ENVIRONMENTAL SENSITIVITY INDEX: NEW YORK/NEW JERSEY METRO, HUDSON RIVER, AND SOUTH LONG ISLAND

INTRODUCTION

This Environmental Sensitivity Index (ESI) atlas was developed for the Hudson River, New York/New Jersey Metro area and the southern Long Island, New York. The atlas covers the entire water body and surrounding riverine areas of the tidally influenced reach of the Hudson River, the New York/New Jersey Metro region, northern New Jersey as far south as Silver Bay, and the southern section of Long Island. The study area includes the sections of Metedeconk, Manasquan, Shark, Shrewsbury, Navesink, Raritan, Passiac and Hackensack Rivers in New Jersey as well as Sandy Hook Bay and the New Jersey side of the Hudson River. In addition to the Hudson River, major New York waterbodies captured in part within this study area include New York Harbor, Jamaica Bay, Jones Bay, South Oyster Bay, Great South Bay, Moriches Bay, Shinnecock Bay, and Mecox Bay. The inland extent of the study area includes lands and fresh waters to five nautical miles from the shoreline of tidal waters. The ESI atlas is a compilation of information from three main categories: shoreline habitats, sensitive biological resources, and human-use resources. Though the data will be useful for many shoreline applications, the goal of the ESI data is to present a concise summary of resources that may be particularly vulnerable to spilled oil. The intent of the data should caveat other uses. As an example, the ESI is not intended to present a catalog or comprehensive listing of species present in an area, rather the focus is on species particularly sensitive to oiling and life stages where vulnerability may increase.

SHORELINE HABITAT MAPPING

The shoreline and classifications were fully updated using the following sources and methods. The shoreline and intertidal habitats were delineated using a mapped sequence of Light Detection and Ranging (LiDAR) and high resolution digital orthophotography datasets. The LiDAR data was acquired in 2014 as part of a post-Super Storm Sandy contract for the United States Geological Survey (USGS). This task required the LiDAR data be collected at a nominal pulse spacing (NPS) of 0.7 meters. The window for tidally impacted waters within the area of interest was mean low water (MLW) +/- 2 hours exclusive of neap tide. Seven (7) missions were flown between April 3, 2014 and April 21, 2014, as part of the USGS project.

The base shoreline was compiled at Mean Higher High Water (MHHW) first by LiDAR extraction, then refined within a Geographic Information System (GIS) utilizing high resolution digital orthophotos. After the shoreline was delineated, digital orthoimagery from various sources was used to classify shoreline segments using the nationally standardized ESI scale (see below and next page). Imagery from the New York State Office of Information Technology Service (2013 and 2011), the New Jersey Office of Information Technology (2013), and various imagery sources for Google Earth and Bing Maps (2014) were used during the classification phase. Shoreline features of 10 meters (m) or greater in length were classified. In addition, wetland polygon datasets originally created by the United States Fish and Wildlife Service National Wetlands Inventory (NWI) were modified and updated to be used in conjunction with the ESI shoreline. Where necessary, multiple types were described for each shoreline segment.

The ESI shoreline classification and ranking scale has been used to assess vulnerability of shoreline to spilled oil since the mid-1970s. Rankings range from 1 – least vulnerable, to 10 – most vulnerable, with a variety of qualifiers unique to the geographic region. The scale incorporates the following considerations:

1) Shoreline type (substrate, grain size, tidal elevation, origin)
2) Exposure to wave and tidal energy
3) Biological productivity and sensitivity
4) Ease of cleanup

Prediction of the behavior and persistence of oil in intertidal habitats is based on an understanding of the dynamics of the coastal environments, not just the substrate type and grain size. The intensity of energy expended upon a shoreline by wave action, tidal currents, and river currents directly affects the persistence of stranded oil. The need for shoreline cleanup activities is determined, in part, by the slowness of natural processes in removal of oil stranded on the shoreline. The potential for biological injury and ease of cleanup of spilled oil are also important factors in the ESI shoreline ranking. Thus, shorelines exposed to high levels of physical energy, such as wave action and tidal currents, and low biological activity rank low on the scale, whereas sheltered shorelines with associated high biological activity have the highest ranking. The shoreline types delineated for metropolitan New York/New Jersey, the Hudson River, and South Long Island presented in order of increasing sensitivity to spilled oil, are listed below.

1A) Exposed Rocky Shores
1B) Exposed, Solid Man-made Structures
2A) Exposed, Wave-cut Platforms in Clay
2B) Exposed Scarps and Steep Slopes in Mud
3A) Fine- to Medium-grained Sand Beaches
3B) Scarps and Steep Slopes in Sand
4) Coarse-grained Sand Beaches
5) Mixed Sand and Gravel Beaches
6A) Gravel Beaches
6B) Riprap
7) Exposed Tidal Flats
8A) Sheltered Scarps in Clay, or Mud
8B) Sheltered, Solid Man-made Structures
8C) Sheltered Riprap
9A) Sheltered Tidal Flats
10A) Salt- and Brackish-water Marshes
9B) Vegetated Low Banks
10B) Freshwater Marshes
10C) Swamps
10D) Scrub-Shrub Wetlands

For each of these shoreline types, a photo and description of the physical attributes, predicted oil behavior, and response considerations are included at the end of the introductory pages.

SENSITIVE BIOLOGICAL RESOURCES

Biological information presented in this atlas was collected, compiled, and reviewed with the assistance of biologists and resource managers from the following agencies/organizations:

- New York State Department of Environmental Conservation (NYSDEC)
    - Division of Fish, Wildlife and Marine Resources (DFWMR)
        - Bureau of Fisheries
        - Bureau of Marine Resources
        - Bureau of Wildlife
        - New York Natural Heritage Program
    - Hudson River Estuary Program

- Hudson River National Estuarine Research Reserve (HRNEER)
- New York State Department of State (NYSDOS), Office of Planning and Development, Division of Coastal Resources
- New York Audubon Society
- New York City Audubon Society
- New Jersey Audubon Society
- U.S. Fish and Wildlife Service (USFWS)
    - Long Island National Wildlife Refuge Complex
    - Migratory Bird Program
- New Jersey Department of Environmental Protection (NJDEP)
    - Division of Fish and Wildlife (DFW)
        - Bureau of Freshwater Fisheries
        - Bureau of Shellfisheries
        - Bureau of Marine Fisheries
        - Endangered and Nongame Species Program
        - Waterfowl Ecology and Management Program
    - Division of Parks and Forestry
        - New Jersey Natural Heritage Program
- Coastal Research and Education Society of Long Island (CRESLI)
- Bayshore Regional Watershed Council
- Gotham Whale
- NatureServe
- Virginia Institute of Marine Science (VIMS) Multispecies Research Group
- National Park Service (NPS)
    - Fire Island National Seashore
    - Gateway National Recreation Area
    - Natural Resource Program Center
    - Cape Cod National Seashore – Robert Cook

The above agencies provided the majority of information included in the atlas. Other participating agencies will be cited throughout the atlas and in the metadata accompanying the digital product.
The biological resources shown in this atlas were extracted from the ESI GIS data compiled for this region. The extracted features were mapped at scale of 1:50,000 and appear on the maps referenced by a combination of number and letter. For example, Map 1B will show the biological features in conjunction with the ESI shoreline. The biology maps on these maps is "layered" in the PDF maps. This allows the user to turn off the biological features to more clearly see the underlying shoreline and habitat polygons.

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The data published date appearing at the bottom of the maps and on the cover page reflect when the data collection and compilation was completed. This atlas represents those data and was published February 2016

KEY BIOLOGICAL FEATURES ON ESI MAPS

1) Occurrences of animal and plant species that are at risk to spilled oil or may be impacted during a spill response are represented in the database by polygons, points, and lines.
2) To avoid clutter, the front of the map features occurrences that cover less than 10 kilometers of the map extent. A Map ID is associated with each of these polygonal, linear or point features.
3) Each map includes a tabular report summarizing the species found in the area. Features that are shown on the map are referenced by their Map ID. Features that cover more than 10 kilometers are presented in the report as Widespread in Mapped Area. Species occurrences that appear in the database as General Distribution are listed in a third category, Also Present in Mapped Area. To fully understand the diversity of species present, ALL sections of the map report should be reviewed.
4) Associated with each species in the table is the state (S) and federal (F) protected status as threatened (T) or endangered (E), as well as concentration, seasonality, and life-history information. Federal listings were provided by USFWS. State listings were provided by NatureServe.
5) The table includes a Mapping Qualifier with each species record (see table of mapping qualifiers and guidelines below). The mapping qualifier should help users understand particular vulnerabilities associated with the map data.
6) Feature level source information is included in the GIS database used to create these maps. The GIS data also provides the extent polygons for all mapped features; it can be queried, filtered, and used with other GIS datasets.
7) Species have been divided into groups and subgroups based on their behavior, morphology, taxonomic classification, and spill vulnerability and sensitivity. The icons below reflect this grouping scheme.
8) Colors depicting monthly seasonality roughly reflect Winter/Spring/Summer/Fall, but are primarily intended to ease readability.

TERRESTRIAL MAMMAL


Bat


Small Mammal

MARINE MAMMAL


Dolphin


Manatee


Pinniped


Whale

HERPETOFAUNA


Amphibian/Frog/ Snake/Lizard


Turtle

BIRD


Alcid/Pelagic Bird


Diving Bird


Gull/Tern/Bird


Passerine


Raptor


Shorebird


Wading Bird


Waterfowl

HABITAT


Upland/Wetland/Plant

INVERTEBRATE


Bivalve


Cephalopod


Crab/Invertebrate/ Shellfish


Insect


Gastropod


Lobster


Shrimp

FISH


Fish


Nursery

Mapping Qualifiers and Guidelines

Element	Qualifier	Guidelines
All	Concentration Area	Areas where concentrations are considerably higher than other records of the same species in the area of interest.
All	General Distribution	Used for broad, general distributions of species that are often mapped to landscape- or habitat-scale features.
All	Vulnerable Occurrence	Intended for records of rare species with discrete occurrences, where the conservation value of the species should be highlighted for spill response.
Birds, Herpetofauna, Marine Mammals, Fish, Invertebrates	Migration	Used when an area is a known staging area of high importance to the species for birds; and/or areas are potential or known migration corridors in the marine environment for other elements.
Birds, Herpetofauna	Nesting	Applicable to all nesting birds and herps. Should represent known nesting areas rather than all potential nesting habitat.
Birds	Rafting	Similar to 'Concentration Area' qualifier, but specific to large on-water concentrations.
Birds	Wintering	Designates known areas of importance to wintering birds.
Benthic	High Ecological Value	For use in areas where benthic organisms provide high ecological services, high quality habitat, or known areas of high biodiversity.
Fish and Invertebrates	Harvest Area	May be used as a qualifier for distributions in special cases, where the general distribution was not mapped and/or widespread and the distribution of the harvested resources is used to depict important areas.
Fish and Invertebrates	Nursery Area	Refers to specific areas of known importance to early life history stages (e.g., larvae, juveniles) of a species.
Fish and Invertebrates	Spawning Area	Areas where animals are spawning. Spawning is loosely defined as the release of gametes or eggs from the adult.

MARINE MAMMALS

Marine mammals depicted in this atlas include whales, dolphins, porpoises, and seals. While all of these species can be found in the marine waters of the New York Bight, bottlenose dolphins and seals are the only species likely to occur regularly in inshore areas and bays.

Pinnipeds – The most abundant pinniped in NY and NJ is the harbor seal, with grey seals regularly found in small but increasing numbers. Harbor and gray seals may occur from September to May, and their numbers peak from December through April. Juvenile gray seals may occur from January through May. Seals in the NY/NJ metro area may arrive slightly later and leave earlier than in Long Island (Biolsi pers. comm.). Harp, hooded, and ringed seals are Arctic species that are occasionally found in NY and NJ. Of these, only harp seals were mapped and this species may occur January through May. Hooded and ringed seals are very rarely observed.

Harbor seals may be found in the Hudson River as far north as Albany, but only their concentration areas were mapped. Seal concentration areas were mapped using digital data and expert knowledge. Haul-out sites were buffered by 100 m to increase the visibility of these locations on the map as well as to account for seals' sensitivity to human disturbance. Areas where seals aggregate adjacent to haul-outs, such as inlets, were mapped as high concentration areas. Concentration values for haul-outs are based on survey data and interviews with experts. These values reflect either the typical range or average number of seals present at a site during the peak season.

There are five major haul-outs on the south shore of Long Island: Montauk Point, Shinnecock Bay, Cupsogue Beach (Moriches Inlet), Democrat Point, and Haunts Creek (Jones Inlet). Seals also regularly haul out on Swinburne Island in Raritan Bay. Sandy Hook contains two major haul-outs; Skeleton Hill Island and Officer's Row. At the request of Gateway National Recreation Area, seals were mapped as occasionally hauled out on the eastern shore of Sandy Hook, but this is not a major site. Seals may also be present and/or hauling out in appropriate habitats throughout the south shore bays of Long Island, Raritan Bay, Sandy Hook Bay, and other NY and NJ bays and channels.

Cetaceans – Cetaceans (whales, dolphins, and porpoises) that may occur in NY and NJ waters that were mapped in this atlas include: bottlenose dolphin (NJ state special concern), harbor porpoise (state special concern), fin whale (state and federally endangered), humpback whale (state and federally endangered), and north Atlantic right whale (state and federally endangered). Sei, blue, and sperm whales (all state and federally endangered) are rarely known to occur within the mapped Area of Interest (AOI) and were not mapped. Marine mammals with no status listing (state or federally endangered, threatened, or of concern) were only mapped if there were known concentration areas. Common dolphins and minke whales may frequent NY/NJ waters, but because there were no known concentration areas for these species, they were not mapped. All marine mammals are protected under the Marine Mammal Protection Act of 1972.

Due to their wide-ranging habits and lack of known concentration areas, cetaceans were mapped using general distributions with the exception of two Biologically Important Areas identified by Duke University. These areas consist of a fin whale foraging concentration near Montauk Point and a right

whale migratory corridor. Humpback whales were added to the Montauk foraging concentration area using expert knowledge.

Cetaceans may be present year-round, but there are seasonal changes in their abundance and distribution. Fin whales are the most common large whale in the AOI and are present throughout the year. Humpback whales are found mainly in the spring, summer, and early winter, and are becoming more common along the coast. The North Atlantic right whale is infrequently but regularly found in the AOI throughout the year and appears to use the New York Bight as a migratory corridor between southern winter calving grounds and northern summer feeding grounds. Bottlenose dolphins are typically present from March through October, while harbor porpoise numbers peak in the winter months. Cetacean concentrations and seasonality were derived from NJDEP Ocean/Wind Power Baseline Studies Final Report (2010) and NYS NHP/DEC Baseline Monitoring of Large Whales in the New York Bight (2014), and reviewed by resource experts.

Expert contacts for NY/NJ Metro Area, Hudson River and South Long Island marine mammals*:

Name	Agency	City	Phone	Species
Arthur Kopelman	CRESLI	West Sayville, NY	631-244-3352	Marine mammals
Jeanette Bowers-Altman	NJDEP	Trenton, NJ	856-629-0261	Marine mammals
Kristy Biolsi	St. Francis College	Brooklyn Heights, NY	718-489-5415	Seals
Lisa Bonacci	NYSDEC	East Setauket, NY	631-444-0462	T&E Marine mammals
Paul Sieswerda	Gotham Whale	Staten Island, NY	718-938-2067	Marine mammals
Robert DiGiovanni	Riverhead Foundation	Riverhead, NY	631-369-9840	Marine mammals

***Note: this list is not meant to represent all marine mammal experts for the region.**

Major Data Sources Used: Marine Mammals

Conserve Wildlife Foundation of New Jersey. 2015. New Jersey Threatened and Endangered Species Field Guide. Available at http://www.conservewildlifenj.org/species/fieldguide/. Accessed July 2015.

DiGiovanni, R. 2015. Seal Haulout Sites around Long Island, NY and CT. Riverhead Foundation. Table and map.

Kopelman, A. 2014. Marine Mammal Sightings Data 1981 – 2013. Coastal Research and Education Society of Long Island (CRESLI). Spreadsheet.

LaBrecque, E., C. Curtice, J. Harrison, S.M. Van Parijs, and P.N. Halpin. 2015. Biologically important areas for cetaceans within U.S. Waters – East Coast Region. Aquatic Mammals 41: 30-38. Supporting vector digital data provided by the authors.

NatureServe 2014. NatureServe Central Databases. Arlington, VA. Vector digital data.

New Jersey Department of Environmental Protection, Office of Science. 2010. Ocean/wind power ecological baseline studies final report, volume III: Marine mammal and sea turtle studies. Prepared by Geo-marine, Inc. Document.

Schlesinger, M.D. and L.A. Bonacci. 2014. Baseline monitoring of large whales in the New York Bight. New York Natural Heritage Program and New York State Department of Environmental Conservation. Albany and East Setauket, NY. Document.

Sieswerda, P. 2014. Marine Mammal Sightings in the NY Bight 2008 – 2014. Gotham Whale. Spreadsheet.

BIRDS

Bird species are included in this atlas either because of their likelihood of direct or indirect impact by an oil spill or similar incident, their general rarity or imperilment, or their special protection status as threatened or endangered. Migratory or wintering concentration areas, nesting sites and colonies, and protected species are especially emphasized. Bird concentration areas depicted in this atlas are described for various groups of birds below.

Colonial waterbirds, shorebirds, and wading birds – Nesting locations for terns, gulls, cormorants, and herons along with breeding locations for piping plovers (state endangered and federally threatened) and other solitary nesting shorebird locations were mapped using digital polygon data obtained from NYSDEC, NY NHP, and NatureServe (NJ). Concentration values were generalized when presented for a range of dates (10-25, or 100s, 1000s, etc.) or left blank when not available. Migratory hotspot locations of terns and shorebirds were mapped using survey data provided by NY Audubon, NY NHP, and NatureServe (NJ). Concentration values, when presented, represent ranges or generalized values. Wading bird hotspot foraging locations and roost sites were mapped using survey data and expert knowledge provided by NJ Audubon and NY Audubon. Concentration values for wading bird foraging and roosting locations indicate high counts. In some instances, general distributions of sensitive species were mapped in association with habitat features using the NYSDOS Significant Coastal Fish and Wildlife Habitats narrative and accompanying digital polygon data.

Secretive marsh birds and marsh obligate passerines – Salt and freshwater marshes are ranked as highly sensitive to oiling due to their biological productivity and the tendency for oil to persist based on low relative expose to wind/wave energy and the difficulties associated with human cleanup activities. Marshes are extremely valuable for a suite of bird species in the region including rails, bitterns, and marsh obligate passerines, and should be prioritized for protection wherever they exist. Due to the difficulties of surveying in these areas, and in an effort to highlight specific known nesting occurrences, we only mapped nesting locations from point count surveys (Hudson River region), NY NHP, NatureServe (NJ), and the NY DOS Significant Coastal Fish and Wildlife Habitats narrative and associated polygon data. General distributions based on habitat associations were not mapped as they have been in the past. Therefore, an absence of a polygon in a region does not mean a species will not be present in the event of a spill.

Waterfowl – The majority of the Atlantic flyway population of Atlantic Brant and a significant portion of American black ducks overwinter in the marshes fringing the large bays of New York and New Jersey. Particular consideration is given to these key species during region wide aerial surveys as is evident in the atlas data. Based on consultation with resource experts and due to the large geographic scale at which winter waterfowl surveys are conducted, we mapped winter waterfowl distributions to large waterbodies and adjacent marsh habitat. In an effort to reduce complexity and place an emphasis on the overall number of individuals utilizing a particular region, we chose to only map species that contained 100 or more individuals per survey area. Counts of species that did not meet this threshold within a surveyed area were aggregated together and displayed as wintering "waterfowl". This method reduces clutter on the map while still placing an emphasis on the regions providing critical over-wintering waterfowl habitat. Smaller non-contiguous habitat within the survey area was noted as providing general distribution habitat to "waterfowl" during the winter season. Qualitative rather than quantitative terms were used to describe the concentration values of these areas. Additional areas providing critical foraging habitat and refuge areas for migrating waterfowl were mapped when data was available. The majority of the wintering and migratory occurrences were mapped using the USFWS Mid-winter Waterfowl Survey, data from NJ Audubon, and the NY DOS Significant Coastal Fish and Wildlife Habitats narrative and associated polygon data.

Nesting locations for resident waterfowl species were obtained from the NYSDEC Breeding Waterfowl Survey, the NY DOS Significant Coastal Fish and Wildlife Habitats narrative and associated polygon data, and some found opportunistically during other regional surveys. Similar to other marsh obligate nesting birds, the difficult nature of surveying in marsh habitat resulted in nesting waterfowl distributions in the area to be underrepresented within the atlas. Resident populations of waterfowl depend heavily on salt and freshwater marshes for breeding and therefore could be present within this habitat during the spring and summer breeding months.

Raptors – Nesting locations for bald eagles (NJ state endangered, NY state threatened), peregrine falcons (state endangered), osprey (NJ state threatened, NY state special concern), and northern harriers (NJ state endangered, NY state threatened) were mapped as points in New Jersey and polygons in New York at the request of the data providers; NatureServe (NJ) and NY NHP. Additionally, breeding locations of the state endangered short-eared owl were mapped as polygons along the southern shore of Long Island, NY. Wintering locations and migratory stopover concentrations were mapped as polygons where appropriate using the NY NHP data and the NY DOS Significant Coastal Fish and Wildlife Habitats narrative and associated polygon data.

Seabirds – No pelagic seabirds nest within the AOI but certain species are predicted to use the offshore region depicted within the atlas. The general distributions of seabirds off of New York and New Jersey were mapped using models created by researchers at the National Centers for Coastal Ocean Science using the Compendium of Avian Information database. Predictive models of seasonal occurrence were evaluated for inclusion on the map. Distributions were shown on the atlas when abundance was predicted to be higher than one individual per one kilometer pixel. These raster pixels were then converted to vector data and incorporated into coastal (0 – 1 nautical miles), nearshore (1-2 nautical

miles), mid-shore (2-4) nautical miles) or offshore polygons (6-12 nautical miles from shore). Additional high concentration areas were added off of the coast of Long Island using information from the NY DOS Significant Coastal Fish and Wildlife Habitats narrative and associated polygon data and a study conducted by Loring and others 2014.

Rare, threatened and endangered passerines – Nesting location of rare, threatened or endangered passerines were included as polygons in this atlas even when hydrographically removed from large waterbodies in an effort to make this regional update more usable in an all hazards context. These data were obtained from the NY NHP and NatureServe (NJ) databases and concentration values were set to equal one pair unless otherwise noted in the original data.

Expert contacts for NY/NJ Metro Area, Hudson River and South Long Island birds*:

Name	Agency	City	Phone	Species
Angelika Beckman	NYSDEC	Albany, NY	845-256-3098	marsh nesting birds
Elizabeth Craig	Cornell University	Ithaca, NY		harbor herons
Kerri Dikun	NY Audubon	Oysterbay, NY	516-922-3200	shorebirds
Nellie Tsipoura	NJ Audubon	Bernardsville, NJ	908-204-8998	wading birds
Susan Elbin	NYC Aubudon	New York, NY	212-691-7483	wading birds
Ted Nichols	NYDEP	Trenton, NJ	609-292-6685	waterfowl

***Note: this list is not meant to represent all bird experts for the region.**

Major Data Sources Used: Birds

Beckmann, A. 2014. Hudson River Marsh Bird Monitoring Program, 2010-2014. Vector digital data and spreadsheet.

Dikun, K. 2014. Shorebird Migration Survey Data. Vector digital data, spreadsheet and expert Knowledge.

Dikun, K. 2014. Long Island Shorebird Hotspots; Selected Ebird Observations. Vector digital data and expert knowledge.

Kinlan, B.P., R. Rankin, A. Winship, and C. Caldow. 2013. Modeling At-Sea Occurrence and Abundance Marine Birds to Support Mid-Atlantic Marine Renewable Energy Planning. U.S. Department of the Interior, Bureau of Ocean Energy Management, Herndon, VA. OCS Study BOEM 2013-xxx. NOAA Technical Memorandum NOS NCCOS xxx. ###+## pp.

Loring, P. H., Paton, P. W.C., Osenkowski, J. E., Gilliland, S. G., Savard, J.-P. L. and Mcwilliams, S. R. 2014. Habitat Use and Selection of Black Scoters in Southern New England and Siting of Offshore Wind Energy Facilities. The Journal of Wildlife Management, 78: 645–656.

Mizrahi, D.S., N. Tsipoura, K. Witkowski, and M. Bisignano. 2007. Avian Abundance and Distribution in the New Jersey Meadowlands District: The Importance of Habitat, Landscape, and Disturbance. Report. New Jersey Audubon Society submitted to New Jersey Meadowlands Commission.

NatureServe 2014. NatureServe Central Databases. Arlington, VA. Vector digital data.

New York Natural Heritage Program, SUNY College of Environmental Science and Forestry and New York State Department of Environmental Conservation. October, 2015. Biodiversity Databases, Element Occurrence Digital Data Set. Albany, NY. Vector digital data.

New York State Department of Environmental Conservation. 2014. Long Island Colonial Waterbird and Piping Plover Survey Results. Vector digital data and spreadsheet.

New York State Department of Environmental Conservation. 2015. Breeding Waterfowl Survey Plots. Vector digital data and spreadsheet.

New York State Department of State, Division of Coastal Resources. 2012. Significant Coastal Fish and Wildlife Habitats Narratives 1987 – 2012. Albany, NY. Documents.

New York State Department of State, Division of Coastal Resources. 1998. Significant Coastal Fish and Wildlife Habitats 2.0. Albany, NY. Vector digital data.

Tsipoura, N. 2014. Great Egret Roost Locations. New Jersey Audubon Society, Citizen Science Program. Vector digital data.

Tsipoura, N. 2014. Harbor Herons Foraging Locations. New Jersey Audubon Society, Citizen Science Program. Vector digital data and expert knowledge.

United States Fish and Wildlife Service. 2014. Mid-winter Waterfowl Survey, 2010-2014. Vector digital data, spreadsheet, and expert knowledge.

HERPETOFAUNA

Sea Turtles – Green (state and federally threatened), Kemp's ridley (state and federally endangered), leatherback (state and federally endangered), and loggerhead (NJ endangered, NY and federally threatened) sea turtles were included in this atlas. The Atlantic hawksbill sea turtle is listed as endangered federally and by the states of NY and NJ, but it was not mapped due to its rarity in this region.

Polygons represent potential in-water presence in bays and the Atlantic Ocean. The bays, particularly along the south shore of Long Island, are seasonal foraging grounds for green, Kemp's ridley, and loggerhead sea turtles. Sea turtles typically do not arrive in NY/NJ waters until May or June and migrate south by mid-November. Sea turtles are not known to nest in this AOI. The loggerhead sea turtle is the most common sea turtle in these waters. Leatherback sea turtles are also common, but tend to be farther offshore in deeper water than the other species. However, leatherback sea turtles will sometimes utilize eastern Long Island bays near the inlets (Kopelman pers. comm.). Kemp's ridley sea turtles are

uncommon but regular in this area as juveniles. Green sea turtles are least common of the mapped sea turtles in this atlas. Sea turtle general distributions were mapped largely based on expert knowledge and the New Jersey Threatened and Endangered Species Field Guide.

Northern Diamondback Terrapin – Terrapins rely exclusively on coastal salt marshes, back bays, tidal creeks and associated habitat making them extremely susceptible to a marine oil spill. Although once widespread in the region, terrapins have declined in recent years owing to high predation rates in historically productive areas. The locations depicted in this atlas indicate known current nesting locations but suitable habitat is widespread in this atlas region and there is potential for terrapins to be present in most bays and estuaries in New York and New Jersey. Breeding locations included in this atlas for terrapins were obtained from survey data collected by Russel Burke, Hofstra University, Michael Farina, Marine Nature Study Area; Oceanside, NY and Robert Cook, National Park Service. Additional nesting locations and some general distribution locations were obtained from NY NHP, NatureServe (NJ), and the NY DOS Significant Coastal Fish and Wildlife Habitats narrative and associated polygon data. These locations were further refined during data review sessions with local resource experts.

Threatened, endangered and other rare reptiles and amphibians – Other reptile and amphibian species were added to the atlas based on their conservation status, their dependence on the aquatic environment during sensitive life stages (breeding in particular), their rarity in the region, or based on expert input. At the request of data providers, some species locations were buffered and species names masked to prevent illegal collection. The bulk of the data was obtained from NY NHP, NatureServe (NJ), NY DOS Significant Coastal Fish and Wildlife Habitats narrative and associated polygon data, and from interviews with resource experts.

Expert contacts for NY/NJ Metro Area, Hudson River and South Long Island herpetofauna*:

Name	Agency	City	Phone	Species
Arthur Kopelman	CRESLI	West Sayville, NY	631-244-3352	Sea turtles
Erik Kiviat	Hudsonia	Annandale, NY	845-758-7053	Atlantic coast leopard frog
Jeanette Bowers-Altman	NJDEP	Trenton, NJ	856-629-0261	Sea turtles
Mike Farina	Marine Nature Study Area	Oceanside, NY	516-766-1580	diamondback terrapins
Nick Conrad	NY NHP	Albany, NY	518-402-8944	Rare, T&E herps
Robert Cook	NPS	Wellfleet, MA	508-487-3262	Reptiles and Amphibians
Robert DiGiovanni	Riverhead Foundation	Riverhead, NY	631-369-9840	Sea turtles
Russell Burke	Hofstra University	Hempstead, NY	516-463-5521	diamondback terrapins

***Note: this list is not meant to represent all herpetofauna experts for the region.**

Major Data Sources Used: Herpetofauna

Burke, R. 2015. Nesting Locations of Northern Diamondback Terrapins. Hofstra University. Spreadsheet and expert knowledge.

Conserve Wildlife Foundation of New Jersey. 2015. New Jersey Threatened and Endangered Species Field Guide. Available at http://www.conservewildlifenj.org/species/fieldguide/. Accessed July 2015.

Cook, R.P., in prep. Amphibians and Reptiles of Gateway NRA: Impacts of Urbanization and Restoration. Report and expert knowledge.

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TERRESTRIAL MAMMALS

The terrestrial mammals depicted in this atlas are limited to special status species. These are: Alleghany woodrat (NY/NJ endangered), New England cottontail (NY special concern), Indiana bat (NY and federally endangered), Eastern small-footed myotis (NY special concern), and northern myotis (NY and federally threatened). The only listed terrestrial mammal occurring within the NJ portion of the AOI is the Alleghany woodrat. Digital polygon data from NatureServe (NJ) and the NYS NHP were used to map terrestrial mammal locations. Bat colonies, after being offset, were buffered by 1,000-m due to their sensitivity to human disturbance.

Semi-aquatic furbearing mammals such as beaver, muskrat, mink, and river otters occur throughout the NY/NJ AOI but were not mapped due to their relatively wide distribution and a lack of information regarding particular concentration areas. Muskrats are common in a variety of wetland habitat including brackish and freshwater marshes, ponds, and streams. Mink are less numerous than muskrats, but are

also widely distributed in a variety of wetland habitats. Beavers are widespread in the Hudson River corridor, but populations tend to be low in areas of dense human population such as the NY/NJ metro area. Beaver rarely occur on Long Island. River otters are gradually re-colonizing Long Island following extirpation, but established territories have not been documented around the south shore bays, including the Carmans River, the Connetquot River, and other suitable habitat (Bottini pers. comm.).

Expert contacts for NY/NJ Metro Area, Hudson River and South Long Island terrestrial mammals*:

Name	Agency	City	Phone	Species
Andrew Burnett	NJDEP	Trenton, NJ	609-748-2058	Furbearers
Jeanette Bowers-Altman	NJDEP	Trenton, NJ	856-629-0261	Rare, T&E mammals
Josh Stiller	NYSDEC	Stonybrook, NY	631-444-0311	Furbearers
Mike Bottini	Private	East Hampton, NY	631-267-5228	River Otter
Nick Conrad	NY NHP	Albany, NY	518-402-8944	Rare, T&E mammals
Sean Madden	NYSDEC	Albany, NY	518-402-8977	Mink

***Note: this list is not meant to represent all terrestrial mammal experts for the region.**

Major Data Sources Used: Terrestrial Mammals

NatureServe 2014. NatureServe Central Databases. Arlington, VA. Vector digital data.

New York Natural Heritage Program, SUNY College of Environmental Science and Forestry and New York State Department of Environmental Conservation. October, 2015. Biodiversity Databases, Element Occurrence Digital Data Set. Albany, NY. Vector digital data.

FISH

Finfish depicted in this atlas include selected marine, estuarine, and freshwater species. Species of conservation interest, commercial or recreational importance, or ecological importance are emphasized. Fish polygons were created based on survey information, digital data, and expert opinion provided primarily by resource experts at NJDEP and NYSDEC. Concentrations used for survey data include "LOW", "MEDIUM", "HIGH", and "ABUNDANT" or in the case of mid-Atlantic Estuarine Living Marine Resources (ELMR) "RARE", "COMMON", "ABUNDANT", AND "HIGHLY ABUNDANT." In the absence of concentration information, a concentration of "PRESENT" was assigned. In special cases, other concentrations are used.

Atlantic and shortnose sturgeon – Atlantic (NJ state endangered, federally endangered) and shortnose sturgeon (federally and state endangered) were mapped to areas where they are known to occur. Polygons were based on data provided by NYSDEC staff, Dr. Keith Dunton of Delaware State University, published literature, and expert knowledge from Kathy Hattala and Kim McKown of NYSDEC. Important spawning, nursery, and wintering areas on the Hudson River were identified by Kathy Hattala. Coastal aggregation areas of subadult Atlantic sturgeon near the Rockaways and Sandy Hook

were based on Dunton and others 2010. An Atlantic sturgeon migratory route along the NY/NJ coast to the 20 m isobath was mapped using Dunton and others 2015.

River herring and American shad - Alewife and blueback herring, collectively known as river herring, and American shad are anadromous fish that once supported the largest commercial and recreational fisheries on the Atlantic Coast but have become severely depleted due to blockages of spawning runs, habitat loss, and overfishing. Spawning runs were mapped using information provided by NJDEP and NYSDEC as well as knowledge from agency biologists and local experts. River herring runs were mapped to the first known barrier such as a dam or impassable gradient. If the run went beyond the water features in the ESI hydrographic layer, then it was mapped using stream line features and buffered by 5 m to convert to a polygon feature. These areas are designated with "Spawning Area" and "Nursery Area" mapping qualifiers to emphasize these important life history stages. The concentration “KNOWN” was used to indicate runs with recently confirmed spawning activity, and “POTENTIAL” was used for runs with fish passage improvement projects. Embayments on the Hudson River are important to early life stages of river herring and were included as nursery areas. River herring pre-spawning concentrations at the mouths of certain rivers were mapped as migration areas. Timing of migration and spawning was provided by resource experts. Additional anadromous fish concentration areas on the Hudson River were mapped using NY NHP data, and an anadromous fish migration corridor on the lower Hudson River was mapped using expert knowledge.

FISH - HUDSON RIVER

In addition to sturgeon, river herring, and American shad, special attention was given to mapping the following commercially or recreationally important species on the Hudson River: American eel, striped bass, Atlantic tomcod, largemouth bass, smallmouth bass, and walleye. The Lower Hudson River and its tributaries provides extensive spawning and nursery habitat for these species. Resource experts from NYSDEC provided most of the information used to map general distributions and critical spawning, nursery, and wintering areas, and seasonalities. The 2002-2007 Hudson fish distribution data (AKRF 2010) were used to delineate spawning and nursery areas for Atlantic tomcod. Mid-Atlantic ELMR data were used map the general distribution, concentration values, and seasonality for other species in the Hudson River estuary based on salinity zones. In some cases, distributions were further refined with additional salinity data from The Nature Conservancy. Important multi-species concentration areas such as Haverstraw Bay were identified using NYSDOS Significant Coastal Fish and Wildlife Habitat digital data and narratives.

FISH – BAYS AND ESTUARIES

Long Island- NYSDEC staff provided Western Long Island (WLI) beach seine data for 1984 – 2013 that was used to develop initial species lists and concentrations for individual bays. The WLI surveys occur May – October and sampling stations are fixed locations based on accessibility. Of the south shore bays, Jamaica Bay has been sampled the longest and most consistently, with limited sampling on the south shore of central Long Island due to lack of accessibility.

On the south shore, the WLI sampling stations are divided into 6 bays: Jamaica Bay, South Oyster Bay, Great South Bay, Bellport Bay, Moriches Bay, and Shinnecock Bay. Species occurrence rates based on how often a species was encountered in each bay were used to determine concentration values of "LOW", "MEDIUM", and "HIGH" based on the first, second and third, and fourth quartiles respectively. Only the five most recent years of survey data were summarized for Jamaica Bay due to its consistent coverage throughout all years of the WLI survey; for less surveyed bays all years of available data were included.

NYSDOS Significant Coastal Fish and Wildlife Habitat narratives were reviewed for additional species information for the south shore bays and rivers including Carls River, Carmens River, and Connetquot River. One listed species, the banded sunfish (NY state threatened), occurs in the Peconic River system on Long Island and was mapped using NYS NHP data. Major inlets were mapped as concentration areas for species such as bluefish and striped bass, as well as for eggs and larvae of tautog and black sea bass that can drift in from nearshore spawning areas. Winter migrants, Atlantic cod and Atlantic mackerel, were mapped using NYSDEC expert knowledge. The resulting species lists and concentrations for each bay were reviewed and modified through discussions with NYSDEC resource experts. Seasonality was determined using Mid-Atlantic ELMR, NYSDEC expert knowledge, and published literature.

Raritan Bay and NJ Bays and Estuaries – Mid-Atlantic ELMR data were used to fill in species information within NJ waters and Raritan Bay. Primarily, mid-Atlantic ELMR data were used in Barnegat Bay and other smaller inland bays along the NJ coast. Concentrations and seasonality were adopted as is. NOAA's Essential Fish Habitat (EFH) vector digital data were used for mapping Highly Migratory Species.

FISH – ATLANTIC OCEAN

The ocean distribution of fish was mapped using three fisheries independent trawl survey datasets; NJ Ocean Trawl Survey (OTS), VIMS Northeast Area Monitoring and Assessment Program (NEAMAP), and NMFS Northeast Fisheries Science Center Bottom Trawl survey. EFH vector digital data were used for mapping Highly Migratory Species. A concentration area at Montauk Point Shoals was mapped using NYSDOS Significant Coastal Fish and Wildlife Habitat. Seasonality was determined using NJ OTS data (described below), EFH source documents, Able and Fahay 2010, Castro 2011, and expert knowledge.

Independent sampling data from NJ OTS and NEAMAP were provided as catch per unit effort (CPUE) by station. Polygons used to aggregate sampling stations were based on the depth strata used by NJ OTS and correspond to generalized 10-m and 20-m isobaths. These polygons were further divided into along the south shore of Long Island from west to east using divisions at the Fire Island and Moriches inlets.

NJ ocean fish – The NJ OTS was the primary dataset used to determine concentration values and seasonality for NJ ocean fish distribution. This is a multispecies survey that occurs five times a year (January, April, June, August, and October). Survey strata are assigned to 3 different depth regimes; inshore (3-5 fathoms), midshore (5-10 fathoms), and offshore (10-15 fathoms). The most recent 10 years of available data (2004 – 2013) were used for this effort.

The presence of a species for a given month, in a given depth strata, was based on the occurrence rates. Species caught more than one tenth of the time at sampling stations within a polygon and across the ten-year sampling window were marked as present for that month. Species with similar life history, behavior, and habitat requirements were grouped into ELMR guilds for comparison. Within these guilds, average CPUE for all months was used to assign "LOW", "MEDIUM", and "HIGH" concentrations, corresponding to the first, second and third, and fourth quartiles of averaged CPUE respectively. Concentration and seasonality information was sometimes adjusted based on review by NJDEP BMF staff or to be consistent with published information.

NY ocean fish – Data from NEAMAP were used to map the inshore and midshore fish distributions in NY. Sampling for this program occurs in the spring and fall (typically May and October) and data used for this effort were collected from 2007 to 2013. NEAMAP data were supplemented with NMFS data (1979-2008) for the offshore polygons and for species not included in the NEAMAP data. Concentrations were assigned using the same method as with NJ OTS. The NMFS data that was downloaded from the U.S. Ocean Biogeographic Information System did not include catch numbers; therefore, species were mapped as "PRESENT" if they appeared in the NMFS bottom trawl survey for a given polygon.

FISH – LAKES AND PONDS

Recreationally important freshwater fish were mapped in NY using the Recommended Public Fishing Areas vector data and interviews with NYSDEC fisheries biologists on Long Island and in the NYC metro area. These areas were given the mapping qualifier "HARVEST AREA" to emphasize the recreational/ economic value of the species mapped within them. NYSDEC biologists provided seasonality and concentrations.

Expert contacts for NY/NJ Metro Area, Hudson River and South Long Island fish*:

Name	Agency	City	Phone	Species
Byron Young	NYSDEC (retired)	East Quogue, NY	631-294-9612	Alewife
Charles Guthrie	NYSDEC	Stonybrook, NY	518-402-8924	Freshwater fish
Chris Bowser	NYSDEC	New Paltz, NY	845-889-4745	American eel
Heather Corbett	NJDEP	Port Republic, NJ	609-748-2020	Marine fish
Jeanette Bowers-Altman	NJDEP	Trenton, NJ	856-629-0261	Sturgeon
Kathy Hattala	NYSDEC	New Paltz, NY	845-256-3071	Anadromous Fish
Kim McKown	NYSDEC	East Setauket, NY	631-444-0454	Marine fish
Melissa Cohan	NYSDEC	Long Island City, NY	718-482-4022	Freshwater fish
Mike Boriek	NJDEP	Lebanon, NJ	908-236-2118	River Herring
Mike Flaherty	NYSDEC	New Paltz, NY	845-256-3066	Freshwater fish

***Note: this list is not meant to represent all fish experts for the region.**

Major Data Sources Used: Fish

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New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Bureau of Marine Fisheries. 2014. New Jersey BMF Ocean Trawl Survey (OTS) Data 2004 – 2013. Spreadsheet.

New York Natural Heritage Program, SUNY College of Environmental Science and Forestry and New York State Department of Environmental Conservation. October 2015. Biodiversity Databases, Element Occurrence Digital Data Set. Albany, NY. Vector digital data.

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INVERTEBRATES

Invertebrates depicted in this atlas include selected marine and estuarine species of commercial, recreational, ecological, and/or conservation interest. Several known invertebrate concentrations, as well as larger, more general areas where invertebrate habitat exists, were mapped.

INVERTEBRATES – HUDSON RIVER

The invertebrates mapped in the Hudson River estuary are blue crab, freshwater mussels, and rare insect species. Blue crab can potentially occur throughout the Hudson River below river mile 74, but only the probable mating and nursery distribution was mapped. Mating and nursery areas are typically shallow (3 m or less) water and salt marsh habitat from river mile 0 to 74 (Kenney pers. comm.). Important concentration areas are Haverstraw Bay, Tappan Zee Bay, and Newburgh Bay.

Based on freshwater mussel sampling by the Cary Institute, the section of the tidal Hudson River from river mile 132 to 154 supports a relatively large freshwater mussel population. The species that occur there are the tidewater mucket, alewife floater, and eastern elliptio. Eastern elliptio is the most common

of these species. While these species are unlisted, their numbers have been greatly reduced by the invasive zebra mussel, and the alewife floater and tidewater mucket are both state ranked as critically imperiled. Gravid females, larvae, and juveniles are particularly sensitive to environmental stress. Densities (number of mussels per m^2) were provided by the Cary Institute and used in the concentration field. Additional locations of the alewife floater and eastern elliptio, as well as rare insect species, were mapped using NYS NHP data.

INVERTEBRATES – BAYS AND ESTUARIES

Shellfish – Shellfish landings data provided by NYSDEC were the primary data source for mapping shellfish distribution and concentrations in the Long Island south shore bays. For concentration, the average number of bushels landed in each bay from 2009 – 2013 was summarized for each species except for whelk. There is no mandatory reporting of harvest for whelk species, resulting in severe underestimates (McKown pers. comm.). Shellfish areas mapped with landings data were assigned the mapping qualifier "HARVEST AREA." NYS Significant Coastal Fish and Wildlife Habitat narratives were used to complete the south shore distribution of shellfish. Raritan Bay shellfish distributions were mapped using the mid-Atlantic ELMR report. For bays in NJ, hardcopy shellfish maps were used to map shellfish concentrations. These maps date as far back as 1983 and are updated as resources allow, with northern quahog in Barnegat Bay the only recently mapped area/species (done in 2012). Pre-2012 data are identified with a concentration value of "HISTORIC." Information from resource experts at the NYSDEC, NYS Significant Coastal Fish and Wildlife Habitat narratives, and mid-Atlantic ELMR data were used to fill data gaps.

Horseshoe crab - Known horseshoe crab spawning areas were mapped using reports from surveyed sites. The actual spawning distribution is more widespread than is depicted on these maps, as any sandy, bayside beach could be potential habitat. High priority spawning beaches (as determined by the data provider) are indicated with "HIGH" in the concentration field. Spawning areas were mapped by buffering the shoreline by 50 m. Spawning areas were reviewed by resource experts and Fire Island National Seashore staff.

Blue crab - Blue crabs were mapped using WLI Beach Seine data, ELMR data, and expert knowledge. A large adult wintering concentration occurs November – March in the western part of New York Harbor (Kenney pers. comm.). A concentration of spawning females was mapped in Raritan Bay with information provided by NYSDEC (McKown pers. comm.).

Rare and Endangered Invertebrates - Rare and endangered invertebrates were mapped using NYSDEC NHP and NatureServe data with additional locations were provided by Fire Island National Seashore staff. Some species names were generalized as "Rare Insect" or "Rare Invertebrate" to protect sensitive species, as requested by the data provider. A large number of monarch butterflies move through Fire Island and Sandy Hook from August-October during their annual migration and these were included as migration areas. The monarch butterfly is a candidate species for federal listing.

INVERTEBRATES – ATLANTIC OCEAN

Atlantic surfclam – Atlantic surfclam distributions in NY were mapped using survey data for NY. NYSDEC conducts routine population surveys using stratified random sampling. The survey takes place along the south shore of Long Island in that Atlantic Ocean from just east of Rockaway Inlet to Montauk Point, extending 3 nautical miles offshore. The study area is divided into 10 strata, with each stratum extending one mile in width and divided from west to east by Jones, Fire Island, and Moriches inlets. There is only one stratum from Moriches Inlet to Montauk Point, extending one mile from shore. Concentration values were determined by calculating the average clam density (clams/m^2) in each stratum from 2005-2012 (total of 4 surveys). Concentrations are described as "LOW", "MEDIUM", and "HIGH" corresponding to the first, second and third, and fourth quartiles of density.

The NJ surf clam resource is severely depleted with no recent landings except for a bait fishery off of Sandy Hook in prohibited waters. This area was given a concentration of "Baitfishery Area." In approved waters the NJ surf clam harvest is virtually nonexistent, and this area was mapped as "historically productive" at the recommendation of NJDEP BS.

Ocean quahog – Ocean quahogs were mapped using the Essential Fish Habitat source document, which states that most adults are found at depths between 25 to 61 m with juveniles at depths of 45-75 m in the middle Atlantic Bight. Based on this information, the ocean quahog distribution was mapped from the 20 m isobath to the offshore extent of the AOI.

Other invertebrates – The ocean distributions of blue crab, horseshoe crab, American lobster, and longfin squid were mapped using fisheries independent datasets: NJ Ocean Trawl, NEAMAP, and NMFS Bottom Trawl, using the same methods as with marine finfish as described above. For NJ OTS and NEAMAP data, the CPUE was calculated for each species by strata, and concentrations were described as "HIGH", "MEDIUM", "LOW" corresponding to the first, second and third, and fourth quartiles. Longfin squid concentrations were described as "ABUNDANT" or "HIGHLY ABUNDANT" due to their abundance in all depth strata. NEAMAP was used to map horseshoe crab and American lobster distributions in NY (except for the offshore strata) and NMFS was used to map blue crab in NY and all invertebrates in the NY offshore strata. A horseshoe crab concentration off the west end of Long Island was identified using the NYSDEC Atlantic surfclam survey data from 1999 – 2012 (6 years). The CPUE of horseshoe crab for each stratum was averaged across all years and concentrations were described as "HIGH", "MEDIUM", "LOW" corresponding to the first, second and third, and fourth quartiles. Only the high concentration strata were mapped as a concentration area. The primary sources for invertebrate seasonality were mid-Atlantic ELMR, NJ OTS, EFH source documents, and resource experts from NYSDEC.

Expert contacts for NY/NJ Metro Area, Hudson River and South Long Island invertebrates*:

Name	Agency	City	Phone	Species
Dave Strayer	Cary Institute	Millbrook, NY	845-677-7600	Freshwater mussels
Gregg Kenney	NYSDEC	New Paltz, NY	845-256-3199	Blue Crab
Jeff Normant	NJDEP	Port Republic, NJ	609-748-2040	Marine bivalves
Jennifer O'Dwyer	NYSDEC	East Setauket, NY	631-444-0489	Marine invertebrates
Joe Reynolds	Bayshore	Navesink, NJ	732-872-2834	Horseshoe crabs
John Tanacredi	Molloy College	Rockville Centre, NY	516-323-3591	Horseshoe crabs
Kim McKown	NYSDEC	East Setauket, NY	631-444-0454	Marine invertebrates
Matt Sclafani	Cornell University Cooperative Extension	Riverhead, NY	631-727-7850 ext. 377	Horseshoe crabs
Nick Conrad	NY NHP	Albany, NY	518-402-8944	Rare, T&E invertebrates

***Note: this list is not meant to represent all invertebrate experts for the region.**

Major Data Sources Used: Invertebrates

NatureServe. 2014. NatureServe Central Databases. Arlington, VA. Vector digital data.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 2009. Northeast Fisheries Science Center Bottom Trawl Survey Data 1979 – 2008. Woods Hole, MA. Downloaded March 31, 2015 from http://www.usgs.gov/obis-usa/search/?datasetid=NEFSC#. Spreadsheet.

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New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Bureau of Shellfisheries. 2012. New Jersey Shellfish Distribution Maps 1983 – 2012. Accessed July 2015 from http://www.nj.gov/dep/landuse/shellfish.html. Hard copy maps.

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Tanacredi, J.T. 2014. Long Island Horseshoe Crab Network Annual Inventory Report. Center for Environmental Research and Coastal Oceans Monitoring (CERCOM), Molloy College. West Sayviille, NY. Document and spreadsheet.

Virginia Institute of Marine Science Multispecies Research Group. January 2015. Northeast Area Monitoring and Assessment Program (NEAMAP) selected bottom trawl data for NY/NJ. Gloucester Pt., VA. Spreadsheet.

BENTHIC HABITATS

Benthic habitats mapped in this atlas consist of submerged aquatic vegetation (SAV) and bivalve reefs. Benthic habitat was given the mapping qualifier of "High Ecological Value" as it provides spawning, nursery, and foraging habitat for fish and shellfish, habitat for macroinvertebrates, and food for waterfowl, fish, and mammals. The Hudson River estuary and Barnegat Bay have data sets for SAV inventories conducted in multiple years. In these cases, SAV in the most recent year for each area was

mapped with a concentration value of "Present" while SAV from prior years was given the concentration value of "Potential." SAV may eventually recover or be restored in areas where it has been lost, and it was recommended by the data providers that these areas be included in the atlas.

Hudson River SAV was mapped using the combined Hudson River NERR/NYSDEC vector digital data from 1997, 2002, and 2007 (Cornell IRIS 2011). The most recently mapped year (2007) was used to differentiate SAV classified as "Present" from the past or "Potential" distribution. The dominant species in the Hudson River estuary SAV community is water celery (*Vallisneria americana*). The dominant seagrass in Barnegat Bay and the South Shore estuary is eelgrass (*Zostera marina*), with widgeon grass (*Ruppia maritima*) occurring in shallower areas with lower salinity. Barnegat Bay SAV was mapped with 1979, 2003, and 2009 data, with 2009 SAV mapped as "Present." Long Island's South Shore estuary benthic habitats were mapped using the 2002 NYSDOS benthic habitat data set and supplemented with Fire Island SAV data (Wang 2004). Fire Island SAV data was included only in areas where it did not overlap with the NYSDOS data. The only bivalve reefs mapped in this AOI were in South Oyster Bay. In addition to seagrass and reefs, areas with macroalgae (seaweed) are shown in the South Shore estuary.

Expert contacts for NY/NJ Metro Area, Hudson River and South Long Island benthic*:

Name	Agency	City	Phone	Species
Jeff Herter	NYSDOS	Albany, NY	518-486-7942	SAV
Rick Lathrop	Rutgers	New Brunswick, NJ	848-932-1580	SAV
Sara Fernald	NYSDEC	Staatsburg, NY	845-889-4745	SAV

***Note: this list is not meant to represent all invertebrate experts for the region.**

Major Data Sources Used: Benthic

Cornell Institute for Resource Information Science (Cornell IRIS). 2011. Hudson River Estuary – Submerged Aquatic Vegetation (SAV). Hudson River national Estuarine Research Reserve (HRNERR) and New York State Department of Environmental Conservation (NYSDEC). Albany, NY. Vector digital data.

Cornell Institute for Resource Information Science (Cornell IRIS). 2011. Hudson River Submerged Aquatic Vegetation 2007.). Hudson River national Estuarine Research Reserve (HRNERR) and New York State Department of Environmental Conservation (NYSDEC). Albany, NY. Vector digital data.

Grant F. Walton Center for Remote Sensing and Spatial Analysis (CRSSA) and Macomber, R.T. and D. Allen. 1999. Submerged Aquatic Vegetation in the Barnegat Bay – Little Egg Harbor estuary, New Jersey: 1979. Grant F. Walton Center for Remote Sensing and Spatial Analysis (CRSSA), Rutgers University. New Brunswick, NJ. Vector digital data.

Greenhorne and O'Mara. 2002. Long Island Benthic Habitat (FINAL_POLY). New York State Department of State. Albany, NY. Vector digital data.

Lathrop, R. G. and S.M. Haag. 2011. Submerged aquatic vegetation (SAV) CRSSA image classification of the Barnegat Bay – Little Egg Harbor estuary, New Jersey: 2009. Grant F. Walton Center for Remote Sensing and Spatial Analysis (CRSSA), Rutgers University. New Brunswick, NJ. Vector digital data.

Lathrop, R. G., P. Montesano, and S. Haag. 2011. Submerged aquatic vegetation (SAV) CRSSA image classification of the Barnegat Bay – Little Egg Harbor estuary, New Jersey: 2003; revision published 20110511. Grant F. Walton Center for Remote Sensing and Spatial Analysis (CRSSA), Rutgers University. New Brunswick, NJ. Vector digital data.

Wang, Y.Q. and M. Traber. 2004. Classification of Submerged Aquatic Vegetation (SAV) from Quickbird-2 Satellite imagery for the Fire Island National Seashore. Kingston, RI. Raster Dataset.

HABITATS

Threatened, endangered, and rare plants and rare plant communities were mapped primarily with data from NY NHP and NJ NHP and were given the mapping qualifier of "Vulnerable Occurrence." NJ NHP grid map contains cells that vary from 358-372 acres in size with a table of rare plant species and ecological communities that occur within each cell. Maritime holly forest, a globally rare forest type, was mapped on Fire Island and Sandy Hook using vegetation data provided by Fire Island National Seashore and Gateway National Recreation Area, respectively. The distribution of seabeach amaranth (NJ endangered, NY state and federally threatened) on Sandy Hook was mapped using information provided by Gateway National Recreation Area. Non-federally listed, state protected plant names were generalized to "Endangered Plant", "Threatened Plant", and "Rare Plant." Although they do not have a listing status in NY, rare mosses were included as "Rare Plant" locations since they occur in wetlands and are vulnerable to oil spills. Small polygons (< 123 m^2) representing plant locations in the NY NHP database were converted to points so that they would be visible on the ESI atlas maps. Critically imperiled, imperiled, and vulnerable wetland and upland plant community types were generalized as "Rare Upland Community" or "Rare Wetland Community" except for the maritime holly forest, vernal pool, and coastal dune woodland community types.

There was a high degree of overlap of certain wetland community types in the NY NHP Communities data with ESI wetland polygons (see shoreline habitat section). NY NHP wetland types that were already represented in the ESI wetland polygon data were not included in the habitat feature class. Rocky summit, cliff, and talus upland community types were not mapped due to their low vulnerability to oil spills. Vernal pools provide important amphibian breeding habitat and these were mapped with NY NHP Communities data, NJ DEP Vernal Habitat data, and Scenic Hudson's Vernal Pools data. NJ vernal habitat areas have been field verified by the NJ DOS and provide documented habitat for amphibians.

Expert contacts for habitats and rare plants*:

Name	Agency	City	Phone	Species
Jordan Raphael	NPS	Ocean Beach, NY	631-687-4769	Vegetation
Mark Christiano	NPS	Staten Island, NY	718-354-4525	Vegetation
Mark Wong	NJDEP	Trenton, NJ	609-292-2797	Rare plants
Nick Conrad	NY NHP	Albany, NY	518-402-8944	Rare plants
Wendy Walsh	USFWS	Pleasantville, NJ	609-383-3938	Seabeach amaranth, swamp pink

***Note: this list is not meant to represent all habitat and rare plant experts for the region.**

Major Data Sources Used: Habitats

New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered Nongame Species Program. 2012. NJDEP Species Based Habitat, Vernal Habitat (Version 3.1, 20120221). Trenton, NJ. Vector digital data.

New Jersey Department of Environmental Protection, Office of Natural Lands Management. 2012. NJDEP Natural Heritage Grid Map, Version 200911. Trenton, NJ. Vector digital data.

New York Natural Heritage Program, SUNY College of Environmental Science and Forestry and New York State Department of Environmental Conservation. October, 2015. Biodiversity Databases, Element Occurrence Digital Data Set. Albany, NY. Vector digital data.

Scenic Hudson. 2014. Woodland Pools 2014 Updated. Vector digital data.

INVASIVE SPECIES

The spread of invasive or non-native species can degrade habitat, increase the potential for crop damage and diseases in humans, livestock and natural resources, reduce biodiversity through competition and limit recreational opportunities. Invasive species often opportunistically spread after disturbance events alter the natural landscape. Oil spill response and clean up often alters the landscape in a manner conducive to the spread of invasive species as crews often mobilize from all over the U.S. in response to large scale spill events. Boats, trailers, waders and clean up equipment can spread invasive species from waterbody to waterbody unless properly cleaned after use. Invasive species that were mapped are shown on the HUMAN-USE RESOURCE maps.

Regulations prohibit boats from launching from or leaving DEC launch sites without first draining the boat and cleaning the boat, trailer and equipment of visible plant and animal material. Many New York counties, towns and villages also have laws in place that prohibit the transport of aquatic invasive species on boats, trailers and equipment.

Asiatic sand sedge and water chestnut are invasive species of particular concern to land managers in this AOI. Asiatic sand sedge is an exotic plant that threatens beaches and the rare species that rely on them such as seabeach amaranth and piping plover. It was recently discovered in New York on Staten Island and Long Island following Hurricane Sandy and a large effort is underway to eradicate it. Invasive plants can also form dense monocultures that could impede oil spill response. Water chestnut, an invasive floating aquatic plant found on the Hudson River, forms thick, impenetrable mats in June and July. Invasive species were not included in the maps as they are not priority resources for protection, but planners and responders should be aware of their presence and coordinate response activities with the appropriate invasive species coordinator and/or land manager to prevent the spread of these species.

Invasive Species Contacts:

New Jersey Invasive Species Strike Team: http://www.njisst.org/

New York Invasive Species Information: http://www.nyis.info/index.php

WILDLIFE REHABILITATION

The following contact provides veterinary care and/or retrieval of wildlife adversely affected by an event:

Tri-State Bird Rescue & Research. 170 Possum Hollow Road, Newark, DE 19711. (302)-737-9543.

HUMAN-USE RESOURCES

The human-use resources shown in this atlas were extracted from the ESI GIS data compiled for this region. The extracted features were mapped at scale of 1:100,000 and appear on the maps referenced by a number. For example, Map 1 will show the human-use features in conjunction with the ESI shoreline.

Management areas such as wildlife refuges and state parks are mapped as polygons. Where the feature is a known point location (e.g., marinas, airports, water intakes), the specific location is displayed.

Map IDs can be found in the accompanying data tables for point and polygon features mapped. The Map ID may provide more information (i.e., name, contact) for that particular resource. The types of human use resources mapped in this atlas are depicted below.

Abandoned Vessels: These areas depict sunken or derelict vessels that may be a hazard to response activities. These locations were obtained from the NOAA.

Access Sites: Access sites were mapped using data from NYSDEC and indicate beach access sites.

Airports: Information on the location of airports was downloaded from the National Transportation Atlas Databases maintained by the FAA.

Aquaculture Locations: Locations of aquaculture sites were obtained from NYSDEC and NJDEP.

Archaeological Site: Archaeological sites in New Jersey were provided by NJDEP and a few other sites were carried over from previous versions of the ESI atlases.

Army Corps of Engineers: Jurisdictional boundaries were obtained from the Army Corps of Engineers.

Artificial Reef: Locations were mapped using data from NOAA.

Beaches: Were mapped using the USGS and US Board of Geographic Names

Boat Ramps: Were mapped using information from NYSDEC and the National Park Service.

Campgrounds: Were mapped using information from the state of New York

Coast Guard Stations and Districts: USCG jurisdictional boundaries and stations were mapped using information from the USCG.

Diving Sites: Diving sites were mapped using the Mid-Atlantic Coastal and Recreation study.

EPA Regions and Select Facilities: Jurisdictional boundaries and facilities were mapped using data from the USEPA.

Essential Habitat: Essential Habitat was mapped using NOAA NMFS Essential Fish Habitat, NYSDEC Significant Coastal Fish and Wildlife Habitat, and New York and New Jersey Audubon Important Bird Area data.

FEMA Regions: Were mapped using data from the Federal Emergency Management Agency (FEMA)

Ferry Terminals: Ferry terminals were mapped using New York City facilities data and New Jersey ferry terminal embarkation points.

Fishery Areas: Shellfish management areas in New York and New Jersey were mapped using data from NJDEP and SeaPlan.

Historic Sites: Data for historic sites came from NYS Office of Parks, Recreation, & Historic Preservation, NYS Office of Cyber Security, NJDEP Green Acres, and NJ Department of State

Landfills: Data for landfills came from the New York State Department of Environmental Conservation.

Locks and Dams: Selected locks and dams were mapped using NYSDEC dam inventory data.

Marinas and Anchorages: Marina locations were provided by the Mohawk Council of Yacht Clubs, the Hudson River Boat and Yacht Club Association, expert knowledge, and digitized using aerial imagery.

Military: Military installation data were provided by the U.S. Census Bureau's MAF/TIGER geographic database.

National Estuarine Research Reserve: Locations were provided from the NOAA NERRS Centralized Data Management Office

National Park: National park boundaries were provided by NPS.

Nature Conservancy: Boundaries of The Nature Conservancy (TNC) properties were obtained from TNC Lands database.

Oil Facilities: Oil facilities were mapped using data from NYSDEC and the USEPA.

Port: Major port location data were compiled from ACE National Transportation Atlas databases.

Recreational Fishing Areas: These areas include NYSDEC public fishing recommended sites, NJDEP sport ocean fishing grounds, and SeaPlan's recreational boater activity locations.

Renewable Energy Sites: Tidal, solar, and nuclear energy sites were mapped using NOAA's coastal energy facilities and offshore tidal hydrokinetic projects data.

Repeated Measurement Sites: These include Mussel Watch Sites, data buoys, and tide gauge stations and were mapped using data from NOAA, USGS, and NY/NJ Baykeeper.

Surfing: provided using data from the Surfrider foundation.

Tribal Land: Tribal land were downloaded from the U.S. Census Bureau's Census MAF/TIGER database.

Washover: A washover, or washover fan, is a relatively flat surface on the top of a barrier spit complex that slopes gently landward. It is usually created when water, forced landward by breaking waves, flows across the top of the barrier spit during high spring tides or storms. This process creates a flattened-off surface along which sand is transported across the top of the spit into the standing water (lagoon) or marsh landward of the spit. The resulting deposit usually has a fan-like shape. Washover locations are represented by points that were digitized from ESRI World Imagery by Research Planning, Inc. at a scale of 1:8,000.

Water Intakes: Water intakes were obscured for security reasons; otherwise they were mapped as provided by NJDEP, NYS DOW, and expert knowledge.

Wildlife Refuge: Locations of NWRs were provided by the USFWS.

GEOGRAPHIC INFORMATION SYSTEM

The entire atlas product is stored in digital form in a Geographic Information System (GIS) as spatial data layers and associated databases. The format for the data varies depending on the type of information or features for which the data are being stored.

Under separate cover is a metadata document that details the data dictionary, processing techniques, data lineage, and other descriptive information for the digital datasets and maps that were used to create this atlas. Below is a brief synopsis of the information contained in the digital version. Refer to the metadata file for a full explanation of the data and its structure.

MAJOR ROADS

The major roads polyline layer represents major thoroughfares within the United States (ArcGIS Content Team (ESRI) and Tele Atlas North America Inc., U.S. Major Roads, ed. 10, published June 30, 2010, ESRI® Data & Maps series, Redlands, CA, USA). These roads are shown on the maps, but are not part of the underlying ESI GIS data.

SHORELINE CLASSIFICATIONS

The ESI shoreline habitat classification is stored as lines and polygons with associated attributes. In many cases, a shoreline may have two or three different classifications or colored lines on the shoreline. These multiple classifications are represented in the database by ESI#1/ESI#2, where ESI#1 is the landward-most classification and ESI#2 is the seaward-most classification. In addition to the line features, marshes (ESI=10A, ESI=10B), swamps (ESI=10C), and scrub-shrub wetlands (ESI=10D) are also stored as polygons.

SENSITIVE BIOLOGICAL RESOURCES

Biological resources are stored as points and polygons. Associated with each feature is a unique identification number that is linked to a series of data tables that further identify the resources. The main biological resource table consists of a list of species identification numbers for each site, the concentration of each species at each site, a mapping qualifier, and identification codes for seasonality and source information. This data table is linked to other tables that describe the seasonality and life-history time periods for each species (at month resolution) for the specified map feature. Other data tables linked to the first table include: the species identification table, which includes common and scientific names; the species status table, which gives information for state and/or federal threatened or endangered listings; and the source database, which provides source metadata at the feature-species level (specific sources are listed for each species occurring at each mapped feature in the biology feature classes).

HUMAN-USE FEATURES

Human-use features are represented as polygons, points or lines. Management areas such as wildlife refuges, national parks and state parks are mapped as polygons. Known locations such as marinas, high use beaches, airports and water intakes are displayed as points when security risks allow. Bridges and railroads are mapped as line features.

ACKNOWLEDGMENTS

This project was supported by the NOAA Office of Response and Restoration, Hazardous Materials Response Division, under the direction of Jill Petersen, NOAA's ESI Program Manager. The development of this atlas was part of a larger effort to update much of the Atlantic coast after the destruction caused by Hurricane Sandy in October 2012. Funding was provided by the Disaster Relief Appropriations Act of 2013. Additional support was provided by Scientific Support Coordinators (SSC) Frank Csulak and Ed Levine.

The biological and human-use data included on the maps were provided by numerous individuals and agencies. Staff at the New York State Department of Environmental Conservation, New York State Natural Heritage Program, and Audubon of New York contributed a vast amount of information to this effort, including first-hand expertise, publications, maps, and digital data. Other agencies and organizations contributing to data development and review included: New Jersey Department of Environmental Protection, U.S. Fish and Wildlife Service, New York Office of Parks, Recreation and Historic Preservation, and the New York Department of State.

At Quantum Spatial (QSI), numerous scientific, GIS, and graphic staff were involved with different phases of the project. Jennifer Halleran was Project Manager. The biological and human-use data were collected, compiled, and produced into the geodatabase by Jennifer Bohannon, Tim Marcella, and Mark Yoders. Jennifer Bohannon, Tim Marcella, and Mark Yoders prepared the final text documents and metadata. The basemap, shoreline and wetland habitat collection and classification was completed by Woolpert Inc.

APPROPRIATE USE OF ATLAS AND DATA

This atlas and the associated database were developed to provide summary information on sensitive natural and human-use resources for the purposes of oil and chemical spill planning and response. Although the atlas and database should be very useful for other environmental and natural resource planning purposes, it should not be used in place of data held by New York State Department of Environmental Conservation, New Jersey Department of Environmental Protection, Audubon of New York, New Jersey Audubon, the New York State Natural Heritage Program, the U.S. Fish and Wildlife Service, or other agencies. Likewise, information contained in the atlas and database cannot be used in place of consultations with natural and cultural resource agencies, or in place of field surveys. This atlas should not be used for navigation.

SPECIES LIST

Common Name*	Scientific Name*
BENTHIC	
ALGAE	
Macroalgae	-
BIVALVE	
Oyster reef	-
SAV	
Submersed aquatic vegetation	-
Water celery	*Vallisneria americana*
BIRDS	
ALCID	
Razorbill	*Alca torda*
BIRD	
Colonial waterbirds	-
DIVING	
Double-crested cormorant	*Phalacrocorax auritus*
Great cormorant	*Phalacrocorax carbo*
Horned grebe	*Podiceps auritus*
Pied-billed grebe	*Podilymbus podiceps*
Red-throated loon	*Gavia stellata*
GULL/TERN	
Black skimmer	*Rynchops niger*
Bonaparte's gull	*Larus philadelphia*
Common tern	*Sterna hirundo*
Forster's tern	*Sterna forsteri*
Great black-backed gull	*Larus marinus*
Gull-billed tern	*Gelochelidon nilotica*
Herring gull	*Larus argentatus*
Laughing gull	*Larus atricilla*
Least tern	*Sternula antillarum*
Roseate tern	*Sterna dougallii*
PASSERINE	
Belted kingfisher	*Ceryle alcyon*
Kentucky warbler	*Oporornis formosus*
Marsh wren	*Cistothorus palustris*
Nelson's sparrow	*Ammodramus nelsoni*
Prothonotary warbler	*Protonotaria citrea*
Seaside sparrow	*Ammodramus maritimus*
Swamp sparrow	*Melospiza georgiana*
Willow flycatcher	*Empidonax traillii*

Common Name*	Scientific Name*
BIRDS, cont.	
PELAGIC	
Black-legged kittiwake	*Rissa tridactyla*
Cory's shearwater	*Calonectris diomedea*
Great shearwater	*Puffinus gravis*
Northern gannet	*Morus bassanus*
Wilson's storm-petrel	*Oceanites oceanicus*
RAPTOR	
Bald eagle	*Haliaeetus leucocephalus*
Endangered raptor 1	-
Endangered raptor 2	-
Northern harrier	*Circus cyaneus*
Osprey	*Pandion haliaetus*
Peregrine falcon	*Falco peregrinus*
Raptors	-
Short-eared owl	*Asio flammeus*
Threatened raptor	-
SHOREBIRD	
American oystercatcher	*Haematopus palliatus*
Black-bellied plover	*Pluvialis squatarola*
Common snipe	*Gallinago gallinago*
Dunlin	*Calidris alpina*
Greater yellowlegs	*Tringa melanoleuca*
Piping plover	*Charadrius melodus*
Plovers	*Charadrius spp.*
Red knot	*Calidris canutus*
Ruddy turnstone	*Arenaria interpres*
Sanderling	*Calidris alba*
Semipalmated plover	*Charadrius semipalmatus*
Semipalmated sandpiper	*Calidris pusilla*
Shorebirds	-
Short-billed dowitcher	*Limnodromus griseus*
Spotted sandpiper	*Actitis macularia*
Threatened shorebird	-
Upland sandpiper	*Bartramia longicauda*
Willet	*Tringa semipalmata*
Wilson's snipe	*Gallinago delicata*
WADING	
American bittern	*Botaurus lentiginosus*
American woodcock	*Scolopax minor*
Black rail	*Laterallus jamaicensis*

SPECIES LIST

Common Name*	Scientific Name*
BIRDS, cont.	
Black-crowned night-heron	*Nycticorax nycticorax*
Cattle egret	*Bubulcus ibis*
Clapper rail	*Rallus longirostris*
Glossy ibis	*Plegadis falcinellus*
Great blue heron	*Ardea herodias*
Great egret	*Ardea alba*
Green heron	*Butorides virescens*
Herons	-
King rail	*Rallus elegans*
Least bittern	*Ixobrychus exilis*
Little blue heron	*Egretta caerulea*
Snowy egret	*Egretta thula*
Sora	*Porzana carolina*
Tricolored heron	*Egretta tricolor*
Virginia rail	*Rallus limicola*
Wading birds	-
Yellow-crowned night-heron	*Nyctanassa violacea*
WATERFOWL	
American black duck	*Anas rubripes*
American wigeon	*Anas americana*
Black scoter	*Melanitta americana*
Brant	*Branta bernicla*
Bufflehead	*Bucephala albeola*
Canada goose	*Branta canadensis*
Canvasback	*Aythya valisineria*
Common eider	*Somateria mollissima*
Common merganser	*Mergus merganser*
Common moorhen	*Gallinula chloropus*
Gadwall	*Anas strepera*
Green-winged teal	*Anas crecca*
Hooded merganser	*Lophodytes cucullatus*
Long-tailed duck	*Clangula hyemalis*
Mallard	*Anas platyrhynchos*
Mergansers	-
Red-breasted merganser	*Mergus serrator*
Ring-necked duck	*Aythya collaris*
Ruddy duck	*Oxyura jamaicensis*
Scaup	*Aythya spp.*
Snow goose	*Chen caerulescens*
Surf scoter	*Melanitta perspicillata*

Common Name*	Scientific Name*
BIRDS, cont.	
Waterfowl	-
White-winged scoter	*Melanitta fusca*
Wood duck	*Aix sponsa*
FISH	
DIADROMOUS	
Alewife	*Alosa pseudoharengus*
American eel	*Anguilla rostrata*
American shad	*Alosa sapidissima*
Anadromous fish	-
Atlantic sturgeon	*Acipenser oxyrinchus*
Blueback herring	*Alosa aestivalis*
Brown trout	*Salmo trutta*
Rainbow trout	*Oncorhynchus mykiss*
Shortnose sturgeon	*Acipenser brevirostrum*
Striped bass	*Morone saxatilis*
ESTUARINE NURSERY	
Atlantic croaker	*Micropogonias undulatus*
Atlantic herring	*Clupea harengus*
Atlantic menhaden	*Brevoortia tyrannus*
Bay anchovy	*Anchoa mitchilli*
Black drum	*Pogonias cromis*
Black sea bass	*Centropristis striata*
Bluefish	*Pomatomus saltatrix*
Northern kingfish	*Menticirrhus saxatilis*
Northern puffer	*Sphoeroides maculatus*
Nursery fish	-
Scup	*Stenotomus chrysops*
Spot	*Leiostomus xanthurus*
Summer flounder	*Paralichthys dentatus*
Weakfish	*Cynoscion regalis*
White perch	*Morone americana*
Windowpane	*Scophthalmus aquosus*
Winter flounder	*Pleuronectes americanus*
ESTUARINE RESIDENT	
Atlantic silverside	*Menidia menidia*
Killifish	*Fundulus spp.*
Northern pipefish	*Syngnathus fuscus*
Silversides	-

SPECIES LIST

Common Name*	Scientific Name*
FISH, cont.	
FRESHWATER	
Banded sunfish	*Enneacanthus obesus*
Black crappie	*Pomoxis nigromaculatus*
Bluegill	*Lepomis macrochirus*
Brook trout	*Salvelinus fontinalis*
Brown bullhead	*Ameiurus nebulosus*
Chain pickerel	*Esox niger*
Common carp	*Cyprinus carpio*
Fathead minnow	*Pimephales promelas*
Golden shiner	*Notemigonus crysoleucas*
Largemouth bass	*Micropterus salmoides*
Pumpkinseed	*Lepomis gibbosus*
Smallmouth bass	*Micropterus dolomieu*
Walleye	*Stizostedion vitreum vitreum*
White sucker	*Catostomus commersoni*
Yellow perch	*Perca flavescens*
MARINE BENTHIC	
American sand lance	*Ammodytes americanus*
Atlantic cod	*Gadus morhua*
Atlantic tomcod	*Microgadus tomcod*
Clearnose skate	*Raja eglanteria*
Goosefish	*Lophius americanus*
Little skate	*Leucoraja erinacea*
Ocean pout	*Macrozoarces americanus*
Pollock	*Pollachius virens*
Red hake	*Urophycis chuss*
Silver hake	*Merluccius bilinearis*
Smooth dogfish	*Mustelus canis*
Tautog	*Tautoga onitis*
Winter skate	*Leucoraja ocellata*
MARINE PELAGIC	
Albacore	*Thunnus alalunga*
Atlantic mackerel	*Scomber scombrus*
Bluefin tuna	*Thunnus thynnus*
Butterfish	*Peprilus triacanthus*
Dusky shark	*Carcharhinus obscurus*
Sand tiger	*Carcharias taurus*
Sandbar shark	*Carcharhinus plumbeus*
Shortfin mako	*Isurus oxyrinchus*
Skipjack tuna	*Katsuwonus pelamis*

Common Name*	Scientific Name*
FISH, cont.	
Spiny dogfish	*Squalus acanthias*
Thresher shark	*Alopias vulpinus*
Tiger shark	*Galeocerdo cuvier*
White shark	*Carcharodon carcharias*
Yellowfin tuna	*Thunnus albacares*
HABITATS	
PLANT	
Endangered plant	-
Federally endangered plant	-
Rare plant	
Threatened plant	-
UPLAND	
Coastal dune woodland	-
Rare upland community	-
Sandplain gerardia	*Agalinis acuta*
WETLAND	
Knieskern's beaked rush	*Rhynchospora knieskernii*
Maritime holly forest	-
Rare wetland community	-
Seabeach amaranth	*Amaranthus pumilus*
Swamp-pink	*Helonias bullata*
Vernal pool	-
HERPETOFAUNA	
AMPHIBIAN	
Blue-spotted salamander	*Ambystoma laterale*
Eastern spadefoot	*Scaphiopus holbrookii*
Eastern tiger salamander	*Ambystoma tigrinum*
Endangered amphibian	-
Fowler's toad	*Anaxyrus fowleri*
Pine Barrens treefrog	*Hyla andersonii*
Rare amphibian	-
Rare frog	-
Rare salamander	-
Southern leopard frog	*Lithobates sphenocephalus*
REPTILE	
Endangered reptile 1	-
Threatened reptile 1	-
Threatened reptile 2	-

SPECIES LIST

Common Name*	Scientific Name*
HERPETOFAUNA , cont.	
Threatened reptile 3	-
SNAKE	
Common wormsnake	*Carphophis amoenus*
Eastern milk snake	*Lampropeltis triangulum triangulum*
Northern black racer	*Coluber constrictor constrictor*
Northern pinesnake	*Pituophis melanoleucus melanoleucus*
Rare snake	-
Timber rattlesnake	*Crotalus horridus*
TURTLE	
Bog turtle	*Glyptemys muhlenbergii*
Common map turtle	*Graptemys geographica*
Common snapping turtle	*Chelydra serpentina serpentina*
Eastern box turtle	*Terrapene carolina carolina*
Eastern mud turtle	*Kinosternon subrubrum*
Green sea turtle	*Chelonia mydas*
Kemp's ridley sea turtle	*Lepidochelys kempii*
Leatherback sea turtle	*Dermochelys coriacea*
Loggerhead sea turtle	*Caretta caretta*
Northern diamondback terrapin	*Malaclemys terrapin terrapin*
Painted turtle	*Chrysemys picta*
Spotted turtle	*Clemmys guttata*
Wood turtle	*Glyptemys insculpta*
INVERTEBRATES	
BIVALVE	
Alewife floater	*Anodonta implicata*
Atlantic razor	*Siliqua costata*
Atlantic surfclam	*Spisula solidissima*
Bay scallop	*Argopecten irradians*
Blue mussel	*Mytilus edulis*
Eastern elliptio	*Elliptio complanata*
Eastern oyster	*Crassostrea virginica*
Northern quahog	*Mercenaria mercenaria*
Ocean quahog	*Arctica islandica*
Softshell clam	*Mya arenaria*
Tidewater mucket	*Leptodea ochracea*
CEPHALOPOD	
Longfin squid	*Loligo pealeii*

Common Name*	Scientific Name*
INVERTEBRATES , cont.	
CRAB	
Blue crab	*Callinectes sapidus*
Horseshoe crab	*Limulus polyphemus*
GASTROPOD	
Channeled whelk	*Busycon canaliculatum*
Whelk	-
INSECT	
Checkered white	*Pontia protodice*
Coastal barrens buckmoth	*Hemileuca maia ssp. 5*
Eastern buckmoth	*Hemileuca maia maia*
Frosted elfin	*Callophrys irus*
Gray petaltail	*Tachopteryx thoreyi*
Hairy-necked tiger beetle	*Cicindela hirticollis*
Hessel's hairstreak	*Callophrys hesseli*
Jersey jair underwing	*Catocala jair ssp. 2*
Leonard's skipper	*Hesperia leonardus*
Little bluet	*Enallagma minusculum*
Monarch butterfly	*Danaus plexippus*
Myrina Fritillary	*Boloria selene myrina*
Northeastern beach tiger beetle	*Cicindela dorsalis dorsalis*
Pine Barrens bluet	*Enallagma recurvatum*
Pine Barrens underwing	*Catocala herodias gerhardi*
Rare insect	-
Sandplain heterocampa	*Heterocampa varia*
Scarlet bluet	*Enallagma pictum*
INVERTEBRATES	
Rare, LT, or LE invertebrate	-
LOBSTER	
American lobster	*Homarus americanus*
MARINE MAMMALS	
DOLPHIN	
Bottlenose dolphin	*Tursiops truncatus*
Harbor porpoise	*Phocoena phocoena*
PINNIPED	
Gray seal	*Halichoerus grypus*
Harbor seal	*Phoca vitulina*
Harp seal	*Pagophilus groenlandicus*
Seals	-

SPECIES LIST

Common Name*	Scientific Name*
MARINE MAMMALS, cont.	
WHALE	
Fin whale	*Balaenoptera physalus*
Humpback whale	*Megaptera novaeangliae*
North Atlantic right whale	*Eubalaena glacialis*
TERRESTRIAL MAMMALS	
BAT	
Eastern small-footed myotis	*Myotis leibii*
Indiana myotis	*Myotis sodalis*
Northern myotis	*Myotis septentrionalis*
SMALL MAMMAL	
Allegheny woodrat	*Neotoma magister*
New England cottontail	*Sylvilagus transitionalis*

* Underlined species are listed as either threatened or endangered under the federal ESA, and/or are listed as threatened, endangered, or special concern by New York and/or New Jersey

SHORELINE DESCRIPTIONS

EXPOSED, ROCKY SHORES **ESI = 1A**

DESCRIPTION

- The intertidal zone is steep (greater than 30° slope), with very little width; solid and composed of bedrock
- Sediment accumulations are uncommon because waves and currents remove debris slumped from the eroding cliffs
- There is strong vertical zonation of intertidal biological communities in the estuarine parts of the river
- This shoreline type is regularly exposed to wave action and strong currents
- Wave reflection is a common phenomenon along the outer coast
- Species density and diversity vary greatly depending on exposure and salinity, but barnacles, snails, mussels, amphipods, and macroalgae can be abundant

PREDICTED OIL BEHAVIOR

- In the lower estuary and outer coast, oil is held offshore by waves reflecting off the steep, hard surfaces; Any oil that is deposited is rapidly removed from exposed faces
- Along the river, oil can form a band at the high water line
- The most resistant oil would remain as a patchy band at or above the high-water line

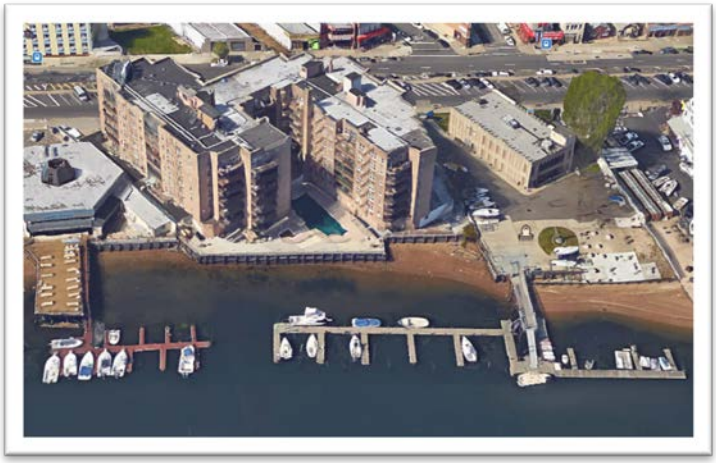
- Impacts to intertidal communities are expected to be short-term in duration; An exception would be where heavy concentrations of a light refined product comes ashore very quickly

RESPONSE CONSIDERATIONS

- Cleanup is usually not required
- Access can be difficult and dangerous

SHORELINE DESCRIPTIONS

EXPOSED, SOLID MAN-MADE STRUCTURES **ESI = 1B**



DESCRIPTION

- These structures are solid, man-made structures such as seawalls, jetties, breakwaters, groins, revetments, piers, and port facilities
- Many structures are constructed of concrete, wood, or metal
- Often there is no exposed substrate at low tide, but multiple habitats are indicated if present
- They are built to protect the shore from erosion by waves, boat wakes, and currents, and thus are exposed to relatively high-energy processes
- Attached animals and plants are variable in cover, with sparse biota in fresh/brackish areas and higher biota in salt water areas
- Common in highly developed industrial and port areas, as well as commercial zones

PREDICTED OIL BEHAVIOR

- Oil is held offshore by waves reflecting off the steep, hard surface in exposed settings
- Oil readily adheres to the dry, rough surfaces, but it does not adhere to wet substrates
- The most resistant oil would remain as a band at or above the high-tide line

RESPONSE CONSIDERATIONS

- Cleanup is usually not required
- High-pressure water spraying may be conducted to:
  - remove persistent oil in crevices;
  - minimize aesthetic damage; and
  - prevent chronic leaching of oil from the structure

SHORELINE DESCRIPTIONS

EXPOSED, WAVE-CUT PLATFORMS IN MUD **ESI = 2A**

DESCRIPTION

- This habitat occurs where the shoreline is eroding across a wetland, leaving behind a wave-cut platform on the old marsh soils; there is often a thin sand/shell washover beach on top of the marsh
- The platform is usually composed of a hard compact peat-rich clay with numerous holes from old root cavities
- The platform width can vary from a few feet to tens of feet
- Species density and diversity are low because they are highly eroding

PREDICTED OIL BEHAVIOR

- Oil will not adhere to the wet muddy surface, but could penetrate root cavities if present
- Persistence of any stranded oil is usually short-term, except where trapped in slump blocks eroded from the marsh scarp

RESPONSE CONSIDERATIONS

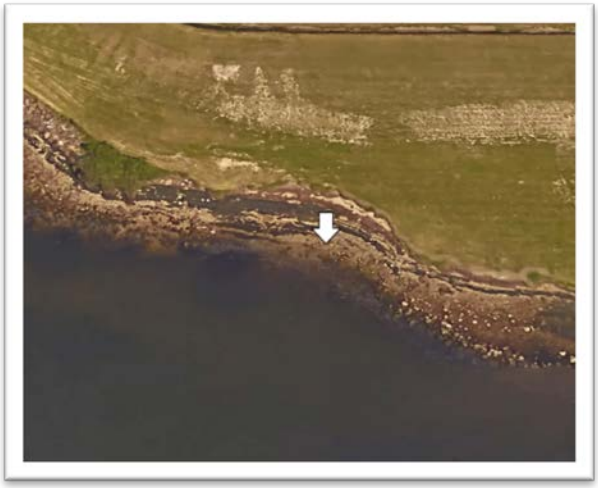
- Cleanup is usually not required except for areas of high biological use and under heavy oil accumulations
- Where the high-tide area is accessible, it may be feasible to manually remove heavy oil accumulations and oiled debris

SHORELINE DESCRIPTIONS

EXPOSED SCARPS AND STEEP SLOPES IN MUD OR CLAY **ESI = 2B**

DESCRIPTION

- These habitats generally occur along tidal channels and major river tributaries in the marsh where the currents cut a steep bank into the marsh soils
- Scarp heights vary from about 1 to 3 feet and usually consist of a heavily rooted, peaty soil
- May be fronted by a narrow beach of fine- to medium-grained sand
- Generally low biological utilization due to strong currents
- Typically backed by wetland vegetation
- Uncommon, occurring mostly along the outer exposed margins of marsh areas.



PREDICTED OIL BEHAVIOR

- Oil is not expected to adhere to the wet, impermeable clay surface
- There may be a thin band of oil left at or above the high water line

RESPONSE CONSIDERATIONS

- Cleanup is usually not required, because any stranded oil is quickly removed by wave action
- Access may be difficult and dangerous
- Where the high-tide area is accessible, it may be feasible to remove the heavy oil accumulations and oiled debris in order to protect a near shore marine resource, such as marine birds

SHORELINE DESCRIPTIONS

FINE- TO MEDIUM-GRAINED SAND BEACHES **ESI = 3A**

DESCRIPTION

- These beaches are flat to moderately sloping and relatively hard packed
- They are composed of quartz sand
- Beachface sediments are subject to regular reworking by waves
- There can be heavy accumulations of wrack present
- They are utilized by birds for nesting, foraging, and loafing, and by turtles for nesting
- They are generally areas of heavy recreational use

PREDICTED OIL BEHAVIOR

- Light oil accumulations will be deposited as oily swashes or bands along the upper intertidal zone
- Heavy oil accumulations will cover the entire beach surface; oil will be lifted off the lower beach with the rising tide
- Maximum penetration of oil into fine- to medium-grained sand is about 10-15 cm
- Burial of oiled layers by clean sand within the first week after a spill typically will be less than 30 cm along the upper beach face
- Organisms living in the beach sediment may be killed by smothering or lethal oil concentrations in the interstitial water
- Biological impacts include temporary declines in infauna, which can affect important shorebird foraging areas

RESPONSE CONSIDERATIONS

- These beaches are among the easiest shoreline types to clean
- Cleanup should concentrate on removing oil and oily debris from the upper swash zone once oil has come ashore
- Traffic through dune areas should be limited to prevent contamination of clean areas and disturbance of habitat and birds
- Manual cleanup is advised to minimize the volume of sand removed from the shore and requiring disposal, particularly for non-amenity beaches
- Mechanical sand sifters may be effective on oil in the form of tarballs and patties
- All efforts should focus on preventing the mixing of oil deeper into the sediments by vehicular and foot traffic
- Mechanical reworking of the sediment into the surf zone may be used as a final polishing step for stained sand treatment without sediment removal

SHORELINE DESCRIPTIONS

SCARPS AND STEEP SLOPES IN SAND — ESI = 3B

DESCRIPTION

- This shoreline type occurs where sandy bluffs are undercut by waves or currents and slump
- The scarps show evidence of active erosion, and beaches in front of the scarps are narrow or absent
- Trees growing at the top of these slopes are eventually undercut and woody debris can accumulate at the base of the scarp
- Biological utilization by birds and infauna is low

PREDICTED OIL BEHAVIOR

- Any stranded oil will concentrate at the high-water line and may penetrate sandy sediments if a beach is present
- Oil will also adhere to the dry surfaces of any woody debris that has accumulated at the base of the scarp
- Burial risk is low except when slumping of the bluff occurs
- Active erosion of the scarp will remove the oil

RESPONSE CONSIDERATIONS

- The need for removal of oiled sediments and debris should be carefully evaluated because of the potential for increased erosion
- Closely supervised manual labor should be used so that the minimal amount of material is removed during cleanup
- Large woody debris may be wiped down with sorbents to reduce contact hazards by wildlife; smaller debris can be cut into smaller pieces for removal

SHORELINE DESCRIPTIONS

COARSE-GRAINED SAND BEACHES ESI = 4

DESCRIPTION

- These beaches are moderate-to-steeply sloping, are of variable width, and have soft sediments. These characteristics combine to lower their trafficability
- Species density and diversity is generally lower than on fine-grained sand beaches

PREDICTED OIL BEHAVIOR

- During small spills, oil will be deposited primarily as a band along the high-tide line
- Under very heavy accumulations, oil may spread across the entire beach face, though the oil will be lifted off the lower part of the beach with the rising tide
- Penetration of oil into coarse-grained sand can reach 25 cm
- Burial of oiled layers by clean sand can be as rapid as one tidal cycle and to depths of 60 cm or more
- Burial to depths of over one meter is possible if the oil comes ashore at the start of a depositional period
- Biological impacts include temporary declines in infaunal populations, which can also affect important shorebird foraging areas
- Organisms living in the beaches may be killed by smothering or lethal oil concentrations in interstitial water

RESPONSE CONSIDERATIONS

- Removed oil primarily from the upper swash lines
- Removal of sediment should be limited to avoid erosion problems
- Mechanical reworking of the sediment into the surf zone may be used as a final polishing step to treat stained sand without sediment removal
- Activity in the oiled sand should be limited to prevent mixing oil deeper into the beach
- Use of heavy equipment for oil/sand removal may result in the removal of excessive amounts of sand; manual cleanup may be more effective

SHORELINE DESCRIPTIONS

MIXED SAND AND GRAVEL BEACHES **ESI = 5**

DESCRIPTION

- Moderately sloping beaches composed of a mixture of sand and gravel (gravel component should comprise between 20 to 80 percent of total sediments
- Because of the mixed sediment sizes, there may be some areas on the beach of pure sand, pebble, or cobbles
- Sediment desiccation and mobility on exposed beaches can cause low densities of attached animals and plants
- There can be large-scale changes in the sediment distribution patterns depending on the season, due to the transport of the sand fraction offshore during storm events
- Substrate had medium-to-high permeability
- Very common throughout the study area

PREDICTED OIL BEHAVIOR

- During small spills, oil will be deposited along and above the high-tide swash
- Large spills will spread across the entire intertidal area
- Oil penetration into the beach sediments may be up to 50 cm; however, the sand fraction can be quite mobile, and oil behavior is much like on a sand beach if the sand fraction exceeds about 40 percent
- Burial of oil may be deep at and above the high-tide line, where oil tends to persist, particularly where beaches are only intermittently exposed to waves
- In sheltered pockets on the beach, pavements of asphalted sediments can form if there is no removal of heavy oil accumulations because most of the oil remains on the surface
- Once formed, these asphalt pavements can persist for years

RESPONSE CONSIDERATIONS

- Remove heavy accumulations of pooled oil as soon as possible
- All oiled debris should be removed
- Sediment removal should be limited as much as possible
- Low-pressure flushing can be used to float liquid oil away from the sediments for recovery by skimmers or sorbents. High-pressure spraying should be avoided because of potential for transporting contaminated finer sediments (sand) to the lower intertidal or subtidal zones
- Mechanical reworking of lightly oiled sediments from the high-tide zone to the middle intertidal zone can be effective in areas regularly exposed to wave activity (as evidenced by storm berms)
- In-place tilling/excavation may be used to reach deeply buried oil in layers in the middle zone on exposed beaches

SHORELINE DESCRIPTIONS

GRAVEL BEACHES **ESI = 6A**

DESCRIPTION

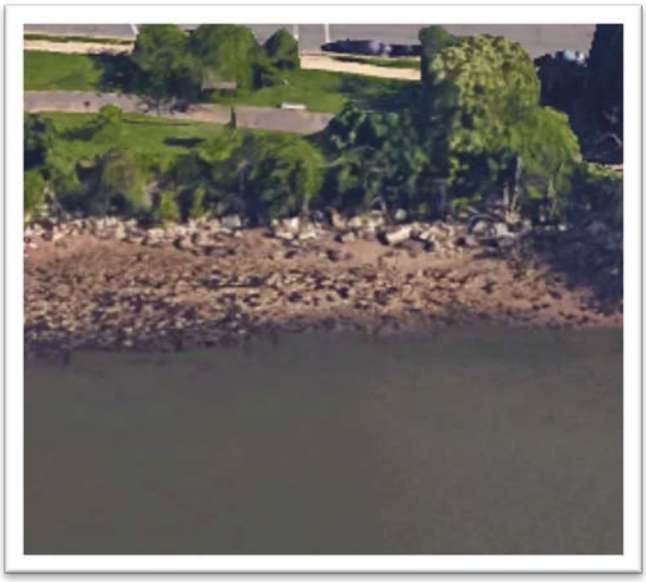
- Gravel beaches can be very steep, with multiple wave-built berms forming the upper beach. Gravel beaches have the lowest trafficability of all beach types and may contain shell and woody debris
- Because of the high mobility of sediments on exposed gravel beaches, there are low densities of animals and plants.
- There are low densities of infauna because the coarse sediments dry out during low tide
- Most permeable of all beach types

PREDICTED OIL BEHAVIOR

- Deep penetration of stranded oil is likely because of their high permeability
- On exposed beaches, oil can be pushed over the high-tide and storm berms, pooling and persisting above the normal zone of wave wash
- Long-term persistence will be controlled by the depth of routine reworking by the waves
- Along sheltered portions of the shorelines, chronic sheening and the formation of asphalt pavements is likely where accumulations are heavy

RESPONSE CONSIDERATIONS

- Heavy accumulations of pooled oil should be removed quickly from the upper beach
- All oiled debris should be removed
- Sediment removal should be limited as much as possible



- High-pressure spraying should be avoided because of the potential for transporting contaminated finer sediments (sand) to the lower intertidal or subtidal zones
- Low-pressure flushing can be used to float fresh oil away from the sediments for recovery by skimmers or sorbents
- Mechanical reworking of oiled sediments from the high-tide line to the lower beachface can be effective in areas regularly exposed to wave activity; the presence of multiple storm berms is evidence of wave activity
- In-place tilling may be used to reach deeply buried oil layers along the mid-intertidal zone on exposed beaches

SHORELINE DESCRIPTIONS

RIPRAP **ESI = 6B**

DESCRIPTION

- Riprap structures are composed of cobble- to boulder-sized blocks of granite, limestone, bedrock or concrete
- Riprap structures are common along shorelines exposed to wave action and are used for shoreline protection and tidal inlet stabilization (jetties)
- Attached biota are sparse to moderate on exposed riprap

PREDICTED OIL BEHAVIOR

- Oil adheres readily to the rough surfaces of the blocks
- Deep penetration of oil between the blocks is likely
- Uncleaned oil can cause chronic leaching until the oil hardens

RESPONSE CONSIDERATIONS

- When the oil is fresh and liquid, high-pressure spraying and/or water flooding may be effective, making sure to recover all mobilized oil
- Heavy and weathered oils are more difficult to remove, requiring scraping and/or hot-water spraying
- It may be necessary to remove and replace heavily oiled blocks in high-use areas

SHORELINE DESCRIPTIONS

EXPOSED TIDAL FLATS — ESI = 7

DESCRIPTION

- Exposed tidal flats are broad, flat, intertidal areas composed primarily of sand and minor amounts of gravel
- The presence of sand and gravel indicates that tidal currents and waves are strong enough to mobilize the sediments
- They are often associated with another shoreline type on the landward side of the flat, though they can occur as separate shoals; they are commonly associated with tidal inlets
- Biological utilization can be very high, with large numbers of infauna, heavy use by birds for roosting and foraging, and by foraging fish

PREDICTED OIL BEHAVIOR

- Oil does not usually adhere to the surface of exposed tidal flats, but rather moves across the flat and accumulates at the high-tide line
- Deposition of oil on the flat may occur on a falling tide if concentrations are heavy
- Oil does not penetrate water-saturated sediments, but can penetrate into the tops of the bars and burrows when they dry out at low tide
- Biological damage may be severe, primarily to infauna, thereby reducing food sources for birds and other predators

RESPONSE CONSIDERATIONS

- Currents and waves can be very effective in natural removal of the oil
- Cleanup is very difficult (and possible only during low tides)
- The use of machinery should be restricted to prevent mixing of oil into the sediments

SHORELINE DESCRIPTIONS

SHELTERED, IMPERMEABLE ROCKY SHORES **ESI = 8A**

DESCRIPTION

- The substrate is solid and composed of bedrock
- This shoreline type is sheltered from large waves and strong currents
- Sediments (rock, debris, etc.) may accumulate at the base of this shoreline type
- The slope of the intertidal zone is generally moderate to steep (greater than 15°) with little width

PREDICTED OIL BEHAVIOR

- Heavy oils tend to coat the dry, irregular surface
- Stranded oil will persist because of low energy setting

RESPONSE CONSIDERATIONS

- Low-pressure flushing at ambient temperatures is most effective when the oil is fresh and still liquid

- Care must be taken during flushing operations to prevent oily effluents from affecting biologically rich, lower intertidal levels
- Where the high-tide area is accessible, it may be feasible to remove heavy oil accumulations and oiled debris

SHORELINE DESCRIPTIONS

SHELTERED, SOLID MAN-MADE STRUCTURES **ESI = 8B**

DESCRIPTION

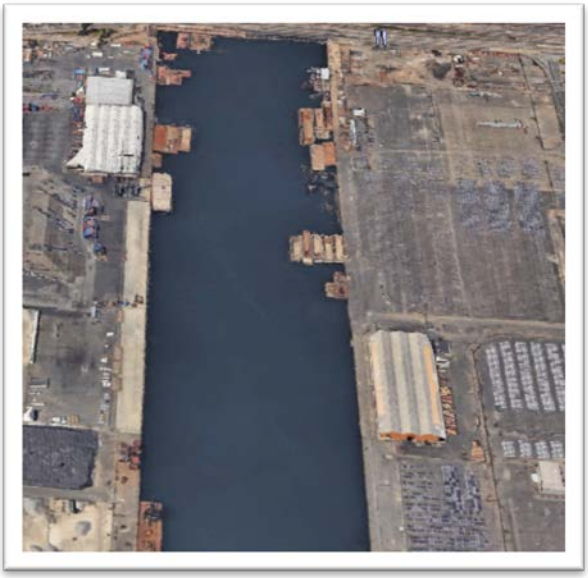
- These structures are solid man-made structures such as seawalls, groins, revetments, piers, and port facilities
- Most structures are constructed of concrete, wood, or metal
- Often there is no exposed beach at low tide, but multiple habitats are indicated if present
- Attached animal and plant life is highly variable

PREDICTED OIL BEHAVIOR

- Oil will adhere readily to rough surfaces, particularly along the high-tide line, forming a distinct oil band
- If the oil is not removed, it may cause chronic sheening until the oil hardens
- The lower intertidal zone usually stays wet (particularly if algae-covered), preventing oil from adhering to the surface

RESPONSE CONSIDERATIONS

- Cleanup of seawalls is usually conducted for aesthetic reasons or to prevent sheening



- Low- to high-pressure spraying at ambient water temperatures is most effective when the oil is fresh
- High-pressure, hot-water flushing will be required for heavy and weathered oil

SHORELINE DESCRIPTIONS

SHELTERED RIPRAP **ESI = 8C**

DESCRIPTION

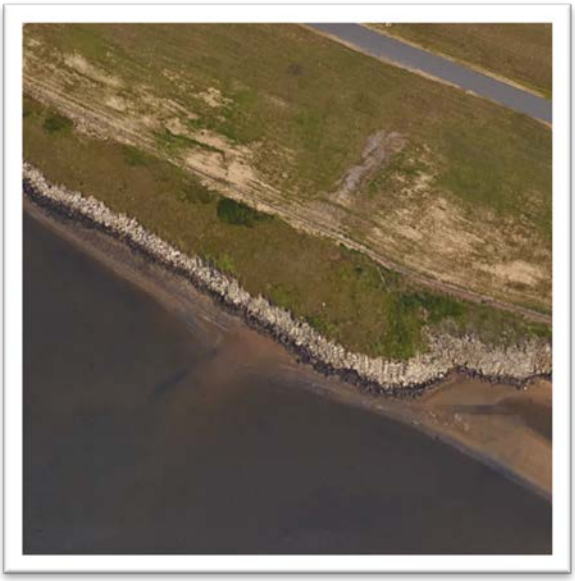
- Riprap structures are composed of cobble- to boulder-sized blocks of granite, limestone, bedrock or concrete
- These structures are found inside harbors and bays in developed areas, sheltered from direct exposure to waves
- Attached biota are highly variable

PREDICTED OIL BEHAVIOR

- Oil adheres readily to the rough surfaces
- Deep penetration of oil between the blocks is likely
- If oil is left uncleaned, it may cause chronic leaching until the oil hardens

RESPONSE CONSIDERATIONS

- High-pressure spraying may be required to remove oil for aesthetic reasons and to prevent leaching of oil from the structure
- Cleanup crews should make sure to recover all released oil



- It may be necessary to remove and replace heavily oiled riprap in high-use areas

SHORELINE DESCRIPTIONS

SHELTERED TIDAL FLATS — ESI = 9A

DESCRIPTION

- Sheltered tidal flats are composed primarily of mud with minor amounts of sand and shell
- They are present in calm-water habitats, sheltered from regular wave activity, and are usually backed by marshes
- The sediments are very soft and cannot support even light foot traffic in many areas
- They can have heavy wrack deposits along the upper fringe
- Sheltered tidal flats can be sparsely to heavily covered with algae and/or seagrass
- Large concentrations of shellfish, worms, and snails can be found on and in the sediments
- They are heavily utilized by birds for foraging

PREDICTED OIL BEHAVIOR

- Oil does not usually adhere to the surface of sheltered tidal flats, but rather moves across the flat and accumulates at the high-tide line
- Deposition of oil on the flat may occur on a falling tide if concentrations are heavy
- Oil will not penetrate the water-saturated sediments, but could penetrate burrows or other crevices in muddy sediments
- In areas of high suspended sediments, sorption of oil can result in deposition of contaminated sediments on the flats
- Biological damage can be severe

RESPONSE CONSIDERATIONS

- These are high-priority areas necessitating the use of spill protection devices to limit oil-spill impact; deflection or sorbent booms and open water skimmers should be used
- Cleanup of the flat surface is very difficult because of the soft substrate; many methods may be restricted
- Low-pressure flushing, vacuum, and deployment of sorbents from shallow-draft boats may be appropriate for use under heavy oiling

SHORELINE DESCRIPTIONS

VEGETATED LOW BANKS **ESI = 9B**

DESCRIPTION

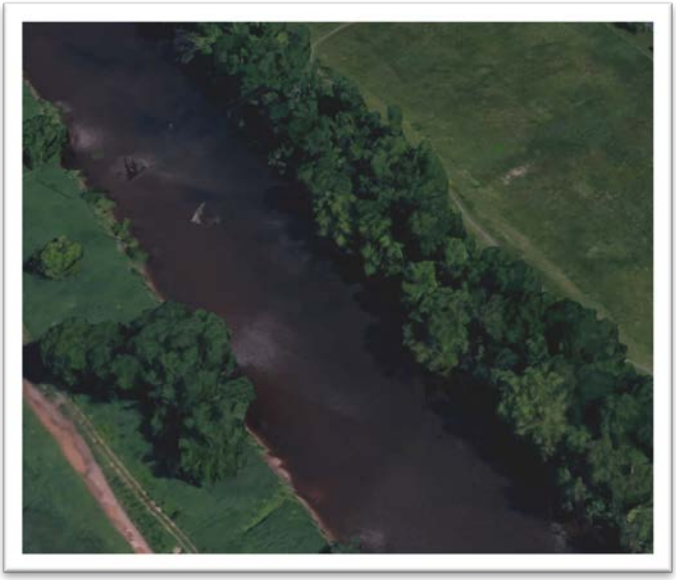
- These habitats are either low banks with grasses or low eroding banks with trees and tree roots exposed to the water
- They are flooded occasionally by high water
- These shorelines are most commonly found in fresh or brackish water settings
- These habitats can be important for fish, shellfish, birds and terrestrial mammals

PREDICTED OIL BEHAVIOR

- During low water stages there is little impact, though the oil can strand as a narrow band of sediment at the water level
- During high water stages, the oil could cover and coat the vegetation
- Oiling may cause loss of the grasses, but the trees should survive unless oil penetrates and persists in the substrate

RESPONSE CONSIDERATIONS

- Low-pressure flushing of oiled areas may be effective in removing moderate to heavy accumulations of fresh oil from along the banks



- Sorbent and containment boom should be placed on the water side of the cleanup operations to contain and collect oil outflow
- Low- to high-pressure flushing can be used to remove weathered oil from tree roots and trunks, if deemed necessary in areas of high-use by humans or wildlife

SHORELINE DESCRIPTIONS

SALT- AND BRACKISH-WATER MARSHES — ESI = 10A

DESCRIPTION

- These are intertidal wetlands containing emergent, herbaceous vegetation
- Width of the marsh can vary widely, from a narrow fringe to extensive areas
- Sediments are composed of organic-rich mud except on the margins of islands where sand is abundant
- Exposed areas are located along bays with wide fetches and along heavily trafficked waterways
- Sheltered areas and tidal creeks are not exposed to significant wave or boat wake activity
- Resident flora and fauna are abundant and diverse, with high utilization by birds, fish, and shellfish

PREDICTED OIL BEHAVIOR

- Oil adheres readily to intertidal vegetation
- The band of coating will vary widely, depending upon the water level at the time oil slicks are in the vegetation; there may be multiple bands
- Large slicks will persist through multiple tidal cycles and coat the entire stem from the high-tide line to the base
- If the vegetation is thick, heavy oil coating will be restricted to the outer fringe, although lighter oils can penetrate deeper, to the limit of tidal influence
- Medium to heavy oils do not readily adhere to or penetrate the fine sediments, but can pool on the surface or penetrate into burrows
- Light oils can penetrate the top few centimeters of sediment and deeply into burrows and cracks (up to one meter)

RESPONSE CONSIDERATIONS

- Under light oiling, the best practice is natural recovery; natural removal processes and rates should be evaluated prior to conducting cleanup
- Heavy accumulations of pooled oil can be removed by vacuum, sorbents, or low-pressure flushing.
- Cleanup activities should be carefully supervised to avoid vegetation damage
- Any cleanup activity must not mix the oil deeper into the sediments; trampling of the roots should be minimized through the use of walking boards
- Cutting of oiled vegetation should only be considered when other resources present are at great risk from leaving the oiled vegetation in place

SHORELINE DESCRIPTIONS

FRESHWATER MARSHES **ESI = 10B**

DESCRIPTION

- These are grassy wetlands composed of emergent herbaceous vegetation
- They occur upstream of brackish vegetation and along major rivers and tributary creeks
- Those along major channels are exposed to strong currents and boat wakes; smaller channels tend to be sheltered
- The substrate is seldom exposed because daily water level changes are low; greater changes result from floods
- Resident flora and fauna are abundant and diverse, with high utilization by birds and fish

PREDICTED OIL BEHAVIOR

- Oil adheres readily to the vegetation
- The band of coating will vary widely, depending upon the water level at the time oil slicks are in the vegetation; there may be multiple bands
- If the vegetation is thick, heavy oil coating will be restricted to the outer fringe, although lighter oils can penetrate deeper
- Medium to heavy oils do not readily adhere to or penetrate the fine sediments, but can pool on the surface or penetrate into burrows

RESPONSE CONSIDERATIONS

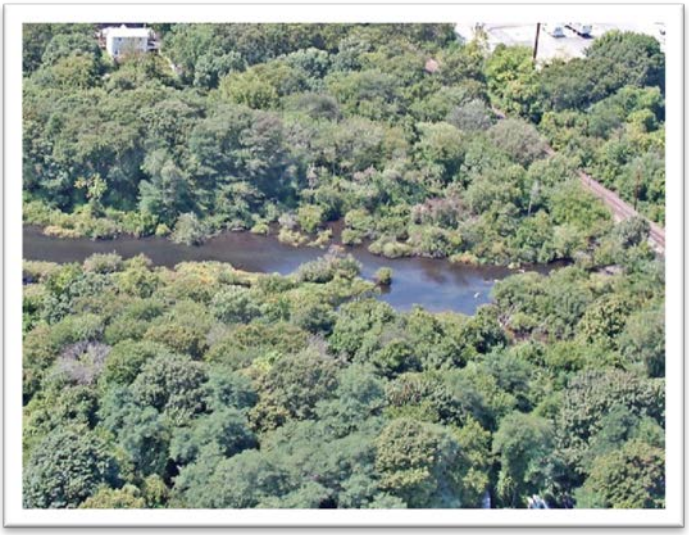
- Under light oiling, the best practice is natural recovery; natural removal processes and rates should be evaluated prior to conducting cleanup
- Heavy accumulations of pooled oil can be removed by vacuum, sorbents, or low-pressure flushing
- Cleanup activities should be carefully supervised to avoid vegetation damage
- Any cleanup activity must not mix the oil deeper into the sediments; trampling of the roots should be minimized through the use of walking boards
- Cutting of oiled vegetation should only be considered when other resources present are at great risk from leaving the oiled vegetation in place

SHORELINE DESCRIPTIONS

SWAMPS **ESI = 10C**

DESCRIPTION

- Swamps consist of shrubs and hardwood forested wetlands, essentially flooded forests; vegetation is taller, on average, greater than 6 m
- The sediment tends to be silty clay with large amounts of organic debris
- They are seasonally flooded, though there are many low, permanently flooded areas
- Resident flora and fauna are abundant with numerous species



PREDICTED OIL BEHAVIOR

- Oil behavior depends on whether the swamp is flooded or not
- During floods, most of the oil passes through the forest, coating the vegetation at the waterline, which changes levels throughout the flood event
- Woody vegetation is less sensitive than grasses to oil coating
- Some oil can be trapped and pooled on the swamp floodplain as water levels drop
- Penetration into the floodplain soils is usually limited because of high water levels, saturated soils, muddy composition, surface organic debris, and vegetation cover
- There can be large amounts of oily debris
- During dry periods, terrestrial spills flow downhill and accumulate in depressions or reach water bodies

RESPONSE CONSIDERATIONS

- Under light oiling, the best practice is to let the area recover naturally
- Heavy accumulations of pooled oil can be removed by vacuum, sorbents, or low-pressure flushing. During flushing, care must be taken to prevent transporting oil to sensitive areas down slope or along shore
- Under stagnant water conditions, herding of oil with water spray may be needed to push oil to collection areas
- Oily debris can be removed where there is access
- Any cleanup activity must not mix the oil deeper into the sediments; use walking boards or restrict foot traffic

SHORELINE DESCRIPTIONS

SCRUB-SHRUB WETLANDS **ESI = 10D**

DESCRIPTION

- Scrub-shrub wetlands consist of woody vegetation less than 6 m tall including true shrubs, small trees, and trees and shrubs that are stunted due to environmental conditions
- The sediments are silty clay mixed with organic debris
- They are seasonally flooded, though there are many low, permanently flooded areas
- Resident flora and fauna are abundant and diverse

PREDICTED OIL BEHAVIOR

- Oil behavior depends on water level
- During high water, most of the oil passes through the wetland, coating the vegetation above the waterline
- Woody vegetation is less sensitive than grasses to oil
- Some oil can be trapped and pooled on the surface as water levels drop
- Penetration into the soils is usually limited because of high water levels, muddy composition, surface organic debris, and vegetation cover
- There can be large amounts of oily debris
- During dry periods, terrestrial spills flow downhill and accumulate in depressions or reach water bodies

RESPONSE CONSIDERATIONS

- Under light oiling, the best practice is natural recovery
- Heavy accumulations of pooled oil can be removed by vacuum, sorbents, or low-pressure flushing
- Under stagnant water conditions, herding of oil with water spray may be needed to push oil to collection areas
- Oily debris can be removed where there is access
- Any cleanup activity must not mix the oil deeper into the sediments. Trampling of the roots must be minimized through the use of walking boards or restricting foot traffic
- Woody vegetation should not be cut