urge the architectural and glassmaking industries to develop non-reflective glass that is visible to birds; and to work with the USFWS and U.S. Geological Survey's Biological Research Division to raise awareness of wild bird collisions with glass and find ways to significantly reduce such collisions. Site developers could be encouraged to work with the NYCAS on implementing conservation measures at the site. The selection of exterior building materials would have to balance reduction of bird strikes with the goal of integrating the conservation and optimization of energy use and minimizing air emissions into the design of the structures of the Proposed Action.

A detailed two-year study by Chicago's Field Museum at McCormick Place, a lakefront glass building that has resulted in the death of as many as 200 birds in one day through bird strikes, found that dimming the lights reduced bird strikes by 83 percent (The Field Museum 2003). Twenty tall buildings in Chicago are now taking part in the "Lights Out" program, dimming the lights on the upper stories after 11 PM each evening during the spring and fall migrations (Audubon News 2003).

As mentioned previously, two mitigation measures were put into effect to reduce the potential for bird strikes approximately one year before September 11, 2001. Because of the destruction of 1 WTC and 2 WTC, the effectiveness of window nets and reduced lighting in reducing bird strikes was not able to be scientifically evaluated. However, initial results suggested that building tenants were cooperating and that the measures were effective. By 2003, these bird strike mitigation efforts would have been in effect for several years, allowing their effectiveness to be evaluated.

18.5.4 FUTURE WITHOUT THE PROPOSED ACTION 2015—PRE-SEPTEMBER 11 SCENARIO

WATER QUALITY AND AQUATIC BIOTA

Under the Pre-September 11 Scenario, future natural resource conditions without the Proposed Action in 2015 would not have withdrawal of cooling water through the WTC intake or discharge of thermal effluent through the WTC outfalls for the Proposed Action, but would have withdrawals and discharges for the WTC complex cooling system. Many of the ongoing projects described in section 18.4.2, "Future Without the Proposed Action 2015—Current Conditions Scenario," would be expected to continue to 2015, resulting in additional improvements to water quality and aquatic habitat conditions in the New York/New Jersey Harbor Estuary, including the area in the vicinity of the WTC cooling water intake on the Lower Hudson River Estuary. (See the discussion presented in section 18.4.4, "Future Conditions Without the Proposed Action 2015—Current Conditions Scenario.")

TERRESTRIAL RESOURCES

Under the Pre-September 11 Scenario, terrestrial resources without the Proposed Action would continue to have very limited habitat in the form of landscaping with wildlife continuing to comprise primarily birds and small mammals tolerant of the urban conditions. The NYCAS Project Safe Flight at the WTC Site complex would likely have been in place for 12 years. The bird collisions would be comparable to pre-September 11, based on the methodology described earlier in this chapter. The floodlights on the roof of 1 WTC would remain off at night, and the same measures to reduce bird collisions (turning off non-essential lights and closing blinds) would still be implemented.

18.5.5 PROBABLE IMPACTS OF THE PROPOSED ACTION 2015—PRE-SEPTEMBER 11 SCENARIO

WATER QUALITY

Because the baseline conditions for water quality are expected to be the same under both the Current Condition Scenario and Pre-September 11 Scenario, even though water would be withdrawn through the WTC intake and thermal effluent discharged through the WTC outfalls in compliance with the 1999 SPDES permit, potential impacts to water quality of the Proposed Action in 2015 would be the same as discussed previously in section 18.4.5, "Probable Impacts of the Proposed Action 2015—Current Conditions Scenario." The cooling water needs, and therefore the volume of water withdrawn, for the Proposed Action is expected to be similar to that required for the WTC pre-September 11, since the amount of space requiring cooling is similar. No adverse impacts would be expected to occur to water quality under the Pre-September 11 Scenario.

Stormwater generated within the Project Site during construction of the project components through 2015 and during operation of the Proposed Action, would not be discharged directly to surface waters, but would be directed to the municipal combined sewer system. (During wet weather conditions, overflow discharge from the combined sewer system is discharged into either the Hudson River or East River.) Implementation of erosion and sediment control measures, and stormwater management measures during construction, including the approved stormwater pollution prevention plan (SWPPP), and the proposed reclamation of stormwater for other uses such as irrigation of open space areas, would minimize potential impacts to the municipal stormwater system from the introduction of stormwater due to the Proposed Action. Pre-September 11, stormwater was collected in sumps and then discharged to the Hudson River through WTC outfall 001. Because the Proposed Action would result in improved stormwater management measures and would no longer discharge stormwater directly to the river, potential impacts associated with stormwater generated on the Project Site would be less than pre-September 11. Therefore, no significant adverse impacts to water quality would be expected to occur from construction or operation of the components expected to be completed by 2015 on the Project Site.

AQUATIC BIOTA

The evaluation of potential impacts to aquatic biota from the Proposed Action in 2015 assesses the potential effects to the aquatic community present under the Pre-September 11 Scenario in which the WTC cooling water system is operating—with water being withdrawn and heated effluent discharged, starting in 2009. However, because the aquatic community was similar pre- and post-September 11, 2001, even though the WTC cooling water system was operating, potential impacts from the Proposed Action in 2015 under the Pre-September 11 Scenario would be the same as under the Current Conditions Scenario, presented in section 18.4.5, "Probable Impacts of the Proposed Action 2015—Current Conditions Scenario." No significant adverse impacts to aquatic biota, including EFH, would be expected to occur as a result of the Proposed Action in 2015 under pre-September 11 conditions. The amount of space that needed to be cooled would be slightly greater than that present pre-September 11. However, increased energy efficiency of new building materials and cooling equipment would be expected to decrease the cooling needs such that they would be no greater than pre-September 11. Therefore, the amount of water withdrawn for the Proposed Action is assumed to be no greater than the amount withdrawn pre-September 11. Therefore, the number of invertebrates and fish that would be impinged or entrained for the Proposed Action in 2015 under the Pre-September 11 Scenario would be expected to be no greater than pre-September 11.

The assessment presented in section 18.4.5, "Probable Impacts of the Proposed Action 2015—Current Conditions Scenario," concluded that while there would be losses of aquatic organisms due to impingement or entrainment at the intake, the estimated number of fish and invertebrates lost through operation of the intake in 2015 would be expected to be an average of 65 to 82 percent lower (depending on the season) than what would be expected to occur from the operation of the intake at the design flow (179 mgd). The estimated low annual loss of some individuals through impingement, and higher estimated annual loss of individuals through entrainment would equate to a much smaller number of older fish that would not be added to the population, or small number of pounds that would be lost to a particular fishery because of the extremely high natural mortality of these lifestages. These losses may, however, result in significant adverse impacts to populations of these species in the Lower Hudson River under the Proposed Action in 2015 if withdrawal volumes increase from those projected and approach design flows.

As part of the SPDES permitting process for operation of the WTC intake, measures to reduce impingement losses (e.g., further flow reduction, modified screens with fish return, reduction of flow velocities, closed-cycle cooling, and fish avoidance systems such as barrier nets, light and sound) and entrainment losses (e.g., flow reduction, closed-cycle cooling, fine mesh barriers to exclude eggs and larvae such as Gunderbooms and fine mesh wedge wire screens) would be explored with respect to feasibility, effectiveness, cost, and constraints imposed by surrounding property owners and land uses such as deed restrictions or easements.

ENDANGERED, THREATENED, AND SPECIAL CONCERN SPECIES

No potential adverse impacts would be expected to occur to endangered or threatened species, or species of special concern under the Pre-September 11 Scenario of the Proposed Action in 2009. The assessment of potential impacts from the Proposed Action in 2009 under the Current

Conditions Scenario presented in section 18.4.3, "Probable Impacts of the Proposed Action 2009—Current Conditions Scenario," would apply to the Pre-September 11 Scenario since the baseline conditions scenario would be the same.

TERRESTRIAL RESOURCES

With the Proposed Action, there would be potential beneficial impacts to the limited terrestrial resources with the development of additional landscaping and open space associated with the full development.

By 2015, it is assumed that redevelopment of the Project Site would be complete. In addition to the Memorial, museum, cultural facilities, and open space, full development would result in about 11.8 million square feet of space. There would be five large, modern office towers between 56 and 70 stories tall. Combined, the five towers and cultural facilities would comprise approximately 3,285,000 square feet of above-ground vertical surface area, or 20 percent more than the approximate 2,759,000 square feet present under pre-September 11 conditions.

The reduction in vertical structure extending higher than 500 feet would result in less surface area for potential bird strikes. As discussed previously, reflective surface and nighttime lighting play an important role in reducing the number of potential bird strikes. Because of the lower amount of exterior vertical surface area of the Proposed Action in 2015 compared to the Pre-September 11 baseline condition, the potential for bird strikes would be lower under the Proposed Action than for the WTC prior to September 11. At this time, actual designs and materials to be used in the office buildings have not been determined, and the potential for bird strikes is difficult to quantify. However, it is anticipated that 15 percent would be the minimum decrease in collisions over pre-September 11 conditions due to the increased awareness of the issue. Current designs offer additional open space and trees over that present under pre-September 11 conditions. These offer beneficial resting and stopover habitat for migrating birds as well as habitat for resident birds.

Potential measures that may reduce bird strikes include reduction in reflective glass surfaces and interior lights visible from the outside, and reduction in the duration of nighttime decorative lighting, especially during the spring and fall migration periods. Peregrine falcons are accustomed to the intensely developed habitats of New York City and are not expected to experience a negative impact due to the Proposed Action. There are no records of peregrine falcons colliding with buildings in the city. The selection of exterior building materials would have to balance reduction of bird strikes with the goal of integrating the conservation and optimization of energy use into the design of the structures of the Proposed Action.

CONCLUSIONS

The results of the analyses of potential effects to natural resources from the Proposed Action in 2009 and 2015 under the Pre-September 11 Scenario led to the following conclusions:

- The water quality and biological resources of the lower Hudson River were not substantially different between the pre-September 11, 2001 and post-September 11 time periods.
- According to the Port Authority, the intake structure, pumphouse, water pipelines and outfalls are largely intact and functional. The reuse of these structures is the most economical and efficient method for cooling the components of the Proposed Action.

- As discussed in Chapter 12, "Infrastructure," the water withdrawal requirements under full build-out condition in 2015 (required to cool approximately 11.8 million square feet of space) would be no greater than prior to September 11, 2001 (approximately 10 million square feet of space). Cooling water needs for the approximately 4 million square feet of space expected to be completed in 2009 would be approximately 60 percent less than pre-September 11.
- Heated effluent discharged through the WTC cooling water outfalls would meet the thermal criteria specified in the 1999 SDPES permit. Therefore, thermal impacts to biota would not be expected as a result of the Proposed Action in 2009 or 2015 and would not differ from the Pre-September 11 Scenario when the cooling water system was operating.
- No stormwater would be discharged directly to the Hudson River during construction or operation of the Proposed Action in 2009 or 2015. This would result in lower impacts than pre-September 11 when stormwater from the WTC complex was discharged to the Hudson River through WTC outfall 001.
- Cooling water requirements varied by season, with daily averages during the 1991 to 1993 impingement/entrainment study of approximately 33 mgd in spring, 62 mgd in summer, 39 mgd in fall, and 22 mgd in winter. These water withdrawal rates are consistent with rates reported at the WTC for the 2-year period prior to September 11, 2001 (33 mgd-spring, 63 mgd-summer, 46 mgd-fall, and 35 mgd-winter), and presumably of the same order needed for the 2015 Proposed Action.
- While there would be losses of aquatic organisms due to impingement or entrainment at the intake, the estimated number of fish and invertebrates lost through operation of the intake in 2015 would be expected to be an average of 65 to 82 percent lower (depending on the season) than what would be expected to occur from the operation of the intake at the design flow (179 mgd). The estimated low annual loss of some individuals through impingement, and higher estimated annual loss of individuals through entrainment would equate to a much smaller number of older fish that would not be added to the population, or small number of pounds that would be lost to a particular fishery because of the extremely high natural mortality of these lifestages. These losses may, however, result in significant adverse impacts to populations of these species in the Lower Hudson River under the Proposed Action in 2015 if withdrawal volumes increase from those projected and approach design flows.
- As part of the SPDES permitting process for operation of the WTC intake, measures to reduce impingement losses (e.g., further flow reduction, modified screens with fish return, reduction of flow velocities, closed-cycle cooling, and fish avoidance systems such as barrier nets, light and sound) and entrainment losses (e.g., flow reduction, closed-cycle cooling, fine mesh barriers to exclude eggs and larvae such as Gunderbooms, and fine mesh wedge wire screens) would be explored with respect to feasibility, effectiveness, cost, and constraints imposed by surrounding property owners and land uses such as deed restrictions or easements.
- Because the area to be cooled in 2009 is as much as 60 percent less than 2015 and the pre-September 11 baseline, the volume of water withdrawn for the Proposed Action in 2009, would be similarly reduced. This lower volume of cooling water withdrawn at the WTC intake for the Proposed Action in 2009 would significantly reduce losses of fish and invertebrates through impingement and entrainment. Therefore, the operation of the WTC

intake for the Proposed Action in 2009 would not be expected to result in significant adverse impacts to aquatic biota.

- Significant adverse impacts would not be expected to occur to EFH for the lifestages of the 15 managed species identified by the NMFS as occurring in the Lower Hudson River Estuary in 2009, and may also not occur in 2015. This conclusion is based upon: the results of the quantitative and qualitative assessment of potential impacts to target species from impingement and entrainment associated with operation of the WTC intake that showed no significant adverse impacts to target species populations (which included four EFH species and two species used as prey by EFH); the lack of in-water construction activities associated with the Proposed Action; the conclusion that the channel leading to the intake under the Battery Park City esplanade would be a less desirable habitat for most fish species than open water or pile field habitats available within the vicinity of the intake; and the findings that significant adverse impacts would not be expected to occur to water quality, and therefore EFH, from the discharge of the heated effluent or stormwater from the Proposed Action.
- Significant adverse impacts would not be expected to occur to threatened or endangered species, or species of special concern to state or federal agencies. None of the four species of sea turtles identified as having the potential to occur as transient individuals nest or reside in the lower Hudson River year round. Sea turtles are rarely observed in these portions of the estuary.
- In 2009, the 1,776-foot Freedom Tower, at the northwest corner of the WTC Site, would be taller than existing adjacent structures, with useable floor space up to an approximate height of 1,150 feet, and broadcast antennae that reach 2,000 feet. The amount of aboveground exterior surface area above 500 feet is 63 percent less than pre-September 11 conditions. This would potentially result in 37 percent of the bird strikes realized under pre-September 11 conditions. The greatest potential for bird strikes would occur in the spring (March – May) and fall (August – October) migration seasons.
- By 2015, the completion of the other four towers would result in approximately 1,246,000 square feet of vertical, exterior, surface area above 500 feet that would likely result in 15 percent fewer bird strikes than the pre-September 11 conditions.
- Large construction equipment such as cranes and nighttime lighting for construction may also result in additional bird strikes. Measures would be implemented as necessary to minimize potential impacts to peregrine falcons within the vicinity of the Project Site. These measures may include bird control devices on the tops of cranes or other tall construction equipment to keep young falcons from landing on them and slipping off, and safety precautions for construction workers.
- Potential measures that may reduce bird strikes include reduction in reflective glass surfaces and interior lights visible from the outside, and reduction in the duration of nighttime decorative lighting, especially during the spring and fall migration periods. The selection of exterior building materials would have to balance reduction of bird strikes with the goal of integrating the conservation and optimization of energy use into the design of the structures of the Proposed Action.
- Peregrine falcons, which are endangered in New York, are accustomed to the intensely developed habitats of New York City and are not expected to experience a negative impact due to the Proposed Action. There are no records of peregrine falcons colliding with buildings in the city.

- The Proposed Action would result in additional open space areas with vegetation, as compared with pre-September 11 conditions, that would provide resting/stopover habitats for migrating birds and resident wildlife.

18.6 REFERENCES

Please see Appendix I.1 for the References to this chapter. ✷