

**SIGNIFICANT HABITATS AND HABITAT COMPLEXES
OF THE NEW YORK BIGHT WATERSHED
Jamaica Bay and Breezy Point
COMPLEX #16**

I. SITE NAME: Jamaica Bay and Breezy Point

II. SITE LOCATION: Jamaica Bay is located on the southwestern tip of Long Island in the boroughs of Brooklyn and Queens, New York City and the town of Hempstead, Nassau County. The bay connects with Lower New York Bay to the west through Rockaway Inlet and is the westernmost of the coastal lagoons on the south shore of Long Island. Breezy Point is the western tip of the Rockaway barrier beach to the south of Jamaica Bay and Rockaway Inlet.

TOWNS: Boroughs of Brooklyn and Queens, New York City, town of Hempstead

COUNTIES: Kings, Nassau, Queens

STATE: New York

USGS 7.5 MIN QUADS: Far Rockaway, NY (40073-57), Coney Island, NY (40073-58), Jamaica, NY (40073-67), Brooklyn, NY (40073-68)

USGS 30 x 60 MIN QUAD: Long Island West, NY (40073-E1)

III. BOUNDARY DESCRIPTION AND JUSTIFICATION: This habitat complex includes the entire Jamaica Bay estuarine lagoon, part of Rockaway Inlet, and the western part of the Rockaway barrier beach. The boundary of this area generally follows the shoreline of Jamaica Bay and includes most of the tidal creeks and undeveloped upland areas adjacent to the bay; these serve as buffers for the bay, as upland habitat, and as existing and potential restoration sites. This complex also contains the western end of the Rockaway barrier beach and the Marine Park/Plumb Beach area just to the west of the main body of Jamaica Bay to include beach and dune habitat for nesting bird and rare plant species. The bay proper and portions of Rockaway Inlet encompass important breeding and juvenile nursery habitat for fisheries as well as year-round foraging areas for waterfowl, shorebirds, and colonial nesting waterbirds. The extensive salt marsh and upland islands in the bay provide nesting habitat for gulls, terns, waterfowl, and herons; foraging and roosting habitat for shorebirds and waterbirds; upland sites for grassland bird nesting and foraging areas; and butterfly concentration areas. Despite the surrounding intensive residential, commercial, and industrial development, Jamaica Bay and Breezy Point continue to be incredibly valuable for resident and migratory fish and birds and for other wildlife and plant populations.

IV. OWNERSHIP/PROTECTION/RECOGNITION: The majority of land within this complex is publicly owned by the federal government and the city of New York. Most of Jamaica Bay proper and portions of the uplands and barrier beach are part of the Gateway National Recreation Area. Administered by the National Park Service, it includes the 3,705-hectare (9,155-acre) Jamaica Bay Wildlife Refuge, Breezy Point, and Floyd Bennett Field. There are several city parks within the bay complex, including Marine Park and Edgemere Park, and numerous smaller parcels of city-owned land. Portions of the wetlands and uplands are part of John F. Kennedy International Airport, owned by the city of New York and operated by the Port Authority of New York and New Jersey. Small areas in the upland buffer around the bay and on the Rockaway Peninsula remain in private residential or commercial ownership. Jamaica

Bay has been designated and mapped as an otherwise protected beach unit pursuant to the federal Coastal Barrier Resources Act, prohibiting incompatible federal financial assistance or flood insurance within the unit. The New York State Natural Heritage Program, in conjunction with The Nature Conservancy, recognizes two Priority Sites for Biodiversity within the Jamaica Bay and Breezy Point habitat complex: Breezy Point (B2 - very high biodiversity significance) and Fountain Avenue Landfill (B3 - high biodiversity significance). Jamaica Bay and Breezy Point have been designated as Significant Coastal Fish and Wildlife Habitats by the New York State Department of State, and the bay up to the high tide line was designated as a Critical Environmental Area by the New York State Department of Environmental Conservation. Jamaica Bay was also designated as one of three special natural waterfront areas by New York City's Department of City Planning. A comprehensive watershed management plan for the bay was completed in 1993 by the New York City Department of Environmental Protection in order to better protect and restore habitats and improve water quality. Wetlands are regulated in New York under the state's Freshwater Wetlands Act of 1975 and Tidal Wetlands Act of 1977; these statutes are in addition to federal regulation under Section 10 of the Rivers and Harbors Act of 1899, Section 404 of the Clean Water Act of 1977, and various Executive Orders.

V. GENERAL AREA DESCRIPTION: Jamaica Bay is located at the southwestern end of Long Island in the Atlantic Coastal Plain physiographic province. The bay drains a watershed of approximately 34,400 hectares (85,000 acres) on the seaward-sloping outwash plain south of the Harbor Hill terminal moraine. The bay and barrier beach sediments are composed predominantly of sand and gravel derived from glacial outwash and marine sources.

Jamaica Bay is a saline to brackish, eutrophic (nutrient-rich) estuary covering about 10,118 hectares (25,000 acres), with a mean depth of 4 meters (13 feet), a semidiurnal tidal range averaging 1.5 meters (5 feet), and a residence time of about 33 days. The bay communicates with Lower New York Bay and the Atlantic Ocean via Rockaway Inlet, a high current area that is one kilometer (0.63 mile) wide at its narrowest point, with an average depth of 7 meters (23 feet). Measurements taken during recent surveys in Jamaica Bay indicate average yearly ranges for temperature of 1 to 26°C (34 to 79°F), salinity of 20.5 to 26 parts per thousand, dissolved oxygen of 3.5 to 18.5 milligrams/liter, and pH of 6.8 to 9. Loadings of nutrients and organic matter into the bay from sewage treatment plants and runoff result in phytoplankton blooms and high suspended solid concentrations which, in turn, result in turbid water and low bottom dissolved oxygen concentrations. Jamaica Bay is in the middle of the New York City metropolitan area and the uplands around the bay, as well as much of the Rockaway barrier beach, are dominated by urban, residential, commercial, and industrial development. The bay itself has been disturbed by dredging, filling, and development, including the construction of Floyd Bennett Field and John F. Kennedy Airport. About 4,856 of the original 6,475 hectares (12,000 of the original 16,000 acres) of wetlands in the bay have been filled in, mostly around the perimeter of the bay. Extensive areas of the bay have been dredged for navigation channels and to provide fill for the airports and other construction projects.

The center of the bay is dominated by subtidal open water and extensive low-lying islands with areas of salt marsh, intertidal flats, and uplands important for colonial nesting waterbirds. The average mean low tide exposes 142 hectares (350 acres) of mudflat, 375 hectares (925 acres) of low salt marsh dominated by low marsh cordgrass (*Spartina alterniflora*), and 213 hectares (526 acres) of high marsh dominated by high marsh cordgrass (*Spartina patens*). The extensive intertidal areas are rich in food resources, including a variety of benthic invertebrates and

macroalgae dominated by sea lettuce (*Ulva latuca*). These rich food resources attract a variety of fish, shorebirds, and waterfowl. In addition, two freshwater impoundments were created on Rulers Bar Hassock in the Jamaica Bay National Wildlife Refuge; the smaller 22-hectare (54-acre) freshwater West Pond is kept as open water, and the larger 49-hectare (120-acre) slightly brackish East Pond is controlled to expose mudflats. Some of the islands in the bay have upland communities, including grasslands consisting of little bluestem (*Schizachyrium scoparium*), switchgrass (*Panicum virgatum*), and seaside goldenrod (*Solidago sempivirens*); scrub-shrub containing bayberry (*Myrica pensylvanica*), beach plum (*Prunus maritima*), sumac (*Rhus* spp.), and poison ivy (*Toxicodendron radicans*); developing woodland consisting of hackberry (*Celtis occidentalis*), willow (*Salix* spp.), black cherry (*Prunus serotina*), and tree-of-heaven (*Ailanthus altissima*); and beachgrass (*Ammophila breviligulata*) dune. Species introduced in the Refuge to attract wildlife include autumn olive (*Elaeagnus umbellata*), Japanese black pine (*Pinus thunbergii*), and Japanese barberry (*Berberis thunbergii*). Breezy Point contains an approximately 81-hectare (200-acre) natural area at the western tip of the Rockaway Peninsula with an accreting wide ocean beach, beachgrass dunes, grassland/shrub thicket, and fringing salt marshes on the bay side. A stone jetty extends out from the tip of Breezy Point. East of this natural area, the barrier behind the beach front has been largely developed into residential, commercial, and recreational areas. The ocean beach narrows to the east and contains numerous short groins.

Floyd Bennett Field is a 579-hectare (1,448-acre) historic civic aviation facility dominated by human-made structures and runways but with extensive areas of open space between the runways, including a 57-hectare (140-acre) grassland area restored and maintained by the National Park Service and New York City Audubon Society as the Grassland Restoration and Management Project; smaller areas of shrub thicket dominated by bayberry, winged sumac (*Rhus copallina*), and Japanese knotweed (*Polygonum cuspidatum*); developing woodland consisting of black cherry, grey birch (*Betula populifolia*), and cottonwood (*Populus deltoides*); common reed (*Phragmites australis*) marsh; and small areas of low marsh and mudflat along the shoreline of the bay.

VI. ECOLOGICAL SIGNIFICANCE/UNIQUENESS OF SITE: The location of Jamaica Bay and Breezy Point and the rich food resources found there make it a regionally important fish, wildlife, and plant habitat complex. Jamaica Bay is located adjacent to the confluence of the New York Bight and New York Bay, and is at the turning point of the primarily east-west oriented coastline of New England and Long Island and the north-south oriented coastline of the mid-Atlantic coast. This geographic location acts to concentrate marine and estuarine species migrating between the New York Bight portion of the North Atlantic and the Hudson-Raritan Estuary. Shorebirds, raptors, waterfowl, landbirds, and various migratory insects are concentrated by the coastlines in both directions. These migratory species are further concentrated by the surrounding urban developed land into the remaining open space and open water of Jamaica Bay. Jamaica Bay and Breezy Point support seasonal or year-round populations of 214 species of special emphasis and listed species, incorporating 48 species of fish and 120 species of birds, and including the following federally listed and state-listed species. (Living resources and their habitats are dynamic; therefore, the ecological significance and species information presented here may not be complete or up-to-date. State and federal environmental agencies (see Appendix III for office contacts) should be consulted for additional information.)

Federally listed endangered

Atlantic (=Kemp's) ridley sea turtle (*Lepidochelys kempii*)

roseate tern (*Sterna dougallii*)

peregrine falcon (*Falco peregrinus*)

Federally listed threatened

loggerhead sea turtle (*Caretta caretta*)

piping plover (*Charadrius melodus*)

seabeach amaranth (*Amaranthus pumilis*)

Federal species of concern⁽¹⁾

diamondback terrapin (*Maclemys t. terrapin*)

Roland's sea-blite (*Suaeda rolandii*)

State-listed endangered

least tern (*Sterna antillarum*)

willow oak (*Quercus phellos*)

State-listed threatened

northern harrier (*Circus cyaneus*)

osprey (*Pandion haliaetus*)

common tern (*Sterna hirundo*)

State-listed special concern

spotted salamander (*Ambystoma maculatum*) (reintroduced)

least bittern (*Ixobrychus exilis*)

Cooper's hawk (*Accipiter cooperii*)

upland sandpiper (*Bartramia longicauda*)

short-eared owl (*Asio flammeus*)

common barn owl (*Tyto alba*)

grasshopper sparrow (*Ammodramus savannarum*)

State-listed rare plants

Houghton's umbrella-sedge (*Cyperus houghtonii*)

blunt spikerush (*Elecharis obtusa* var. *ovata*)

field-dodder (*Cuscuta pentagona*)

smartweed-dodder (*Cuscuta polygonorum*)

Schweinitz's flatsedge (*Cyperus schweinitzii*)

The **waters and sediments of Jamaica Bay** are a highly productive and regionally significant habitat for finfish, shellfish, and wildlife. Eighty-one species of fish were found to use Jamaica Bay in a survey conducted by the National Park Service in 1985, corroborating other findings. The majority of fish collected were juveniles using the bay as a nursery area. Winter flounder (*Pleuronectes americanus*) was the most important commercial and recreational fish to use the bay in great numbers during all life stages; the bay is also believed to be a significant breeding area for this species. Forage fish species with high abundances, including Atlantic silverside (*Menidia menidia*), bay anchovy (*Anchoa mitchilli*), mummichog (*Fundulus heteroclitus*), Atlantic menhaden (*Brevoortia tyrannus*), and striped killifish (*Fundulus majalis*), form a prey base for other fish and birds that use the area. Some of the other common species found in surveys and recreational landings include scup (*Stenotomus chrysops*), bluefish (*Pomatomus saltatrix*), windowpane (*Scophthalmus aquosus*), tautog (*Tautoga onitis*), weakfish (*Cynoscion regalis*), black sea bass (*Centropristis striata*), summer flounder (*Paralichthys dentatus*), American eel (*Anguilla rostrata*), and searobin (*Prionotus* spp.). Anadromous species that use the area include blueback herring (*Alosa aestivalis*), Atlantic sturgeon (*Acipenser oxyrinchus*),

alewife (*Alosa pseudoharengus*), American shad (*Alosa sapidissima*), and striped bass (*Morone saxatilis*).

Muddy fine sand characterizes the eastern and northern sections of the bay, while fine to medium sands predominate in the southern and western sections of the bay. The sediments in the bay support a diverse assemblage of benthic species as indicated by the large number of species (121) found in a 1983 survey. The muddy fine sand is habitat for a number of plentiful amphipod crustacean species, especially *Ampelisca abdita* and small polychaetes. This substrate is prime feeding habitat for both juvenile and adult winter flounder as well as for diving ducks such as greater scaup (*Aythya marila*). The Plumb Beach area has a large contiguous mudflat where substantial numbers of horseshoe crab (*Limulus polyphemus*) breed in late spring, attracting shorebirds. The mud snail (*Ilyanassa obsoleta*) is ubiquitous throughout this habitat, scouring the littoral zone's microalgal film as it feeds. The Atlantic ribbed mussel is a major biomass component of the salt marsh and mudflats. These abundant feeders filter a large proportion of the bay each day. The fine to medium sands are habitat for a number of invertebrate species, including representatives of the mollusca and crustacea phyla. Shellfish species include northern quahog (*Mercenaria mercenaria*) and the intertidal soft clam (*Mya arenaria*), with the Atlantic surf clam (*Spisula solidissima*) occupying the nearshore and inlet area. The blue mussel (*Mytilus edulis*) attaches to structures, especially piers and jetties. Although shellfishing is not allowed due to pollution, it was significant prior to 1920. Because a substantial area in the bay is a National Wildlife Refuge, shellfishing in the future will likely be precluded as a noncompatible use.

Jamaica Bay has significant wintering waterfowl concentrations, with mid-winter ground counts over the period from 1980 to 1992 averaging about 11,000 birds, with a peak of 36,000 birds. The most abundant waterfowl during this survey period were greater scaup, American black duck (*Anas rubripes*), brant (*Branta bernicula*), Canada goose (*Branta canadensis*), bufflehead (*Bucephala albeola*), canvasback (*Aythya valisneria*), mallard (*Anas platyrhynchos*), ruddy duck (*Oxyura jamaicensis*), red-breasted merganser (*Mergus serrator*), snow goose (*Chen caerulescens*), and American wigeon (*Anas americana*). Jamaica Bay supports some of the largest wintering populations of greater scaup and American black duck in New York State. Regularly occurring waterfowl in lesser numbers include horned grebe (*Podiceps auritus*), green-winged teal (*Anas crecca*), gadwall (*Anas strepera*), northern shoveler (*Anas clypeata*), and common goldeneye (*Bucephala clangula*). Concentrations of waterfowl also occur in the bay during spring and fall migrations. A year-round weekly survey of birds in Jamaica Bay during 1978-1979 counted a total of 263,607 ducks of 32 species. The most abundant ducks on a year-round basis that year were greater scaup, American black duck, canvasback, and mallard. Waterfowl confirmed breeding in the bay include Canada goose, American black duck, mallard, northern shoveler, gadwall, redhead (*Aythya americana* - introduced), and ruddy duck. Waterfowl hunting in Jamaica Bay is prohibited.

Loggerhead sea turtles have occasionally been reported as strandings in the area. Harbor seals (*Phoca vitulina*) are winter visitors to the bay and inlet area and use local docks, the jetty at Breezy Point Tip, and other locations as haulout areas. Humpback whales (*Megaptera novaeangliae*) occasionally feed in New York Bay adjacent to the inlet, and bottlenosed dolphin (*Tursiops truncatus*) and the endangered sperm whale (*Physeter catodon*) have been noted as strandings in the area.

Focus Areas in Jamaica Bay

In addition to the waters and intertidal areas of Jamaica Bay itself, there are three focus areas

within this complex.

Breezy Point: Breezy Point is the western tip of the Rockaway marine barrier beach with associated dunelands and residential development. This area supports some of the highest concentrations of beach-nesting birds in New York State and in the entire New York Bight coastal region. Breezy Point consistently supports one of the largest piping plover nesting sites in the entire New York Bight coastal region, with an average of 22 pairs and a maximum of 33 pairs during the period 1985 to 1995. The area also supports one of the largest concentrations of least terns, with an average of 340 nesting pairs from 1985 to 1995 and a maximum of 703 pairs in 1992. This was the largest least tern colony in New York State and the second largest in the entire New York Bight region for several years. Breezy Point is also the site of one of the largest black skimmer (*Rhynchops niger*) colonies in New York State and in the New York Bight region in recent years; an average of about 160 pairs nested here from 1990 to 1995 with a maximum of 227 pairs in 1995. Breezy Point has also supported the largest common tern colony on the south shore of Long Island in recent years, with an average of about 1,060 pairs from 1990 to 1995. Small numbers of roseate terns began nesting at Breezy Point in 1993. Other notable nesting waterbirds include common tern, great black-backed gull (*Larus marinus*), herring gull (*Larus argentatus*), willet (*Catoptrophorus semipalmatus*), and American oystercatcher (*Haematopus palliatus*). Nesting and migrating piping plovers and other shorebirds feed on the intertidal beach. The gulls, terns, and oystercatchers nesting here feed throughout Rockaway Inlet and Jamaica Bay.

Breezy Point is also a concentration area for other migratory shorebirds, raptors, waterfowl, and landbirds, especially during the summer and fall migrations. The raptor banding station at Breezy Point banded a total of 2,414 raptors during the period from 1978 to 1987 and sighted a total of 15,715 raptors. The most numerous species sighted were American kestrel (*Falco sparverius*) and sharp-shinned hawk (*Accipiter striatus*) with a total of 9,244 and 4,373 birds, respectively, sighted during that period. Other species consistently sighted include Cooper's hawk, northern harrier, osprey, peregrine falcon, and merlin (*Falco columbarius*). The federally listed endangered peregrine falcon nest on the Marine Parkway bridge and feed throughout the bay.

Breezy Point also supports three species of rare plants, including the federally listed threatened and globally rare seabeach amaranth and globally rare seabeach knotweed (*Polygonum glaucum*) along the ocean beach and dune, and state-listed rare Schweinitz's flatsedge on the bay side of the barrier.

Also included in the Breezy Point unit are the portions of ocean beach extending east to Jacob Riis Park, presently used by beach-nesting birds and rare plant species. Further to the east, a section of the Rockaway barrier beach in the vicinity of Arverne has supported a large population of seabeach amaranth in recent years. Piping plovers have also attempted to nest on this stretch of the beach.

Floyd Bennett Field: This area includes the upland and shoreline of the civil aviation facility that was largely created by the filling of salt marsh islands in the bay. The airfield was decommissioned in 1950 and became a haven for grassland and open-country birds until the last several decades when succession of open areas into shrub and developing forest eliminated habitat. In 1985, a portion of Floyd Bennett Field was restored to grassland and now about 57 hectares (140 acres) are maintained through clearing, mowing, and burning. This is one of the few sizable grasslands within the urban core of New York City; it supports a variety of grassland birds, several of which are rare and/or declining in the northeastern United States. Grassland

birds confirmed nesting in or near the grasslands in recent years include grasshopper sparrow, horned lark (*Eremophila alpestris*), eastern meadowlark (*Sturnella magna*), upland sandpiper, savannah sparrow (*Passerculus sandwichensis*), northern harrier, American kestrel, and common barn-owl. Use of this area by grasshopper sparrow increased significantly in average abundance and shifted their distribution into the grassland management area between 1984 and 1992. In 1996 there were no grasshopper sparrows nesting at Floyd Bennett Field, but there were 22 pairs of savannah sparrow. Overwintering grassland birds at Floyd Bennett Field include northern harrier, rough-legged hawk (*Buteo lagopus*), American kestrel, common barn-owl, short-eared owl, horned lark, eastern meadowlark, and savannah sparrow. Bobolink (*Dolichonyx oryzivorus*) is a regular migrant visitor in the grasslands. Grassland birds, especially upland sandpiper, also utilize the grassland habitat along the runways at John F. Kennedy Airport. In recent years, there have also been two nesting locations for American oystercatcher along the northeast shoreline of Floyd Bennett Field. The rare Schweinitz's flatsedge is found in the southern and northern portions of the area, and willow oak saplings occur in the bayberry thickets at the northern end of this site.

Jamaica Bay Islands (National Wildlife Refuge): The salt marsh, dredged material, and upland islands in the middle of Jamaica Bay are largely separated from disturbance and predation occurring on the surrounding mainland, and support large numbers of nesting waterbirds and diverse migratory birds throughout the year. At least 326 species of birds have been sighted in the Refuge, including confirmed breeding by 62 species. A few islands in the bay support or have supported heronries, including a heronry located on Canarsie Pol that has supported a variety of nesting waders including glossy ibis (*Plegadis falcinellus*), great egret (*Casmerodius albus*), snowy egret (*Egretta thula*), cattle egret (*Bubulcus ibis*), black-crowned night-heron (*Nycticorax nycticorax*), and tricolored heron (*Egretta tricolor*). Although no wading birds nested here in recent years, Canarsie Pol also has nesting by the state-listed threatened common tern, as well as by great black-backed gull, herring gull, and American oystercatcher. A smaller heronry occurred on Ruffle Bar in 1995. Common terns occur on several other islands in the bay, including Jo Co Marsh and Silver Hole Marsh, with smaller numbers at Duck Creek Marsh, East High Meadow, Ruffle Bar, and Subway Island. An average of about 1,000 common terns and a maximum of 1,630 common terns have nested on the combined seven colonies in Jamaica Bay since 1984. Laughing gull (*Larus atricilla*) re-colonized the bay in 1979 and now occur at three colonies in the bay at East High Meadow, Silver Hole Marsh, and Jo Co Marsh, with a total of over 5,800 pairs in 1995. These colonies, along with a small colony in West Hempstead Bay, represent the only colonies for this species in New York State and one of the northernmost colonies for this species. There have been four pairs of osprey nesting in the Refuge in recent years. Clapper rail (*Rallus longirostris*) and common moorhen (*Gallinula chloropus*) nest in the salt marshes in the bay. Piping plover nested along the shoreline of John F. Kennedy Airport in 1984, but have not nested since. American oystercatcher nest at several islands in the bay for a total of 30 pairs in 1995; they also have nested along the airport shoreline. A variety of other birds breed on the islands and uplands in the bay including one of only two New York State sites for, and the northernmost nesting extent of, the boat-tailed grackle (*Quiscalus major*). Jamaica Bay is one of the most important migratory shorebird stopover sites in the New York Bight region, especially during fall migration (July to November). The shorebirds utilize much of the bay, but tend to focus on the intertidal areas during low tide and move to East and West Ponds on Ruler's Bar Hassock during higher tides. The water in East Pond is artificially lowered after July 1 each year. During the period 1981 to 1990 there was an average of 27 and a

maximum of 36 shorebird species counted at the East and West Ponds in the Refuge during the fall. The most abundant shorebirds during that period were black-bellied plover (*Pluvialis squatarola*), semipalmated plover (*Charadrius semipalmatus*), greater yellowlegs (*Tringa melanoleuca*), ruddy turnstone (*Arenaria interpres*), sanderling (*Calidris alba*), semipalmated sandpiper (*Calidris pusilla*), least sandpiper (*Calidris minutilla*), dunlin (*Calidris alpina*), and short-billed dowitcher (*Limnodromus griseus*). Jamaica Bay is also important during spring migration (March to June) on the ponds for black-bellied plover, semipalmated plover, ruddy turnstone, red knot (*Calidris canutus*), semipalmated sandpiper, least sandpiper, and dunlin. Shorebirds known to breed in or around Jamaica Bay include killdeer (*Charadrius vociferus*), American oystercatcher, willet (*Catoptrophorus semipalmatus*), spotted sandpiper (*Actitis macularia*), upland sandpiper, and American woodcock (*Scolopax minor*).

Fifty-four species of butterflies and skippers have been recorded at the Refuge and surrounding uplands, with regular use by several rare species, including checkered white (*Pieris protodice*), white m hairstreak (*Parrhasius m-album*), Appalachian azure (*Celastrina neglectamajor*), tawny emperor (*Asterocampa clyton*), and salt marsh skipper (*Panoquina panoquin*).

Diamondback terrapin use habitats throughout the bay for nesting and feeding. Terrapins typically nest on sandy habitats with sparse to moderate vegetative cover. Much of the shoreline of the bay contains this type of habitat and is thus potential nesting area. Ruler's Bar Hassock is used extensively for nesting, including the system of roads, trails, and firebreaks in addition to the area known as the "terrapin nesting area" and the dunes south of the visitor center. Other known nesting areas are Dubos Point, Floyd Bennett Field, and the community of Broad Channel. Terrapin activity in the waters of Jamaica Bay is predominantly in association with salt marshes and mudflats. Specific sites in the bay where terrapins are regularly observed include Jo Co and Silver Hole marshes, East High Meadow, and the complex of marsh and tidal flats in western Jamaica Bay that lies west of Ruler's Bar Hassock and east of Canarsie Pol-Ruffle Bar. A variety of amphibians and reptiles have been re-introduced at a few locations in the Refuge, including Fowler's toad (*Bufo woodhousii fowleri*), spring peeper (*Pseudacris crucifer*), gray treefrog (*Hyla versicolor*), green frog (*Rana clamitans*), spotted salamander, redback salamander (*Plethodon cinereus*), northern brown snake (*Storeria d. dekayi*), smooth green snake (*Opheodrys vernalis*), eastern hognose snake (*Heterodon platirhinos*), eastern milk snake (*Lampropeltis triangulum triangulum*), northern black racer (*Coluber c. constrictor*), snapping turtle (*Chelydra serpentina*), eastern painted turtle (*Chrysemys p. picta*), and eastern box turtle (*Terrapene c. carolina*).

Although not rare in the Bight region, many small mammals are rare within the urban core of New York City and are an important food base for the hawks and owls feeding on the islands and shorelines of Jamaica Bay. Resident mammals on the islands and bay shorelines include opossum (*Didelphis virginiana*), black-tailed jackrabbit (*Lepus californicus*) escaped from John F. Kennedy Airport cargo, eastern cottontail rabbit (*Sylvilagus floridanus*), eastern chipmunk (*Tamias striatus* - introduced), gray squirrel (*Sciurus carolinensis*), white-footed mouse (*Peromyscus leucopus*), meadow vole (*Microtus pennsylvanicus*), muskrat (*Ondatra zibethicus*), and house mouse (*Mus musculus*). Migratory bats found at the Refuge include little brown myotis (*Myotis lucifugus*), silver-haired bat (*Lasionycteris noctivagans*), red bat (*Lasiurus borealis*), and hoary bat (*Lasiurus cinereus*).

The regionally rare retrorse flatsedge (*Cyperus retrorsus*) occurs in salt marshes in the Refuge and historically occurred at a few locations around the bay. The globally rare Roland's sea-blite occurs at two locations around the bay on a tidal flat next to the Fountain Avenue landfill and in

a salt marsh adjacent to the Vernam-Barbadoes Peninsula.

Undeveloped salt marshes and uplands around the perimeter of the bay are an important buffer between the bay and the surrounding developed areas and also an integral part of the Jamaica Bay ecosystem. The remaining unprotected parcels around the bay are described in the New York City Audubon and Trust for Public Land *Buffer the Bay* reports. Notable areas include the Vernam-Barbadoes Peninsula, which contains a mosaic of maritime communities including salt marsh shrubland, heathland, and grassland, and Vandalia Dunes, an approximately 93-hectare (230-acre) sandy upland site with tremendous potential for restoration as a duneland/grassland area.

VII. THREATS AND SPECIAL PROBLEMS: Jamaica Bay has been substantially altered by extensive dredging, filling, and development in and around the bay. The bay continues to be threatened by poor water quality, loss of upland and wetland buffer, and disturbance of habitat areas. Virtually the entire watershed of Jamaica Bay is urban, developed land and the bay receives substantial pollution from a variety of point and nonpoint sources; these include municipal waste water discharge from three plants (320 million gallons per day), combined sewer overflows, untreated storm water runoff from the roads and developed areas around the bay (including the runways at John F. Kennedy Airport which are contaminated with de-icing chemicals), leaching of contaminants from three large closed landfills (Edgemere, Fountain Avenue, and Pennsylvania Avenue landfills), atmospheric pollution, especially soot and toxic chemicals from transportation, and windblown trash; there is the added potential risk of spills due to substantial water transportation of oil and chemical products in the bay. Nutrient and high oxygen-demanding organic matter inputs result in phytoplankton blooms, low levels of light transmission, and low bottom dissolved oxygen concentrations. Present and historic inputs of toxics, including hydrocarbons (especially polynuclear aromatic hydrocarbons such as naphthalene) and heavy metals, have resulted in contaminated sediments in parts of the bay which have lethal and sublethal effects on benthic organisms and may bioaccumulate in fish and bird predators feeding on these benthic organisms. The long residence time in the bay exacerbates the water quality problems. The mean depth of the bay has been increased by dredging from 1 to 4 meters (3 to 13 feet) and, consequently, the residence time has increased from 11 to 33 days. Besides this three-fold increase in the residence time, the extensive dredging has resulted in hypoxic (low dissolved oxygen) or anoxic (no dissolved oxygen) conditions and toxic accumulation in the deeper parts of the bay (especially in Grassy Bay).

Additional residential, commercial, and industrial development threatens some of the upland and wetland buffer areas around the shoreline of the bay. These buffer areas at risk are identified in the *Buffer the Bay* and *Buffer the Bay Revisited* reports produced by the Trust for Public Land and the New York City Audubon Society. The Vandalia Dunes are presently being considered by New York City for large-scale residential and commercial development. Expansion of recreational facilities within the Gateway National Recreation Area may threaten some of the species found there, such as the proposed construction of ballfields in and near the grasslands area of Floyd Bennett Field. Other special problems in Jamaica Bay include collisions between aircraft and gulls from the colonies in the bay, especially the laughing gulls at Jo Co Marsh, and invasive nuisance species in the bay including the common reed, Norway rat (*Rattus norvegicus*), and feral cats and dogs. Erosion and beach nourishment projects on the south shore of the Rockaway Peninsula threaten the populations of seabeach amaranth and piping plover found there.

VIII. CONSERVATION RECOMMENDATIONS: Any activities that would further degrade the water quality in Jamaica Bay should be prohibited, and efforts to improve the water quality in the bay and throughout the watershed should be strongly encouraged. Recommendations for restoring the water quality, habitat quality and quantity, and species diversity are detailed in the Jamaica Bay Watershed Management Plan recently published by the New York City Department of Environmental Protection. Habitat recommendations in that report include: preserve remaining wetland and upland areas adjacent to the bay; restore and enhance existing wetlands; preserve and restore grassland habitat; control invasive species; and create freshwater ponds. Pollution prevention recommendations include: complete landfill cleanup; enhance industrial pretreatment and pollution prevention programs; control urban runoff using best management practices; utilize floatable controls; implement a combined sewer overflow (CSO) strategy throughout the watershed; and reduce nitrogen loading by utilizing biological nutrient removal and sludge-dewatering-centrate denitrification. Other major recommendations of this report are to recontour the bay by filling in portions of the eastern bay to an average depth of 6 meters (20 feet) and reducing the depth of Mill and Shellbank basins. A model has shown that this process will increase the minimum dissolved oxygen in the bay to an acceptable level (above 3.5 mg/l). Additional studies should be conducted in order to assess the impacts of this major project on the processes and organisms in the bay.

The culverting of Runway 46 at John F. Kennedy Airport would greatly improve water circulation in the eastern bay and improve water quality in Grassy Bay and Head of Bay. Future dredging should be limited to existing channels that are necessary for existing facilities in the bay. Remaining open space areas that have not yet been protected and are directly adjacent to the bay and its tributaries identified in the *Buffer the Bay* and *Buffer the Bay Revisited* reports should be transferred to public ownership and maintained as open space. The Vandalia Dunes should be transferred to public ownership and restored and maintained as a grassland/duneland complex. City-owned non-park acreage should be managed to enhance the natural quality of the bay, including Four Sparrow Marsh, Paerdegat Basin, Fresh Creek, Spring Creek, Hook Creek, Mott Point Peninsula, Sommerville Basin, and Vernam-Barbadoes Peninsula. Several of these sites should be restored as wetlands or grasslands. Large areas of Floyd Bennett Field should be maintained as grasslands, and only compatible recreation facilities should be developed there. Restoration of wetlands and grasslands on White Island in Marine Park would make this a valuable island and grassland habitat. Open space at John F. Kennedy Airport should be managed to protect nesting and feeding grassland bird species and to discourage use by gulls. Disturbances to wintering and nesting bird populations need to be minimized or eliminated entirely, particularly for colonial beach-nesting birds such as least terns and piping plovers. Human intrusions into beach nesting areas during the critical nesting season (April to August) should be prevented using a variety of methods, including protective fencing, posting, warden patrols, and public education. Public education and cooperative approaches with landowners are essential to successful protection of beach species in this area. When determined to be a problem, as it is at most mainland-connected nesting beaches, predator control and/or removal should be instituted. Those tasks and objectives of the piping plover and seabeach amaranth recovery plans that are applicable to this area should be undertaken, including restoration or enhancement of degraded sites where appropriate. Fencing and protection of beach-nesting birds should be expanded to include protection for seabeach amaranth and seabeach knotweed, where appropriate. Breezy Point is the southernmost known nesting colony for roseate tern, and enhancement of habitat to help maintain the nesting colony would help meet the recovery goal of

establishing additional colonies south of the main breeding area. Additional development along the Rockaway barrier beach should be limited; existing erosion control policies and proposed erosion control projects need to be carefully planned and implemented in order to minimize impacts and existing and potential habitat for piping plover, seabeach amaranth, and other beach strand species at Breezy Point, Arverne, and other beaches on the Rockaway Peninsula.

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1. ¹Species of special concern listed here include former Category 2 candidates.