Preassessment Screen Determination for the Berry's Creek Watershed
Bergen County, New Jersey

Issued by the:

United States Department of Commerce
National Oceanic and Atmospheric Administration

And

United States Department of the Interior
U.S. Fish & Wildlife Service

In their Capacity as Trustees of Natural Resources

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I. INTRODUCTION, AUTHORITIES, AND DELEGATIONS

This determination addresses potential claims for damages pertaining to injured natural resources of Berry's Creek and adjacent ecosystems, as authorized by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), 42 U.S.C. §9601 et seq., as amended, and the Clean Water Act (CWA), 33 U.S.C. §1251 et seq. Based on a review of relevant information gathered as of this date, we conclude that there is a reasonable probability that a successful claim for damages to natural resources within the trusteeship of the United States Department of Commerce, acting through the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Department of the Interior (DOI), acting through the U.S. Fish and Wildlife Service (USFWS), (collectively the Federal "Trustees"), can be made in this case.

This determination was prepared by the Federal Trustees for natural resources, under the authority of Section 107(f) of CERCLA, as amended, 42 U.S.C. §9607(f), the National Contingency Plan, Title 40 Code of Federal Regulations (C.F.R.), Part 300, the DOI Natural Resource Damage Assessment (NRDA) Regulations, Title 43 C.F.R. Part 11, and other applicable Federal regulations and directives which serve to designate Federal, state, and tribal natural resource Trustees and which authorize the recovery of natural resource damages. The State of New Jersey, which shares trusteeship of natural resources within the Berry's Creek Watershed, is currently not participating as an active party in the development of this Preassessment Screen (PAS). However, both State and Federal Trustees are working to ensure that the public is adequately and appropriately compensated for injuries to natural resources incurred by the release of hazardous substances at the Site.

The first step in developing a natural resource damage claim is preparation of a PAS. The purpose of a PAS is to provide a review of readily available information on hazardous substance releases and the potential impacts of those releases on natural resources under the trusteeship of Federal, tribal, and state authorities. The review should ensure there is a reasonable probability of making a successful claim against the responsible parties for releasing hazardous substances into the environment. This determination is made to ensure that money and effort will be expended appropriately in moving forward with a NRDA, as required by 43 C.F.R. §11.23. For the Berry's Creek Watershed specifically, the Trustees have determined that:

(1) A release of hazardous substances has occurred;
(2) Natural resources for which the Trustees may assert trusteeship under CERCLA, CWA, and other applicable Federal laws, as well as State law statutory and common law claims, have been or are likely to have been adversely affected by the discharge or release;
(3) The quantity and concentration of the released hazardous substance(s) is sufficient to potentially cause injury to natural resources;
(4) Data sufficient to pursue an assessment are readily available or likely to be obtained at a reasonable cost; and
(5) Response actions carried out or planned, if any, do not or will not sufficiently remedy the injury to natural resources without further action.

II. INFORMATION ON SITES AND DISCHARGES OR RELEASES

A. Berry’s Creek Background and History

The Berry’s Creek Watershed is located in Bergen County, New Jersey (Figure 1). It is one of the largest tidal tributaries of the lower Hackensack River, discharging into the River six miles upstream of Newark Bay. The wetlands associated with Berry's Creek are comprised primarily of emergent brackish marsh and provide important nursery habitat for many fishery resources, especially near the lower reaches of Berry's Creek. Marine, brackish, and anadromous species all use these lower reaches as well as the Hackensack River estuary during various life history stages. In addition, a variety of migratory bird species use the wetland, open water, and upland habitats within and near the Berry’s Creek Watershed.

Berry’s Creek drains approximately 12 square miles as it flows through the Hackensack Meadowlands and into the Hackensack River (USACE and USEPA 2005). Jersey City is located southwest of the Creek, Carlstadt and Lyndhurst lie to the west, Moonachie borders the Creek to the north, and the Hackensack River and New Jersey Turnpike (Interstate 95) border the Creek to the southeast (Figure 1). South of the Route 3 Bridge, Berry’s Creek divides into Berry’s Creek and Berry’s Creek Canal. Berry’s Creek flows through East Rutherford, along the western border of the Meadowlands Sports Complex, and into Rutherford, where it empties into the Hackensack River. Berry’s Creek Canal branches off from Berry’s Creek just south of the Sports Complex. The Canal runs along the northern border of Oritani Marsh in East Rutherford, where it empties into the Hackensack River north of the Creek’s confluence with the River. Berry’s Creek has several tributaries, including Riser Ditch, Peach Island Creek, and Ackerman’s Creek. The Berry’s Creek Watershed also contains several wetland tracts (Nevertouch Marsh, Patterson Plank Marsh, Rutherford Marsh, Tollgate Marsh, Ackerman’s Marsh, Eight Day Swamp, Walden Marsh, Oritani Marsh, and Berry’s Creek Marsh) (Figure 2). Many of these wetlands have been identified by the USFWS as areas of substantial concern with respect to environmental contamination (USFWS 2005, 2007).

The Berry’s Creek Watershed contains a variety of industrial and commercial properties, including three hazardous waste sites currently on the U.S. Environmental Protection Agency’s (USEPA) Superfund National Priorities List (NPL): the Ventron/Velsicol Site, the Scientific Chemical Processing (SCP) Site, and the Universal Oil Products (UOP) Site (Figure 1). These sites are associated with releases of multiple hazardous substances, including mercury and other metals, polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs). Mercury concentrations in Berry’s Creek are much higher than levels considered protective of wildlife and are among the highest ever measured in a freshwater ecosystem in the United States (USEPA and USACE 2009). Mercury and PCB contamination in the surface water and sediment throughout the Berry’s Creek Watershed are being investigated as part of the Berry’s Creek Study Area (BCSA) Remedial Investigation/Feasibility Study (RI/FS), which began in 2009. The BCSA includes Berry’s Creek, Berry’s Creek Canal, all tributaries to Berry’s Creek from its headwaters to the Hackensack River, and wetlands that are hydrologically connected to Berry’s Creek and/or its tributaries (USACE and USEPA 2005) (Figure 1). State and Federal agencies, including the Federal Trustees, are assisting USEPA in remedial planning for the BCSA, with the goal of maximizing protection of trust resources.

The Ventron/Velsicol Site is located in a densely populated and industrialized area on the headwaters of Berry's Creek, just north of Never Touch Creek, in the Boroughs of Wood-Ridge and Carlstadt, New Jersey. From 1929 to 1974, the Ventron/Velsicol Site operated as a chemical processing plant, primarily for mercury. As of 1956, discharge from the plant was passed through several settling tanks into a private sewer, which ultimately discharged into Berry's Creek (USACE and USEPA 2005). Solid waste, domestic waste, and hazardous waste from the plant were disposed of on-site. Approximately160 tons of process waste might have been buried on the 40-acre property (USEPA 2011c). Contamination still remains on-site. The Ventron/Velsicol facilities were abandoned and demolished in 1974. Since then, two new buildings were constructed on-site, one of which houses a food distribution center and the other a warehouse (USEPA 2011c). The Site was placed on the NPL in 1984. In 2004, a Record of Decision (ROD) was issued for the upland portion of the property to address contamination of on-site soil (NJDEP 2006b). The remedy calls for excavation and off-site disposal of soil with mercury concentrations greater than 620 parts per million (ppm), capping of soil with mercury concentrations exceeding the New Jersey Department of Environmental Protection's (NJDEP) non-residential direct contact soil cleanup criterion (270 ppm), deed restrictions on properties with mercury contamination greater than the NJDEP residential soil cleanup criterion (14 ppm), and establishment of a 55 foot wide clean buffer zone between capped areas and creeks or wetlands (NJDEP 2006b). The remedy also includes installation of a vertical hydraulic barrier system to serve as a physical barrier to groundwater flow and to encapsulate the areas of highest mercury concentrations.

The SCP Site is a 6-acre site located along Peach Island Creek in a light industrial area in Carlstadt, New Jersey. Peach Island Creek discharges via inconsistently functioning tide gates into Berry's Creek, which then joins the Hackensack River downstream of the Site. SCP was a chemical recycling and waste processing plant that performed recovery and disposal of industrial wastes from 1941 to 1980 (USEPA 2002; USACE and USEPA 2005). SCP received liquid by-product from chemical and industrial firms and processed it to recover marketable products (USACE and USEPA 2005), which were often sold back to the originating companies (USEPA 2002). It also processed liquid hydrocarbons, which were blended with fuel oil and sold back to originating companies or to cement and aggregate kilns for fuel. Approximately 375,000 gallons of hazardous materials that had been stored on-site were removed in 1979 and 1980 (USEPA 2007). The facility shut down operations in 1980 and is now vacant. In 1983, the SCP Site was listed on the NPL. In 1990, the USEPA selected an interim remedy consisting of a slurry wall, infiltration barrier, and dewatering system, which temporarily eliminates direct contact with contaminated materials and controls off-site migration of contamination from on-site soils and shallow groundwater (USEPA 1990). This interim remedy was completed in 1992. In 2002, USEPA issued a ROD for a final remedy for the on-site soil and on-property groundwater, which includes solidification of the most contaminated parts of the Site, installation of a new cap over the soil, and upgrading of the groundwater recovery system and the underground barriers (USEPA 2002). Construction of this remedy began in 2008 and is continuing. Study of, and final remedy selection for, off-site groundwater is underway as well (USEPA 2011a).

The UOP Site is located on 75 acres adjacent to Route 17 at the end of Ackerman's Creek in East Rutherford, New Jersey. Berry's Creek borders the southeastern part of the Site and Ackerman's

Creek passes though the Site. UOP began operations in 1932 as an aroma-chemical laboratory and then operated as a solvent recovery facility and waste handler beginning in 1955 (USEPA 1999a). From 1960 to 1971, approximately 4.5 million gallons of wastewater and solid chemical wastes from the Site were deposited in two holding lagoons, which resulted in contamination of the surrounding soil and groundwater. The facility ceased operations in 1979 and the plant was dismantled. The Site was listed on the NPL in 1982. A ROD was issued in 1993, and amended in 1998 (USEPA 1993, 1999b). Under immediate response actions, 950,000 gallons of contaminated water were removed from the lagoon areas, with 271,589 gallons treated and discharged on-site and 678,411 gallons transported to an off-site treatment facility. Approximately 8,600 tons of contaminated soil/sediment were removed from the lagoon areas and transported to a hazardous waste landfill. Remedial actions that address the contaminated upland soil and a portion of the groundwater have also been completed. PCB / PAH contaminated soil was addressed through a combination of thermal desorption and off-site disposal. A portion of the soil contaminated with volatile organic compounds (VOCs) has been treated using soil vapor extraction. Lead contaminated soil has been excavated to a remediation goal of 600 ppm and placed under an on-site cap. From October 1997 through November 1998, contaminated groundwater was remediated by an on-site treatment system. Additional RIs investigations and supplemental characterization work to evaluate the adjacent wetland/creek areas were initiated in 2005 and completed in 2011 (USEPA 2011b; CH2MHill 2011).

The RIs currently underway within the BCSA do not include the Hackensack River or other areas of the Meadowlands located outside the Berry’s Creek Watershed. However, according to the Statement of Work for the BCSA, “Tidal portions of the Hackensack River and adjacent areas will also be studied, as necessary, using an iterative investigative approach, to evaluate ecological relationships and exchanges of contamination between these areas and the Berry’s Creek Watershed” (USACE and USEPA 2005). Further, according to the Administrative Settlement Agreement and Order On Consent for the RI/FS of the Berry's Creek Study Area (USEPA 2008a), the "Site" is defined as, “the water body known as Berry's Creek, including the Berry's Creek Canal and the natural course of Berry's Creek; all tributaries to Berry's Creek from its headwaters to the Hackensack River; and wetlands that are hydrologically connected to Berry's Creek or its tributaries, all located in the Boroughs of Rutherford, East Rutherford, Carlstadt, Wood-Ridge, Moonachie, and Teterboro in Bergen County, New Jersey… and any areas where contamination from the Study Area has come to be located.” As of yet, the USEPA has not delineated the extent of contamination outside the BCSA to identify where contamination from within the Study Area has come to be located. Therefore, this PAS uses data from areas of the Meadowlands outside the BCSA to evaluate potential injury to natural resources from certain compounds identified as primary contaminants of concern (COCs) at the hazardous waste sites within the BCSA.

B. Contaminants of Concern

Although mercury and PCBs are considered the primary COCs in the Berry’s Creek Watershed, other hazardous substances including lead and other metals; VOCs such as benzene and trichloroethylene; pesticides; and PAHs are also found in groundwater, surface water, soils, and sediment (USEPA 2007, 2011b, c). Future assessment efforts may expand the hazardous substances of concern to include other potentially injurious contaminants, such as dioxins and furans, not currently identified as contaminants of concern under the current RI/FS process.

Mercury

One of the principal hazardous substances of concern in the Berry's Creek Watershed is mercury. Concentrations of mercury in creek and marsh sediments are high throughout the study area and extremely high upstream, nearer to source areas. Walden Swamp, Berry's Creek Marsh, and Oritani Marsh (Figure 2), in addition to other marsh areas in the Meadowlands, are highly contaminated with mercury (USFWS 2005; NJDEP 2006b; USEPA 2007, 2011b, c).

Mercury is naturally found in the environment in several forms: as elemental or metallic mercury, inorganic mercury compounds, and organic mercury compounds (USEPA 2012b). It is a heavy metal whose properties make it valuable in the technological and manufacturing industries (Washington State Department of Ecology and Washington State Department of Health 2003). Mercury that enters water can be transformed by microorganisms into methylmercury, the most toxic form, which is easily adsorbed to sediments and taken up by biota (USEPA 2012b). Methylmercury also biomagnifies; organisms higher in the food web are therefore particularly susceptible to harmful effects of mercury, including developmental, neurological, physiological, and behavioral abnormalities and impaired reproduction and survival (see reviews in Eisler 1987; Wolfe *et al.* 1998; New Jersey Mercury Task Force 2002; and Scheuhammer *et al.* 2007).

Other Metals

Within the BCSA and Hackensack Meadowlands, concentrations of a variety of metals including arsenic, cadmium, chromium, copper, lead, nickel, and zinc have exceeded environmental guidelines or criteria for abiotic media (Tables 1 through 4). Arsenic is a metalloid that occurs in aquatic environments as arsenic III or arsenic V. In streams, arsenic will either adsorb to sediment or stay dissolved in the water depending on its chemical form and environmental conditions (Eisler 1988). Heavy metals, such as chromium and lead, are likely to accumulate in sediment, especially if the sediment has a high organic content (Commonwealth of Australia 2010). Cadmium is more mobile in the environment than other metals, but in streams has still been found to concentrate in sediment (John and Leventhal 1995). The extent to which metals other than methylmercury bioaccumulate generally varies with chemical form, organism, and environmental factors, although most do not bioaccumulate to a large degree. Some metals, especially cadmium, copper, lead, nickel, silver, and zinc, form insoluble sulfide complexes in sediment, particularly under anaerobic conditions. In such cases, the biological availability of these metals is low and toxicity cannot be predicted by concentration alone (USEPA 2005).

VOCs

VOCs are a group of chemicals that are most commonly found in chlorinated solvents and fuel products. VOCs such as trichloroethylene and benzene, which have been detected in Berry's Creek, easily evaporate from surface water and do not readily adsorb to soil or sediment particles (National Library of Medicine 2011). These VOCs are likely to migrate away from their source through groundwater (Commonwealth of Australia 2010). Trichlorethylene has been found to bioaccumulate to some extent in fish; benzene has a low bioaccumulation factor and is not likely to bioaccumulate in aquatic organisms (Commonwealth of Australia 2010). VOCs are primarily of concern with respect to groundwater resources.

PAHs

PAHs including acenaphthene, acenaphthylene, anthracene, benzo(g,h,i)perylene, fluoranthene, naphthalene, phenanthrene, and pyrene are all considered contaminants of concern in the BCSA. PAHs tend to persist in the environment. In streams, they are generally associated with sediment, especially when the sediment has a high organic content (ATSDR 1995). PAHs are grouped into two classes, low molecular weight PAHs (LPAHs) and high molecular weight PAHs (HPAHs). LPAHs are more mobile in the environment than HPAHs, as HPAHs have higher molecular weights and are characterized by extremely low volatility and solubility (National Library of Medicine 2011). Of the PAHs that are considered contaminants of concern in the BCSA, benzo(g,h,i)perylene, pyrene, and fluoranthene are considered HPAHs and the other five are considered LPAHs.

PAHs can cause the formation of deoxyribonucleic acid (DNA) adducts, which are considered precursors to tissue lesions and cancerous tumors. Fish and other aquatic organisms exposed via water or through the consumption of contaminated sediments are particularly at risk. However, because PAHs are readily metabolized by most fish and wildlife, they generally do not bioaccumulate significantly unless there is an active source (National Library of Medicine 2011).

PCBs

Elevated levels of PCBs have been documented in the Berry's Creek Watershed. PCBs are persistent organic compounds that are composed of two benzene rings attached to chlorine atoms. There are multiple forms, or congeners, of PCBs, which are identified by the number and position of attached chlorine atoms. The more chlorinated the PCB mixture, the more likely it is to adsorb to sediment in a stream; PCB mixtures with low chlorination are likely to volatilize from surface water. Although production of PCBs is now banned, chemical companies historically mixed different combinations of PCB congeners under the trade name Aroclor (ATSDR 2001).

PCBs are likely to accumulate in aquatic organisms and biomagnify in the food chain. Rates of accumulation and toxicity depend on species, age, sex, and size of the organism (Eisler and Belisle 1996). The bioavailability of PCBs to aquatic organisms decreases with increased organic content in sediment.

C. Potentially Responsible Parties

Numerous Potentially Responsible Parties (PRPs) were notified by the USEPA in March 2006 under CERCLA §107(a) in the matter of the BCSA (Appendix A). Other PRPs could be identified as part of the ongoing RI. Additionally, the Trustees acknowledge that there are other sources of hazardous substances to Berry's Creek than those detailed in this PAS; those sources may be addressed in future NRDA investigations.

D. Damages Excluded from Liability Under CERCLA or CWA

The regulations in 43 C.F.R. §11.24 (b),(c) state that the Trustees must determine whether damages from the release of hazardous substances are barred by specific defenses or exclusions from liability under CERCLA or the CWA. The required determinations are as follows:

The Trustees must determine whether: (i) damages resulting from the discharge or release were specifically identified as an irreversible and irretrievable commitment of natural resources in an environmental impact statement or other comparable environmental analysis, that the decision to grant the permit or license authorizes such commitment of natural resources, and that the facility or project was otherwise operating within the terms of its permit or license, so long as, in the case of damages to an Indian tribe occurring pursuant to a Federal permit or license, the issuance of that permit or license was not inconsistent with the fiduciary duty of the United States with respect to such Indian tribe; or (ii) the release of a hazardous substance from which the damages have resulted has not occurred wholly before the enactment of CERCLA; or (iii) damages resulted from the application of a pesticide product registered under the Federal Insecticide, Fungicide, and Rodenticide Act, 7 U.S.C. §§135-135k; or (iv) damages resulted from any other federally permitted release, as defined in §101(10) of CERCLA; or (v) damages resulted from the release or threatened release of recycled oil from a service station dealer described in §§9607(a)(3) or (4) of CERCLA if such recycled oil is not mixed with any other hazardous substance and is stored, treated, transported or otherwise managed in compliance with regulations or standards promulgated pursuant to §6935 of the Solid Waste Disposal Act and other applicable authorities.

The Trustees must also determine whether the discharge meets one or more of the exclusions provided in Sections 311(a)(2) or (b)(3) of the CWA.

The Trustees have determined that the potential injuries as cited herein are not subject to the exceptions to liability under CERCLA §§107(f), (i-j) and 114(c) and CWA §311 (a)(2) or (b)(3). Further, the Trustees are not aware at this time of any other defenses or exclusions from liability under applicable laws that would forestall initiating a NRDA. Therefore, the continuation of an assessment is not precluded.

III. PRELIMINARY IDENTIFICATION OF RESOURCES POTENTIALLY AT RISK

A. Potentially Affected Resources

Numerous trust resources in the Meadowlands, including benthic invertebrates, fish, amphibians, reptiles, birds, and mammals, as well as their habitats, may have been affected by releases of hazardous substances including mercury, PCBs, and other compounds. Impaired water and sediment quality have contributed to historical declines of fish and wildlife diversity in the Meadowlands (USFWS 2007). Elevated mercury and PCB concentrations, in particular, have been detected in various biological resources in the Berry's Creek Watershed (HMDC 1978a, b; Lipsky *et al.* 1980; ERM-Southeast Inc. 1985; Konsevick 1988; Konsevick 1989; New Jersey Mercury Task Force 2002; CH2MHill 2011).

Benthic Invertebrates and Fish

Fish and shellfish species use the Berry's Creek Watershed for feeding, breeding, and as a nursery. Species include anadromous and catadromous fish, which use Berry's Creek and the Hackensack River and estuary at various stages in their life history; estuarine and marine fish; and freshwater fish. The wetlands associated with Berry's Creek are comprised primarily of emergent brackish marsh, which may provide important nursery habitat, especially near the lower reaches of Berry's Creek. There is little information available on species that may periodically enter upper Berry's Creek.

The majority of trust fish resources in the Hackensack River are located between Newark Bay and approximately four miles upstream of the mouth of Berry's Creek Canal. Species using this area include alewife, American eel, American shad, Atlantic croaker, Atlantic menhaden, Atlantic tomcod, bay anchovy, blue crab, bluefish, blueback herring, grass shrimp, mummichog, striped bass, spot, summer flounder, weakfish, and white perch (USFWS 1997; Kiviat and MacDonald 2002; Bragin *et al.* 2005; NJDEP 2006a; Mizrahi *et al.* 2007; USFWS 2007).

Birds

The Hackensack Meadowlands is one of the largest estuarine complexes in the Northeast. It offers a variety of habitats, supporting avian species that frequent open saltwater, estuarine, and marsh habitats. It thus presents an attractive landscape for birds, particularly because it is surrounded by densely populated urban areas. A number of bird species, including marsh invertebrate-feeding passerines such as wrens and swallows, fish and benthic invertebrate feeding waterbirds such as egrets and herons, and fish- eating raptors including bald eagles and ospreys, are known to use the Berry's Creek Watershed or the Hackensack Meadowlands (USFWS 2007).

Amphibians and Reptiles

Northern spring salamanders, northern diamondback terrapins, snapping turtles, frogs, and a variety of other amphibians and reptiles may inhabit the Hackensack Meadowlands (USFWS 2007) and are likely come into contact with contaminated water, sediment, or food sources.

Mammals

Mammal species expected to occur in the vicinity of Berry's Creek are primarily those capable of surviving in an urban environment, including white-tailed deer, raccoon, skunk, eastern cottontail, opossum, and a variety of rodents. Other species, including masked and short-tailed shrew, eastern mole, little brown bat, Keen's *Myotis*, small-footed *Myotis*, big brown bat, red and gray fox, coyote, and long-tailed weasel, have also been documented in the Meadowlands (TAMS Consultants Inc. 1985; HMDC 1987b; The Louis Berger Group Inc. 2001). Although not common, harbor and harp seals were seen in the Hackensack River in 2010 and 2011, respectively (NJMC 2010b, 2011). Mink, albeit rare, may be present in the Meadowlands as well (Quinn 1997).

Threatened and Endangered Species

No federally listed threatened or endangered species are believed to be present in the Berry's Creek watershed or Hackensack Meadowlands. However, several State listed species are likely to use the area, including the blue spotted salamander, American bittern, northern harrier, pied-billed grebe, red-shouldered hawk, peregrine falcon, least tern, short-eared owl, northern goshawk, black skimmer, sedge wren, upland sandpiper, roseate tern, loggerhead shrike, bald eagle, and vesper sparrow, which are classified as endangered (NJDEP 2012a, b, c) (Table 5). State-listed threatened species include the triangle floater (a mollusk), wood turtle, American shad, long-eared owl, yellow-crowned night-heron, osprey, black-crowned night heron, Cooper's hawk, red knot (a Federal candidate species), barred owl, red-headed woodpecker, savannah sparrow, bobolink, and grasshopper sparrow. In addition, a variety of fish and bird species frequenting the Meadowlands have been identified by the State of New Jersey or the National Marine Fisheries Service as Species of Special Concern (NJDEP 2012a, c; NMFS 2012); many bird species are considered Regional Priority Species (NJDEP 2012a); and portions of the Berry's Creek and Hackensack River watersheds have been identified as essential fish habitat for several species federally managed under the Magnuson-Stevens Act (16 U.S.C. §§1801-1882 (1976) as amended (NMFS 2011a, b) (Table 2). Though not federally listed, mammals of concern that may be present within the Meadowlands include harp seals and harbor seals, which are protected under the Marine Mammal Protection Act, 16 U.S.C. §§1361-1407, (1972) as amended.

B. Exposed Areas

Areas into which hazardous substances have been released include the Berry's Creek Watershed and associated floodplains and wetlands. Hazardous substances have likely migrated into adjacent areas such as the Hackensack River and associated wetlands, both downstream of the Site and upstream to the extent of tidal influence.

C. Preliminary Identification of Pathways

The suspected primary pathways for injury to trust resources include: surface water and sediment transport, groundwater discharge, airborne transport and atmospheric fallout of particulates, overland runoff and sedimentation, and bioaccumulation via the foodchain.

Surface water pathway

Effluent from mercury processing activities at the Ventron/Velsicol Site was discharged directly into Berry's Creek (USACE and USEPA 2005). Seepage of groundwater contaminated by waste lagoons at the UOP Site has led to contamination of surface water in Ackerman's Creek (USEPA 1993). Discharges from the SCP Site have resulted in contamination of surface water in Peach Island Creek (USFWS 2007). Other historical and active surface water discharge points, which include both industrial and municipal discharges, are found throughout the BCSA (USACE and USEPA 2005).

Contaminants in surface water may be distributed via flow by any means, including surface water run-off, river flow, or tidal action. Thus, the extent of contamination via surface water transport can be widespread and extend a considerable distance from the original source. The surface water pathway includes transport of hazardous substances dissolved in water as well as those adsorbed to particulates suspended in water. The fate (i.e., ultimate endpoint and environmental impact) of dissolved and particulate fractions of contaminants in surface water may be very different.

Groundwater pathway

The Hackensack Meadowlands discharges area groundwater to Berry's Creek, the Hackensack River, Newark Bay, and the Atlantic Ocean, with shallower groundwater generally discharging to the surface water bodies in the area and deeper groundwater discharging directly to the ocean (Exponent 2004a, b). The aquifer beneath the Site has been designated as a Class II-A aquifer (N.J.A.C. 7:9-6), the primary designated uses of which are potable water and conversion to potable water through conventional water supply treatment, mixing, or similar techniques. However, due to groundwater contamination and saltwater intrusion, the Hackensack Meadowlands is currently not a source of potable water (Exponent 2004a, b).

A variety of sources of contamination to groundwater exist in the BCSA. Groundwater remediation activities have been completed or are underway at multiple sites within the study area including Arsynco Incorporated, Bectin-Dickinson and Company, Cosan Chemical Company, SCP, UOP, and Ventron/Velsicol (Exponent 2004a, b; USACE and USEPA 2005).

Airborne pathway

Although air pollution impacts to and from the BCSA have not been thoroughly investigated, some contamination, particularly of mercury, can be associated with atmospheric transport and deposition from outside sources. A study of regional and / or BCSA-specific atmospheric deposition for several COCs, including mercury and PCBs, is being incorporated into the RI/FS currently underway for the BCSA (Geosyntec Consultants *et al.* 2010).

Sediment pathway

Contaminants in surface water run-off and effluent from pollution sources have traveled and adsorbed onto particulate matter and settled in sediments. Sediments within the BCSA have been found to contain high concentrations of multiple hazardous substances including mercury and PCBs. These contaminated sediments can be transported to other areas within the BCSA as well as to the Hackensack River and surrounding marshland by river flow, tidal flow, and wind during both high-energy storm and normal flow conditions.

Soil pathway

Soils at the UOP, SCP, and Ventron/Velsicol Sites, as well as in surrounding residential properties, have been shown to contain high concentrations of hazardous substances including

VOCs, mercury, PCBs, and lead (NJDEP 2006b; USEPA 2007, 2011b, c). Remedial actions including removal and capping have been or are being undertaken to remove or sequester contaminated soil at these sites. However, these remedial activities will not completely address soil contamination throughout the BCSA or the Meadowlands. Little information is available regarding the extent to which contaminated soils have, or will, contribute to overall contamination within the Berry's Creek watershed and Hackensack River following remedial activities at specific sites.

Bioaccumulation

Mercury and PCBs bioaccumulate and biomagnify. Thus, one of the primary avenues for exposure of trust resources to these substances in the BCSA is via the food chain. These and other contaminants have been measured in a variety of species evaluated. Most bioaccumulation studies within the BCSA to date have focused on fish (*e.g.*, JMA 1976, as reported in ERM-Southeast Inc. 1985; CH2MHill 2011; Geosyntec Consultants *et al.* 2010; HMDC 1978b, 1987a, 1988; Konsevick 1989; Lipsky *et al.* 1980; NJDEP 1985 [as reported in ERM-Southeast Inc.1985]; Weis *et al.* 2001; and Weis 2005); however, avian trust resources, particularly piscivorous and insectivorous birds, are likely to accumulate hazardous substances in their tissues as well. Seals, river otter, and mink, although uncommon, may occur in the Meadowlands (Kiviat and MacDonald 2002; NJMC 2010b, 2011) and could become more prevalent if restoration proceeds. These piscivorous species are known to accumulate PCBs, mercury, and other contaminants (see, for example, Lake *et al.* 1995; USEPA 1997; Elliott *et al.* 1999; Ben-David *et al.* 2001; Basu *et al.* 2007a; Basu *et al.* 2007b; Das *et al.* 2008) and may be especially susceptible to bioaccumulation of hazardous substances released in the BCSA.

D. Estimates of Concentrations

Groundwater

Although not used as a drinking water source due to contamination and salt intrusion (Exponent 2004b), groundwater in the BCSA has been found to contain concentrations of a variety of COCs at levels exceeding State groundwater standards, which may constitute injury under NRDA regulations. According to the New Jersey State Administrative Code for groundwater quality (NJDEP 2010), most groundwater in the State of New Jersey, including that in the vicinity of the Hackensack Meadowlands, is required by the State to adhere to Class II-A criteria. Multiple hazardous substances, including mercury and other metals, VOCs, PAHs, and PCBs, have been detected in groundwater within the Berry's Creek Watershed at concentrations exceeding their respective criteria (Table 1).

According to USACE and USEPA (2005) groundwater samples from the BCSA were found to have dissolved mercury concentrations ranging from 2.9 micrograms per liter (µg/L) to 4,100 µg/L, which exceed the New Jersey Groundwater Quality Standard (GWQS) of 2 µg/L (NJDEP 2010). Arsenic in groundwater reached a maximum concentration of 3,100 µg/L near the SCP Site (USEPA 2002), a value more than 150,000 times greater than the New Jersey GWQS of 0.02 µg/L (NJDEP 2010). Lead has also been measured at elevated concentrations in groundwater from the BCSA; concentrations measured in 1987 at the UOP Site ranged from 5 µg/L to 280 µg/L, while the standard is 5 µg/L (NJDEP 2010).

A variety of organic compounds have also been detected at elevated concentrations in groundwater within the BCSA (Table 1). Trichloroethene, a VOC, was measured at 2,800 µg/L (USACE and USEPA 2005); 2,800 times the New Jersey GWQS of 1 µg/L (NJDEP 2010). Total VOC concentrations in groundwater at the UOP Site have been found at concentrations as high as 210,000 µg/L (USEPA 2006). Total PAHs were measured at concentrations of 21 µg/L at the UOP Site (USEPA 1993). Total PCBs at the SCP Site reached 17,000 µg/L (USEPA 2002), exceeding the New Jersey GWQS of 0.02 µg/L (NJDEP 2010) by a factor of 850,000.

Surface Water

Surface water in the BCSA has been shown to contain multiple compounds at concentrations exceeding the New Jersey Surface Water Quality Criteria (SWQC) (NJDEP 2011) and / or the National Recommended Water Quality Criteria (NRWQC) (USEPA 2009) (Table 2). Freshwater acute and /or chronic criteria were exceeded for cadmium, chromium, copper, lead, mercury, nickel, zinc, and PCB Aroclors 1242, 1248, and 1254. Samples collected during the 2009 RI investigation had maximum (1,150 µg/L) and average (98.9 µg/L) concentrations of dissolved total mercury that exceed the freshwater acute (1.4 µg/L) and chronic (0.77 µg/L) New Jersey SWQC by several orders of magnitude, while the State's proposed but un-promulgated water quality criterion for mercury in wildlife (530 picograms per liter [pg/L]) was exceeded by a factor of over 185,000 (NJDEP *et al.* 2001; Geosyntec Consultants *et al.* 2010).

Contaminant concentrations in Hackensack River surface water have also been measured, as part of the New York-New Jersey Harbor and Estuary Program's (HEP) Contaminant Assessment and Reduction Project (CARP; Figure 3). The CARP project involved the collection and analysis of thousands of water samples throughout the Harbor to develop an understanding of the sources and movement of hazardous substances throughout the watershed and to predict future conditions under various scenarios for dredging of contaminated sediment (New York/New Jersey Harbor & Estuary Program 2012). Measured concentrations of lead, mercury, and PCBs in the Hackensack River exceeded water quality criteria, but were considerably lower than concentrations measured in the BCSA during the RIs (Stevens Institute of Technology 2007; Wilson and Bonin 2007; NJDEP 2011) (Tables 2 and 3). Notably, mercury concentrations in surface water at the Hackensack River Head of Tide, upstream of the Meadowlands but within the urban corridor, were within a factor of two of the proposed wildlife criterion (Table 3), indicating the magnitude of reduction in surface water contamination that could potentially be achieved with comprehensive remediation and source control within the Harbor Estuary.

Sediment

Creek sediment, like surface water, serves as a medium for the transport of energy and nutrients and as habitat for various aquatic biota, including benthic fish and shellfish. Sediment in the BCSA is affected by mercury and other heavy metals, VOCs, PCBs, and PAHs (USEPA 2007, 2011b, c) (Table 4). Flood-prone areas, which can be subject to increased contaminant input, in the Berry's Creek watershed include two separate areas near Patterson Plank Road (NJMC 2004).

Mercury concentrations in surface (within the Biologically Active Zone, or BAZ) sediment analyzed in 2009 reached 1,110 milligrams per kilogram (mg/kg) in Berry's Creek, which exceeds the NJDEP's least conservative screening guideline for marine sediment (the effects range-median or ER-M) by over three orders of magnitude (Long *et al.* 1995; NJDEP 2009) (Table 4). Mercury has been detected at concentrations that exceed sediment guidelines as deep as 6 feet below the sediment surface (USACE and USEPA 2005). A mercury gradient exists in Berry's Creek, with concentrations increasing with distance upstream from the confluence with the Hackensack River (Lipsky and Galuzzi 1982; ERM-Southeast Inc. 1985; Geosyntec Consultants *et al.* 2010).

Other metals including arsenic, chromium, lead, and zinc have also been detected in sediment at concentrations greater than screening guidelines (Table 4). In 2009, the maximum concentration of chromium exceeded the ER-M by more than an order of magnitude (NJDEP 2009; Geosyntec Consultants *et al.* 2010). Maximum and average concentrations of PCB Aroclors 1248, 1254, and 1260 exceeded screening values as well. Values exceeded the effects range-lows (ER-Ls) by factors of up to 1100, 151, and 420, respectively. Maximum total PCB concentrations measured between 1990 and 2004 exceeded ER-Ls by factors ranging from around six to 1,300, depending on the location; concentrations of samples taken in 2009 exceeded ER-Ls by over a factor of 3,600 (Table 4).

Biota

<u>Mercury</u>
Inorganic mercury is converted to methylmercury under certain environmental conditions. Methylmercury is moderately lipophilic (soluble in fats) and hydrophilic (soluble in water), which allows it to enter the aquatic food chain rapidly and to bioaccumulate easily (New Jersey Mercury Task Force 2002).

Relatively few recent studies have evaluated mercury concentrations in biota from the Berry's Creek Watershed and Meadowlands. However, both historical and recent data for fish, crabs, and birds indicate that mercury is entering the food chain and accumulating to levels exceeding thresholds for human consumption as well as values associated with harmful effects in wildlife.

Fish and Crabs
Fish and shellfish consumption advisories have been issued for the Newark Bay Complex, which includes the Hackensack River and tributaries, due to mercury, PCB, and dioxin contamination (NJDEP and NJDHSS 2012). The State of New Jersey recommends against eating blue crab and other shellfish, white perch, or American eel from these waters. High risk populations (*e.g.*, pregnant women and children) are also advised not to consume striped bass or white catfish, while the general public is advised to restrict consumption of these species. A ban on commercial fishing of shellfish, striped bass, and American eel has been imposed (USEPA 2012a). Consumption advisories have also been issued for Overpeck Creek, a tributary to the Hackensack River, located along the northern boundary of the Meadowlands District (NJDEP and NJDHSS 2012). High risk populations are advised not to consume striped bass, American eel, or common carp,

while the general public is advised to restrict consumption of these species. Under 43 C.F.R. 11.62 (f)(1)(iii), a biological resource is considered to be injured if contaminant concentrations are sufficient to cause an appropriate state health agency to limit or ban consumption of that resource.

Contaminant analyses of 15 fish species that could potentially be consumed by humans show that 13 species had mercury concentrations in fillet or muscle tissue that exceeded the recommended maximum (0.3 mg/kg) for human consumption (USEPA 2001) (Tables 6 and 7). The highest concentration (>2 mg/kg) was measured in muscle tissue from a brown bullhead catfish collected in 1985. It is important to note that although the human health threshold is for methylmercury and the most of the concentrations presented in Tables 6 and 7 represent total mercury, most mercury in fish species likely to be consumed by humans is in the form of methylmercury (Bloom 1992; Lasorsa and Allen-Gil 1995; Kannan *et al.* 1998; Raymond and Rossmann 2009). Further, fillets of white perch analyzed specifically for methylmercury had average and maximum tissue concentrations exceeding the USEPA (2001) threshold at all sampling locations except Lower Berry's Creek (Table 7).

Mercury concentrations in edible tissue (muscle or claws) of blue crabs collected within the BCSA also reached concentrations exceeding the protective threshold, with average concentrations ranging from 0.207 mg/kg to 0.623 mg/kg, depending on the study (Table 8). Maximum concentrations, which were measured by the Hackensack Meadowlands Development Commission (HMDC) in 1985, exceeded 2 mg/kg. Although recent (2009) sampling revealed somewhat lower levels of mercury in blue crab claws, the maximum concentration of methylmercury still exceeded the USEPA recommended threshold for human consumption (USEPA 2001; Geosyntec Consultants *et al.* 2010) (Table 8).

Mercury concentrations measured in tissue of fish from the Meadowlands also have exceeded literature-based body residues associated with adverse effects. Model dose response relationships developed using toxicity data from a variety of studies indicate that early life stage fish are particularly sensitive to mercury, and that adverse effects (mortality, developmental or behavioral abnormalities, or decreased reproductive success) increase with increasing tissue mercury concentrations (Dillon *et al.* 2010). Beckvar *et al.* (2005) suggested that to be protective, whole body tissue mercury concentrations should not exceed 0.2 mg/kg in juvenile and adult fish or 0.02 mg/g in early life stage fish. Tissue concentrations measured in multiple species, collection areas, and years within the BCSA and Hackensack Meadowlands have exceeded 0.2 mg/kg (Tables 6 and 7). Most recently, 2009 sampling within the BCSA revealed somewhat lower concentrations in mummichogs than in earlier studies, although whole-body values still exceeded 0.2 mg/kg in fish from the BCSA (Geosyntec Consultants *et al.* 2010) (Table 7). Mercury values were higher in white perch, with concentrations in whole body samples and fillets ranging from 0.163 to 0.267 mg/kg and 0.343 to 0.523 mg/kg, respectively. The maximum measured concentration (0.66 mg/kg) was measured in white perch from middle Berry's Creek. No other fish species were analyzed during the 2009 and 2010 sampling events.

Birds

The data available for evaluating mercury concentrations in birds within the BCSA are somewhat dated, having been collected in 1978 through 1985. More recent studies evaluating mercury in birds have been performed in areas of the Meadowlands outside the boundaries of the BCSA. In both cases, however, concentrations of mercury in several species exceeded relevant protective levels (Figures 4 and 5). Game species evaluated, including black duck, blue winged teal, gallinule, lesser scaup, mallard, Canada goose, and moorhen, all had mercury concentrations in edible tissue (liver or muscle) that exceeded the U.S. Food and Drug Administration (FDA) tolerance level for mercury (1 ppm) in edible portions of aquatic organisms, established under section 402 of the Food, Drug, and Cosmetic Act (21 U.S.C. 342) (Figure 4). Exceedances of FDA tolerance levels are considered biological injury under NRDA regulations, 43 C.F.R. Part 11.62(f)(1)(ii).

In addition, maximum mercury concentrations in feathers of black-crowned night heron, coot, gallinule, great blue heron, green heron, green winged teal, laughing gull, lesser scaup, mallard, marsh wren, and tree swallow, in both early and more recent sampling events, exceeded 2.4 mg/kg, an effects threshold shown to be associated with a 10% reduction in reproductive success of Carolina wrens (Jackson *et al.* 2011) (Figure 4). The corresponding effects threshold for egg tissue of 1.1 mg/kg (Jackson *et al.* 2011) was exceeded in marsh wrens, red-winged blackbirds, and tree swallows sampled in the Meadowlands in 2006 and 2007 (Tsipoura *et al.* 2009) (Figure 5), despite the fact that eggs were only evaluated in areas outside the BCSA, the epicenter of mercury contamination.

Reptiles

Snapping turtles and diamondback terrapins, both of which occur in the Meadowlands, may be commercially harvested throughout the State of New Jersey (NJDFW 2012). Turtles and terrapins are sold in both local and global markets. Between 2003 and 2005, 173,243 wild-caught common snapping turtles and 1,450 wild-caught diamondback terrapins were declared in shipping documentation as being exported from the United States, bound primarily for Asian food markets (Senneke 2006). Mercury concentrations in edible organs of individuals of these species collected in the Meadowlands have exceeded the FDA tolerance level for mercury of 1 ppm. For example, livers from snapping turtles collected in Moonachie Creek, Sawmill Creek, and Sawmill Creek Marsh averaged 1.28 mg/kg in males and 1.27 mg/kg in females (Albers *et al.* 1986). Livers of diamondback terrapins collected in Sawmill Creek and Sawmill Canal ditch contained 3.6 and 7.6 mg/kg, respectively (Galluzzi 1981). Also of potential ecological significance is the fact that despite intensive sampling efforts, Albers *et al.* (1986) captured no snapping turtles in the two sites most heavily contaminated by metals: Mill Creek and the Berry's Creek drainage.

<u>PCBs</u>

PCBs are a group of synthetic organic chemicals containing 209 different forms (termed "congeners") whose basic structure consists of chlorinated biphenyl rings. Some commercially-developed PCB mixtures are known in the United States by their industrial trade name, followed by a number indicating the number of carbon atoms and the chlorine content of the compound. For example, the trade name Aroclor 1254 refers to a mixture of PCBs containing twelve carbon atoms and approximately 54 percent (%) chlorine by mass. Over time, Aroclors typically undergo physical and chemical environmental weathering, which results in changes to congener profiles in the environment. For this reason, evaluation of PCB contamination using Aroclor analyses may not adequately assess the potential for ecological effects. Different PCB congeners also have different rates of bioaccumulation. Because of this, PCB concentrations in abiotic media such as water and sediment, although useful for evaluating relative PCB concentrations in time or space, are not necessarily a good indicator of the potential for biological toxicity (USEPA 2008b). Therefore, the best way to evaluate potential impacts of PCBs in biota is to use information regarding PCB congener (as opposed to Aroclor) concentrations in tissue. PCB-congener data for biota in the BCSA and Meadowlands are few. However, some information is available to assess potential impacts of PCBs to fish.

For vertebrates including fish, the most severe effects from PCBs are those resulting from interactions with a cellular receptor for a protein termed aryl hydrocarbon (Ah). Invertebrates are not known to have an Ah receptor (AhR) and do not show the same AhR- mediated effects of exposure. Compounds with AhR-mediated effects are termed "dioxin-like"," because their mechanism of action is the same as that of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin, or 2,3,7,8-TCDD, one of the most toxic chemicals known to exist. 2,3,7,8-TCDD is in a class of compounds known as polychlorinated dioxins and furans, all of which have two benzene rings as their basic structure but vary in the number and position of chlorine atoms (dioxins have two oxygen molecules connecting the benzene rings while furans have one). Dioxin-like compounds include certain dioxin, furan, and PCB congeners. Toxicity of these compounds is generally known to be additive. Among the 209 PCB congeners, 12 are considered "dioxin-like". Therefore, to effectively assess biological impacts of PCBs in vertebrates in the Meadowlands, all dioxin-like PCB congeners must be evaluated together. However, because different congeners have differing degrees of toxicity, a "toxic equivalency factor", or TEF (van den Berg *et al.* 1998; van den Berg *et al.* 2006) is typically applied to calculate a "toxic equivalent (TEQ)" for each congener. The individual TEQs are then summed to derive a total TEQ, which gives an estimate of the total dioxin-like activity to which an organism is exposed.

PCBs also exert non-Ah- receptor-mediated toxicity. Non-Ah-receptor-mediated toxicity may be caused, in varying degrees, by all 209 PCB congeners. The potential for ecological effects due to non-Ah-receptor PCB toxicity can be evaluated by obtaining the concentrations of all 209 congeners and comparing the sum to literature-based body residue effect thresholds. As with dioxin-like PCBs, however, evaluating total Aroclors in tissue does not give as accurate a measure of potential total PCB toxicity as the sum of congeners, because Aroclor analyses do not pick up all the PCBs present in tissue, due to reasons previously discussed. Therefore, given the lack of available PCB congener data for biota from the BCSA (results are available only for a small sample of mummichogs from the UOP Site and Mill Creek) and Meadowlands, along with the fact that toxicity is likely to be more significant from exposure to dioxin-like PCBs, total PCB toxicity is not being evaluated in this PAS, but may be evaluated in the future.

The existing data suitable for using a TEF approach to evaluate dioxin-like PCBs in fish from the BCSA and Meadowlands are from mummichogs collected at the UOP Site and Mill Creek during 2010, of which a total of 18 samples (plus 3 duplicates) were analyzed for PCB congeners. For all samples, PCB 126 showed the highest TEQ, indicating that the greatest contribution to total PCB toxicity is expected to be from this PCB congener (CH2MHill 2011) (Table 9).

Early life stages of fish have been shown to be highly sensitive to dioxin-like PCBs. Therefore, the relationship between lipid and dioxin-like PCB concentrations (PCBs accumulate primarily in lipids) measured in mummichogs in the Study Area were used along with published egg lipid contents for the species (Bailey 1973) to predict total TEQs in mummichog eggs (Table 10). Calculated values in every sample exceeded an effects threshold based on altered prey capture ability in hatched larval fish exposed as embryos (Couillard *et al.* 2011). This effects threshold is particularly relevant because it is based on exposure of mummichogs to PCB 126, the congener with the highest TEQ at the Site. It is important to note that the effects concentration was derived using lab-raised fish; mummichogs in the Study Area may be less responsive to PCBs compared to newly exposed fish as a result of physiological acclimation or genetic adaptation. However, such resistance may be associated with evolutionary costs and compromise population viability (Wirgin *et al.* 2006). Further, even if early life history stages of fish in polluted environments become more tolerant, adult fish can be stressed by those conditions and die sooner (Weis 2002).

Congener-specific data are not available for other biota in the Meadowlands, so potential impacts to other trust resources from dioxin-like PCBs cannot be evaluated at the present time. More detailed evaluations of the likely effects of PCBs in biota may be performed during the Assessment phase of the NRDA. Total PCB concentrations may also be used to evaluate whether FDA tolerance thresholds (2 mg/kg for fish and shellfish; 3 mg/kg for poultry on a fat basis; USFDA 2009) have been exceeded in game birds, blue crabs, snapping turtles, or edible fish, which would represent injury to a biological resource (43 C.F.R. §11.62 (f)(1)(ii)). In addition, future injury studies may include congener-based analyses of PCBs in biota and abiotic media outside the BCSA to evaluate the extent of site-related contamination.

<u>Other Organisms, Pathways, and Hazardous Substances</u>
In addition to the fish, crab, turtle, and bird data presented here, mercury concentrations have been measured in a variety of plants, terrestrial invertebrates, reptiles, and mammals from the Meadowlands and the BCSA. The Trustees may address potential mercury impacts to some or all of these resources in future evaluations. Food chain pathways may be evaluated as well. For example, fish and benthic invertebrate contaminant concentrations can be used along with dietary effects thresholds identified in the scientific literature to provide an additional line of evidence to evaluate the potential for injury to predatory fish and birds. Further, there are other hazardous substances in, and sources of contamination to, the BCSA and Meadowlands. These substances and their sources may be addressed in future NRDA activities. A list of potential dischargers, as evidenced by USEPA's 2006 list of Potentially Responsible Parties being notified under CERCLA Section 107 (a), is included in Appendix A.

IV. PREASSESSMENT SCREEN CRITERIA

In accordance with the Federal NRDA Regulations (43 C.F.R. §11.23(e)), the Trustees have determined that all of the following criteria are met.

A. Criterion #1 – A release of a hazardous substance has occurred

There have been releases of hazardous substances as defined by CERCLA, the CWA, and related applicable laws. Substances that have been released into Berry's Creek include, but are not limited to, mercury and other heavy metals, PCBs, PAHs, and VOCs. These compounds are listed as hazardous substances in Federal Regulations at 40 C.F.R. §302.4, pursuant to Section 102(a) of CERCLA and Section 311 of the Federal Water Pollution Control Act. These substances were released into the geographic area of concern from various industrial and commercial properties and other sources. They have entered the soil, groundwater, surface water, and sediments of Berry's Creek and the adjacent ecosystems and have adversely affected trust resources.

B. Criterion #2 – Natural resources for which the Trustees may assert trusteeship under CERCLA have been or are likely to have been adversely affected by the release

The exposed areas and the natural resources adversely affected by releases of mercury and other hazardous substances present in the Berry's Creek Watershed are within the trusteeship of the State and Federal Trustees as defined under CERCLA. Specific affected resources of trusteeship include groundwater, surface water, sediment, and biota including birds, fish, benthic invertebrates, amphibians, reptiles, and mammals, along with their habitats.

C. Criterion #3 – The quantity and concentration of the released hazardous substance is sufficient to potentially cause injury to natural resources

Injury is defined as a measurable adverse change, either long or short-term, in the chemical or physical quality or the viability of a natural resource resulting either directly or indirectly from exposure to a discharge or release of a hazardous substance, or exposure to a product of reactions resulting from such discharge or release (43 C.F.R. §11.14(v)). As outlined above, the quantity and concentrations of released hazardous substances have injured natural resources in the BSCA, Meadowlands and related sites. In particular, Berry's Creek is considered to be one of the largest mercury-contaminated sites in the nation. Mercury has contaminated the soil, groundwater, surface water, and sediments in the watershed (USEPA 2007, 2011b, c). Mercury concentrations are sufficient to cause injury to the surface water, sediment, and biota of Berry's Creek. Other hazardous substances, including other heavy metals, PCBs, PAHs and VOCs, are also known to be present above effects-level concentrations.

D. Criterion #4 – Data sufficient to pursue an assessment are readily available or are likely to be obtained at a reasonable cost

Data relevant to natural resources and potential injuries resulting from exposure to mercury and other hazardous substances in Berry's Creek are available from NJDEP, USFWS, USEPA, the New Jersey Meadowlands Commission (NJMC), and other sources. These data include information on contaminant releases, concentrations in the environment, and the effect of contamination on natural resources. Given the volume of available information, additional data useful for an assessment could be obtained at a reasonable cost. Additional data are also expected to become available through collection efforts currently underway as part of the RIs of the UOP Site and the BCSA. The availability of this information will facilitate the preparation of both an assessment plan and a NRDA, thereby reducing associated costs.

E. Criterion #5 – Response actions carried out or planned do not or will not sufficiently remedy the injury to natural resources without further action

The Trustees do not expect that the remedial measures carried out to date, or those planned for the future, will fully address the various sources and pathways of exposure of natural resources to mercury and other hazardous substances, or the past, current, and future injuries resulting from such exposure. For example, activities anticipated as part of the remedial process will not address interim lost use, or the injuries and lost services from the time of release, or necessarily ensure a return to baseline. Also, the ongoing/anticipated cleanup may not fully address cumulative ecosystem impacts of hazardous substance releases, such as residual contamination in sediment and bioaccumulation in biota. Therefore, the Trustees have determined that the response actions carried out or currently planned do not or will not sufficiently remedy the injury to the natural resources of the Berry's Creek Watershed without further action.

V. PRE-ASSESSMENT SCREEN DETERMINATION

Following the review of information described in this Preassessment Screen, the Federal Trustees have determined that the criteria specified in 43 C.F.R. Part 11 are satisfied. The Federal Trustees further have determined that there is a reasonable probability of making a successful claim for damages with respect to natural resources over which the Trustees have trusteeship. Therefore, the Federal Trustees conclude that an assessment of natural resource damages is justified. As the next step in the NRDA process, the Federal Trustees plan to develop a Notice of Intent to Perform an Assessment (NOI), which will be submitted to EPA-identified PRPs for the BCSA. The NOI, PAS, and other documents supporting decisions regarding the NRDA for the BCSA will be maintained in the Administrative Record and made available for public review.

VI. LITERATURE CITED

Albers, P.H., L. Sileo, and B.M. Mulhern. 1986. Effects of environmental contaminants on snapping turtles of a tidal wetland. Archives of Environmental Contamination and Toxicology 15:39-49.

ATSDR. 1995. Toxicological Profile for Polycyclic Aromatic Hydrocarbons. Agency for Toxic Substances and Disease Registry. Available at: http://www.atsdr.cdc.gov/toxprofiles/tp69.pdf. Accessed 15 March 2012.

ATSDR. 2001. Toxicological Profile for Polychlorinated Biphenyls. Available at: http://www.atsdr.cdc.gov/toxprofiles/tp17.pdf. Accessed 15 March 2012.

Bailey, C.F. 1973. Lipids of the fertilized egg and adult brain of *Fundulus heteroclitus*. Journal of Experimental Zoology 185:265-276.

Basu, N., A.M. Scheuhammer, and M. O'Brien. 2007a. Polychlorinated biphenyls, organochlorinated pesticides, and polybrominated diphenyl ethers in the cerebral cortex of wild river otters (*Lontra canadensis*). Environmental Pollution 149 (1):25-30.

Basu, N., A.M. Scheuhammera, S.J. Bursian, J. Elliotte, K. Rouvinen-Wattr, and H.M. Chan. 2007b. Mink as a sentinel species in environmental health. Environmental Research 103:130-144.

Beckvar, N., T.M. Dillon, and L.B. Read. 2005. Approaches for linking whole-body fish tissue residues of mercury or DDT to biological effects thresholds. Environmental Toxicology and Chemistry 24 (8):2094-2105.

Ben-David, M., L.K. Duffy, G.M. Blundell, and R.T. Bowyer. 2001. Natural exposure of coastal river otters to mercury: Relation to age, diet, and survival. Environmental Toxicology and Chemistry 20 (9):1986–1992.

Bloom, N.S. 1992. On the chemical form of mercury in edible fish and marine invertebrate tissue. Canadian Journal of Fisheries and Aquatic Sciences 49 (5):1010-1017.

Bonin, J.L. and I.A. Wilson. 2006. Organic Compounds, Trace Elements, Suspended Sediment, and Field Characteristics at the Heads-of-Tide of the Raritan, Passaic, Hackensack, Rahway, and Elizabeth Rivers, New Jersey, 2000-03. Data Series 123. USGS and NJDEP.

Bragin, A.B., J. Misuik, C.A. Woolcott, K.R. Barrett, and R. Justino-Atresino. 2005. A Fishery Resource Inventory of the Lower Hackensack River within the Hackensack Meadowlands District: A Comparative Study 2001-2003 vs. 1987-1988. New Jersey Meadowlands Commission Meadowlands Environmental Research Institute.

CH2MHill. 2008. Draft Preliminary Site Characterization Report, Universal Oil Products, Operable Unit 3 (Area 4). Universal Oil Products Site, East Rutherford, New Jersey. EPA ID# NJD002005106. Prepared by CH2MHill for Honeywell. October.

CH2MHill. 2011. Draft Baseline Ecological Risk Assessment, Universal Oil Products, Operable Unit 2, East Rutherford, New Jersey. Prepared by CH2MHill for Honeywell. April.

Commonwealth of Australia. 2010. National Pollutant Inventory. Available at: http://www.npi.gov.au/substances/index.html. Accessed 16 March 2012.

Couillard, C.M., B. Legare, A. Bernier, and Z. Dionne. 2011. Embryonic exposure to environmentally relevant concentrations of PCB126 affect prey capture ability of *Fundulus heteroclitus* larvae. Marine Environmental Research 71 (4):257-265.

Das, K., U. Siebert, A. Gillet, A. Dupont, C. Di-Poi, S. Fonfara, G. Mazzucchelli, E. De Pauw, and M.C. De Pauw-Gillet. 2008. Mercury immune toxicity in harbour seals: links to in vitro toxicity. Environ Health 7:52.

Dillon, T., N. Beckvar, and J. Kern. 2010. Residue-based mercury dose-response in fish: an analysis using lethality-equivalent test endpoints. Environ Toxicol Chem 29 (11):2559-2565.

Eisler, R. 1987. Mercury Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. U.S. Fish and Wildlife Service, Patuxent Wildlife Research Center, Maryland. Contaminant Hazard Reviews Report Number 10; Biological Report No. 85(1.10).

Eisler, R. 1988. Arsenic Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. U.S. Fish and Wildlife Service, Patuxent Wildlife Research Center, Maryland. Contaminant Hazard Reviews Report Number 12; Biological Report No. 85(1.12).

Eisler, R. and A.A. Belisle. 1996. Planar PCB Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. U.S. Fish and Wildlife Service, Patuxent Wildlife Research Center, Maryland. Contaminant Hazard Reviews, Report Number 31; Biological Report 31.

Elliott, J.E., C.J. Henny, M.L. Harris, L.K. Wilson, and R.J. Norstrom. 1999. Chlorinated hydrocarbons in livers of American mink (*Mustela vison*) and river otter (*Lutra canadensis*) from the Columbia and Fraser River Basins, 1990-1992. Environmental Monitoring and Assessment 57:229–252.

ERM-Southeast Inc. 1985. Volume I, Berry’s Creek Study, Nature of the Problem, Final Report. Task I of the Berry’s Creek RI/FS Investigation. ERM-Southeast Inc., Brentwood, TN.

Exponent. 2004a. Operable Unit 1 Remedial Investigation Report for the Ventron/Velsicol Site, Wood-Ridge/Carlstadt, New Jersey. Volume 1 of 4, Remedial Investigation Report. Prepared for the Velsicol Chemical Corporation. June.

Exponent. 2004b. Operable Unit 1 Remedial Investigation Report for the Ventron/Velsicol Site, Wood-Ridge/Carlstadt, New Jersey. Volume 4 of 4, Background Investigation Technical Memorandum. Prepared for Velsicol Chemical Corporation. June.

Galluzzi, P. 1981. Mercury Concentrations in Mammals, Reptiles, Birds, and Waterfowl Collected in the Meadowlands, New Jersey Hackensack Meadowlands Development Commission, East Rutherford, New Jersey. March 28.

Geosyntec Consultants, Integral Consulting, and The ELM Group. 2010. Draft Phase I Site Characterization Report, Berry’s Creek Study Area. Prepared for the Berry’s Creek Cooperating Parties Group. February 26.

HMDC. 1978a. Mercury in Birds and Waterfowl. Hackensack Medowlands Development Commission.

HMDC. 1978b. Mercury in Fish and Aquatic Invertebrates. Hackensack Medowlands Development Commission. December. Available at: http://merilibrary.njmeadowlands.gov. Accessed 18 March, 2012.

HMDC. 1987a. Mercury in Biota. Hackensack Meadowlands Development Commission Environmental Operations Research Laboratory. October.

HMDC. 1987b. Species Lists of Organisms Found in the Hackensack Meadowlands: Vascular Plants - Mammals. Hackensack Meadowlands Development Commission. May.

HMDC. 1988. Berry’s Creek Mercury in Aquatic Biota. Spring Sampling, 1988. Hackensack Meadowlands Development Commission Environmental Operations Research Laboratory.

HMDC. 1997. Mill Creek Wetlands Mitigation Site Baseline Monitoring Program: Soil and Sediment Analysis. June. Hackensack Meadowlands Development Commission.

Jackson, A.K., D.C. Evers, M.A. Etterson, A.M. Condon, S.B. Folsom, J. Detweiler, J. Schmerfeld, and D.A. Cristol. 2011. Mercury exposure affects the reproductive success of a free-living terrestrial songbird, the Carolina Wren (*Thryothorus ludovicianus*). The Auk 128 (4):759-769.

JMA. 1976. Summary Report on Analysis of Mercury in Sediments and Waters of the Hackensack Meadowlands District. Prepared for the New Jersey Sports and Exposition Authority. Jack McCormick and Associates. Cited in ERM-Southeast Inc. 1985.

John, D.A. and J.S. Leventhal. 1995. Bioavailability of Metals. Pages Pp. 10-18 *in* DuBray, E.A., ed. Preliminary Compilation of Descriptive Geoenvironmental Mineral Deposit Models. Open File Report 95-831. USGS, Denver.

Kannan, K., R.G. Smith, Jr., R.F. Lee, H.L. Windom, P.T. Heitmuller, J.M. Macauley, and J.K. Summers. 1998. Distribution of total mercury and methyl mercury in water, sediment, and fish from South Florida estuaries. Archives of Environmental Contamination and Toxicology.34:109–118.

Kiviat, E. and K. MacDonald. 2002. Hackensack Meadowlands, New Jersey, Biodiversity: A Review and Synthesis. Hudsonia Ltd. August 8.

Konsevick, E. 1988. Mercury Concentrations in Surface Waters of Berry’s Creek, Collected by The Hackensack Meadowlands Development Commission Environmental Operations Laboratory, March 1987 through January 1988.

Konsevick, E. 1989. Berry’s Creek Mercury in Aquatic Biota Data Summary. Hackensack Meadowlands Development Commission Environmental Operations Research Laboratory. October.

Konsevick, E. and A.B. Bragin. 2007. Chemical Characteristics of Sediment Collected as Part of the Fishery Resource Inventory of the lower Hackensack River within the Hackensack Meadowlands District. A Comparative Study 2001-2003 and 1987-1988. New Jersey Meadowlands Commission Meadowlands Environmental Research Institute.

Lake, C.A., J.L. Lake, R. Haebler, R. McKinney, W.S. Boothman, and S.S. Sadove. 1995. Contaminant levels in harbor seals from the northeastern United States. Arch Environ Contam Toxicol 29 (1):128-134.

Lasorsa, B. and S. Allen-Gil. 1995. The methylmercury to total mercury ratio in selected marine, freshwater, and terrestrial organisms. Water, Air, & Soil Pollution 80:905-913.

Lipsky, D. and P. Galuzzi. 1982. The Investigation of Mercury Contamination in the Vicinity of Berry’s Creek.

Lipsky, D., R.J. Reed, and R. Harkov. 1980. Mercury Levels in Berry’s Creek. New Jersey Department of Environmental Protection, Office of Cancer and Toxic Substances Research.

Long, E.R., D.D. Morgan, S.L. Smith, and F.D. Calder. 1995. Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. Environmental Management 19 (1):81-97.

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. New Jersey Audubon Society, Bernardsville, New Jersey. November 28.

National Library of Medicine. 2011. TOXNET (Toxicology Data Network) HSDB (Hazardous Substances Data Bank). Bethesda, Maryland. Available at: http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB. Accessed 16 March 2012.

New Jersey Mercury Task Force. 2002. New Jersey Mercury Task Force Report Volume II. Exposure and Impacts. Available at: http://www.state.nj.us/dep/dsr/mercury_task_force.htm#Volume%20II:%20Exposure%20and%20Impacts. Accessed 15 March 2012.

New York/New Jersey Harbor & Estuary Program. 2012. CARP - Contaminant Assessment and Reduction Project. Program Objectives. Available at: http://www.carpweb.org/main.html. Accessed 1 June, 2012.

NJDEP. 1985. Interoffice Summary of Berry's Creek Biota Database 1983 (Bruce Ruppel); Including Water and Sediment Monitoring Data of November, 1981. Cited in ERM-Southeast Inc. 1985.

NJDEP. 2006a. Marine Fish of New Jersey. New Jersey Department of Environmental Protection, Trenton, New Jersey. Available at: http://www.state.nj.us/dep/fgw/chkfishmarine.htm. Accessed 15 March, 2012.

NJDEP. 2006b. Superfund Record of Decision: Ventron/Velsicol Site, Wood-Ridge and Carlstadt, Bergen County, New Jersey. New Jersey Department of Environmental Protection.

NJDEP. 2009. Ecological Screening Criteria. New Jersey Department of Environmental Protection, Trenton, New Jersey. Available at: http://www.nj.gov/dep/srp/guidance/ecoscreening/esc_table.pdf. Accessed 15 March, 2012.

NJDEP. 2010. Ground Water Quality Standards. New Jersey Administrative Code Chapter 7:9C. New Jersey Department of Environmental Protection, Trenton, New Jersey. Available at: http://www.nj.gov/dep/rules/rules/njac7_9c.pdf. Accessed 15 March 2012.

NJDEP. 2011. Surface Water Quality Standards. New Jersey Administrative Code Chapter 7:9B. New Jersey Department of Environmental Protection, Trenton, New Jersey. Available at: http://www.nj.gov/dep/standards/surface%20water.pdf. Accessed 23 March, 2012.

NJDEP. 2012a. Birds of New Jersey. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Trenton, New Jersey. Available at: http://www.state.nj.us/dep/fgw/chkbirds.htm. Accessed 15 March, 2012.

NJDEP. 2012b. New Jersey's Endangered and Threatened Wildlife. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Trenton, New Jersey. Available at: http://www.state.nj.us/dep/fgw/tandespp.htm#pdf. Accessed 15 March, 2012.

NJDEP. 2012c. NJ Endangered and Nongame Species Program Special Concern – Species Status Listing. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Trenton, New Jersey. Available at: http://www.njfishandwildlife.com/ensp/pdf/spclspp.pdf. Accessed 15 March, 2012.

NJDEP and NJDHSS. 2012. Fish Smart, Eat Smart - A Guide to Health Advisories for Eating Fish and Crabs Caught in New Jersey Waters. New Jersey Department of Environmental Protection and New Jersey Department of Health and Senior Services, Trenton, New Jersey. Available at: http://www.state.nj.us/dep/dsr/2012-advisory-report.pdf. Accessed 3 May, 2012.

NJDEP, USFWS, and USEPA. 2001. Derivation of New Jersey-specific Wildlife Values as Surface-Water Quality Criteria for: PCBs, DDT, Mercury. New Jersey Department of Environmental Protection, U.S Fish and Wildlife Service, and U.S. Environmental Protection Agency.

NJDFW. 2012. Summary of New Jersey Division of Fish and Wildlife, Marine Fisheries Administration, Commercial Regulations. March 13. Available at: http://www.state.nj.us/dep/fgw/pdf/2012/comregs12.pdf. Accessed 8 May, 2012.

NJMC. 2004. NJMC Master Plan. New Jersey Meadowlands Commission, Lyndhurst, New Jersey.

NJMC. 2010a. Hackensack Meadowlands District Open Space Map. Available at: http://meri.njmeadowlands.gov/downloads/gis/maps/OpenSpace_WebMap_District_11x17_Portrait.pdf. Accessed April 19, 2013.

NJMC. 2010b. Seal Seen in Hackensack River at Carlstadt. Meadowlands Nature Blog, New Jersey Meadowlands Commission, April 26. Available at: http://www.meadowblog.net/2010/04/seal-seen-in-hackensack-river-at-carlstadt.html. Accessed January 17, 2012.

NJMC. 2011. Rare Seal Sighting Along the Hackensack River. Meadowlands Nature Blog, March 4. Available at: http://www.meadowblog.net/2011/03/rare-seal-sighting-along-the-hackensack-river.html. Accessed January 17, 2012.

NMFS. 2011a. Essential Fish Habitat Mapper v2.0. National Marine Fisheries Service. Available at: http://www.habitat.noaa.gov/protection/efh/habitatmapper.html. Accessed 15 March, 2012.

NMFS. 2011b. Summary of Essential Fish Habitat and General Habitat Parameters for Federally Managed Species. National Marine Fisheries Service. Available at: http://www.nero.noaa.gov/hcd/efhtables.pdf. Accessed 15 March, 2012.

NMFS. 2012. Proactive Conservation Program: Species of Concern & Candidate Species. National Marine Fisheries Service. February. Available at: http://www.nmfs.noaa.gov/pr/species/concern/#list. Accessed 15 March, 2012.

Quinn, J.R. 1997. Fields of Sun and Grass: An artist's journal of the New Jersey Meadowlands. Rutgers University Press, New Brunswick, New Jersey.

Raymond, B. and R. Rossmann. 2009. Total and methyl mercury accumulation in 1994–1995 Lake Michigan lake trout and forage fish. Journal of Great Lakes Research 35 (3):438-446.

Scheuhammer, A.M., M.W. Meyer, M.B. Sandheinrich, and M.W. Murray. 2007. Effects of environmental methylmercury on the health of wild birds, mammals, and fish. Ambio 36 (1):12-18.

Senneke, D. 2006. Declared Turtle Trade From the United States. Chelonia World Trust, Vacaville, CA. Available at: http://www.chelonia.org/articles/us/usmarketintropage.htm. Accessed 10 May 2012.

Stevens Institute of Technology. 2007. The New Jersey Toxics Reduction Workplan for NY-NJ Harbor: Ambient Monitoring of Water Quality within Major Tributaries & the Estuary, Studies I-D and I-E. Final Report, April.

TAMS Consultants Inc. 1985. Anderson Marsh Wetlands Management Study. April.

TAMS Consultants Inc. 2001a. Riverbend Wetland Preserve: Sampling and Analysis of Sediment. June. Prepared by TAMS Consultants Inc. for the Hackensack Meadowlands Development Commission.

TAMS Consultants Inc. 2001b. Secaucus High School Wetlands Mitigation Site Baseline Studies: Sampling and Analysis of Surface Water and Sediment. Meadowlands Environmental Research Institute. March. Available at: http://meri.njmeadowlands.gov/ecorisk/secaucus/. Accessed 15 March, 2012.

The Louis Berger Group Inc. 2001. Oritani Marsh Mitigation Site - Baseline Studies. February. Available at: http://meri.njmeadowlands.gov/ecorisk/oritani/. Accessed 27 March, 2012.

Tsipoura, N., J. Burger, and M. Newhouse. 2009. Contaminant Levels and their Effects in Birds Breeding in the Hackensack Meadowlands. A Final Report Submitted to the New Jersey Meadowlands Commission. December 14.

USACE and USEPA. 2005. Draft Framework Document, Berry's Creek Study Area, Bergen County, New Jersey. Prepared by Malcolm Pirnie, Inc., Fair Lawn, New Jersey for U.S. Army Corps of Engineers, New York District, New York, NY, and U.S. Environmental Protection Agency, Region 2, New York, NY. June.

USEPA. 1990. EPA Superfund Record of Decision: Scientific Chemical Processing. EPA ID# NJD070565403, OU1 Carlstadt, New Jersey. Available at: http://www.epa.gov/superfund/sites/rods/fulltext/r0290109.pdf. Accessed 15 March, 2012.

USEPA. 1993. EPA Superfund Record of Decision: Universal Oil Products (Chemical Division). EPA ID# NJD002005106, OU1. East Rutherford, New Jersey. U.S. Environmental Protection Agency. Available at: http://www.epa.gov/superfund/sites/rods/fulltext/r0293206.pdf. Accessed 15 March 2012.

USEPA. 1997. Mercury Study Report to Congress. U.S. Environmental Protection Agency, Washington, D.C. EPA-452/R-97-003.

USEPA. 1999a. EPA Superfund Explanation of Significant Difference: Universal Oil Products (Chemical Division). EPA ID# NJD002005106, OU1, East Rutherford, New Jersey. U.S. Environmental Protection Agency. Available at: http://www.epa.gov/superfund/sites/rods/fulltext/e0299122.pdf. Accessed 15 March, 2012.

USEPA. 1999b. EPA Superfund Record of Decision Amendment: Universal Oil Products (Chemical Division). EPA ID# NJD002005106, OU 01. East Rutherford, New Jersey. U.S. Environmental Protection Agency. EPA/AMD/R02-99/516.

USEPA. 2001. Human Health Criteria – Methylmercury Fish Tissue Criterion. U.S. Environmental Protection Agency. EPA-823-R-01-001. January. Available at: http://water.epa.gov/scitech/swguidance/standards/criteria/aqlife/pollutants/methylmercury/upload/2009_01_15_criteria_methylmercury_mercury-criterion.pdf. Accessed 15 March, 2012.

USEPA. 2002. EPA Superfund Record of Decision: Scientific Chemical Processing. EPA ID# NJD070565403, OU2, Carlstadt, New Jersey. U.S. Environmental Protection Agency. Available at: http://www.epa.gov/superfund/sites/rods/fulltext/r0202011.pdf. Accessed 15 March, 2012.

USEPA. 2005. Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: Metal Mixtures (Cadmium, Copper, Lead, Nickel, Silver, and Zinc). U.S. Environmental Protection Agency, Washington, D.C. EPA-600-R-02-011.

USEPA. 2006. Second Five-Year Review Report, Universal Oil Products Superfund Site, East Rutherford, Bergen County, New Jersey. U.S. EPA Region 2, New York, NY. Available at: http://www.epa.gov/superfund/sites/fiveyear/f2006020001197.pdf. Accessed 19 March, 2012.

USEPA. 2007. Scientific Chemical Processing, New Jersey NPL Site fact sheet. EPA ID# NJD070565403. U.S. Environmental Protection Agency Region 2 Superfund Program, New York, NY. Available at: http://www.epa.gov/region02/superfund/npl/0200431c.pdf. Accessed 19 March, 2012.

USEPA. 2008a. Administrative Settlement Agreement and Order on Consent for Remedial Investigation and Feasibility Study Berry's Creek Study Area. U.S. Environmental Protection Agency. USEPA Index Number II-CERCLA-2008-2011.

USEPA. 2008b. Framework for the Application of the Toxic Equivalence Methodology for Polychlorinated Dioxins, Furans, and Biphenyls in Ecological Risk Assessment. U.S. Environmental Protection Agency. EPA 100/R-08/004. June.

USEPA. 2009. National Recommended Water Quality Criteria. U.S. Environmental Protection Agency Office of Water, Office of Science and Technology.

USEPA. 2011a. Scientific Chemical Processing, Carlstadt, New Jersey. U.S. Environmental Protection Agency. Available at: http://www.epa.gov/region2/superfund/npl/scientificchemical/. Accessed 19 March, 2012.

USEPA. 2011b. Universal Oil Products, NPL Site fact sheet. EPA ID# NJD002005106. U.S. Environmental Protection Agency Region 2 Superfund Program, New York, NY. Available at: http://www.epa.gov/region02/superfund/npl/0200101c.pdf. Accessed 19 March, 2012.

USEPA. 2011c. Ventron/Velsicol, New Jersey NPL Site Fact Sheet. EPA ID#: NJD980529879. U.S. EPA Region 2 Superfund Program, U.S. Environmental Protection Agency, New York, NY. Available at: http://www.epa.gov/region02/superfund/npl/0200674c.pdf. Accessed 19 March, 2012.

USEPA. 2012a. Fish Consumption Advisories. U.S. Environmental Protection Agency. Available at: http://water.epa.gov/scitech/swguidance/fishshellfish/fishadvisories/. Accessed May 3, 2012.

USEPA. 2012b. Mercury Basic Information. Last updated 2 May 2007. U.S. Environmental Protection Agency. Available at: http://www.epa.gov/hg/about.htm. Accessed 19 March, 2012.

USEPA and USACE. 2009. Berry's Creek Study Area Remedial Investigation and Feasibility Study Community Involvement Plan. Prepared by Malcolm Pirnie, Inc., Fairlawn, New Jersey for U.S. Environmental Protection Agency and U.S. Army Corps of Engineers. May.

USFDA. 2009. Inspections, Compliance, Enforcement, and Criminal Investigations; CPG Section 540.600. Fish, Shellfish, Crustaceans and other Aquatic Animals - Fresh, Frozen or Processed - Methyl Mercury. U.S. Food and Drug Administration. Available at: http://www.fda.gov/ICECI/ComplianceManuals/CompliancePolicyGuidanceManual/ucm074510.htm.

USFWS. 1997. Significant Habitats and Habitat Complexes of the New York Bight Watershed. U.S. Fish and Wildlife Service Southern New England-New York Bight Coastal Ecosystems Program, Charlestown, RI. November. Available at: http://training.fws.gov/library/pubs5/web_link/text/ec_app1.htm. Accessed 15 March, 2012.

USFWS. 2005. Planning Aid Report, Hackensack Meadowlands Ecosystem Restoration Project, Bergen and Hudson Counties, New Jersey. U.S. Fish and Wildlife Service New Jersey Field Office, Pleasantville, New Jersey. November.

USFWS. 2007. The Hackensack Meadowlands Initiative: Preliminary Conservation Planning. U.S. Fish and Wildlfe Service New Jersey Field Office, Pleasantville, New Jersey.

USFWS. 2011. Endangered and Threatened Wildlife and Plants; 90-Day Finding on a Petition To List the American Eel as Threatened. U.S. Fish and Wildlife Service. Federal Register Volume 76, Number 189. September 29. Available at: http://www.gpo.gov/fdsys/pkg/FR-2011-09-29/pdf/2011-25084.pdf.

van den Berg, M., L. Birnbaum, A.T.C. Bosveld, B. Brunstrom, P. Cook, M. Feeley, J.P. Giesy, A. Hanberg, R. Hasegawa, S.W. Kennedy, T. Kubiak, J.C. Larsen, F.X.R. van Leeuwen, A.K.D. Liem, C. Nolt, R.E. Peterson, L. Poellinger, S. Safe, D. Schrenk, D. Tillitt, M. Tysklind, M. Younes, F. Waern, and T. Zacharewski. 1998. Toxic equivalency factors (TEFs) for PCBs, PCDDs, PCDFs for humans and wildlife. Environmental Health Perspectives 106 (12):775-792.

van den Berg, M., L.S. Birnbaum, M. Denison, M. De Vito, W. Farland, M. Feeley, H. Fiedler, H. Hakansson, A. Hanberg, L. Haws, M. Rose, S. Safe, D. Schrenk, C. Tohyama, A. Tritscher, J. Tuomisto, M. Tysklind, N. Walker, and R.E. Peterson. 2006. The 2005 World Health Organization re-evaluation of human and mammalian toxic equivalency factors for dioxins and dioxin-like compounds. Toxicological Sciences 93 (2):223-241.

Washington State Department of Ecology and Washington State Department of Health. 2003. Washington State Mercury Chemical Action Plan. Department of Ecology Publication No. 03-03-001. Department of Health Publication No. 333-051. Available at: http://www.ecy.wa.gov/pubs/0303001.pdf. Accessed 19 March, 2012.

Weis, J.S. 2002. Tolerance to environmental contaminants in the mummichog, *Fundulus heteroclitus*. Human and Ecological Risk Assessment: An International Journal 8 (5):933-953.

Weis, J.S., J. Samson, T. Zhou, J. Skurnick, and P. Weis. 2001. Prey capture ability of mummichogs (*Fundulus heteroclitus*) as a behavioral biomarker for contaminants in estuarine systems. Canadian Journal of Fisheries and Aquatic Sciences 58 (7):1442-1452.

Weis, P. 2005. Contaminants in Fish of the Hackensack Meadowlands (3.0). Report presented to Meadowlands Environmental Research Institute. January.

Wilson, T.P. and J.L. Bonin. 2007. Concentrations and Loads of Organic Compounds and Trace Elements in Tributaries to Newark and Raritan Bays, New Jersey. U.S. Geological Survey. Scientific Investigations Report 2007-5059. 176 p.

Wirgin, I., J.S. Weis, and A.E. McElroy. 2006. Physiological and genetic aspects of toxicity in Hudson River species. Pages 441-464 *in* Levinton, J.S. and Waldman J.R., eds. The Hudson River Estuary. Cambridge University Press, New York.

Wolfe, M.F., S. Schwarzbach, and R.A. Sulaiman. 1998. Effects of mercury on wildlife: A comprehensive review. Environmental Toxicology and Chemistry 17 (2):146–160.

FIGURES

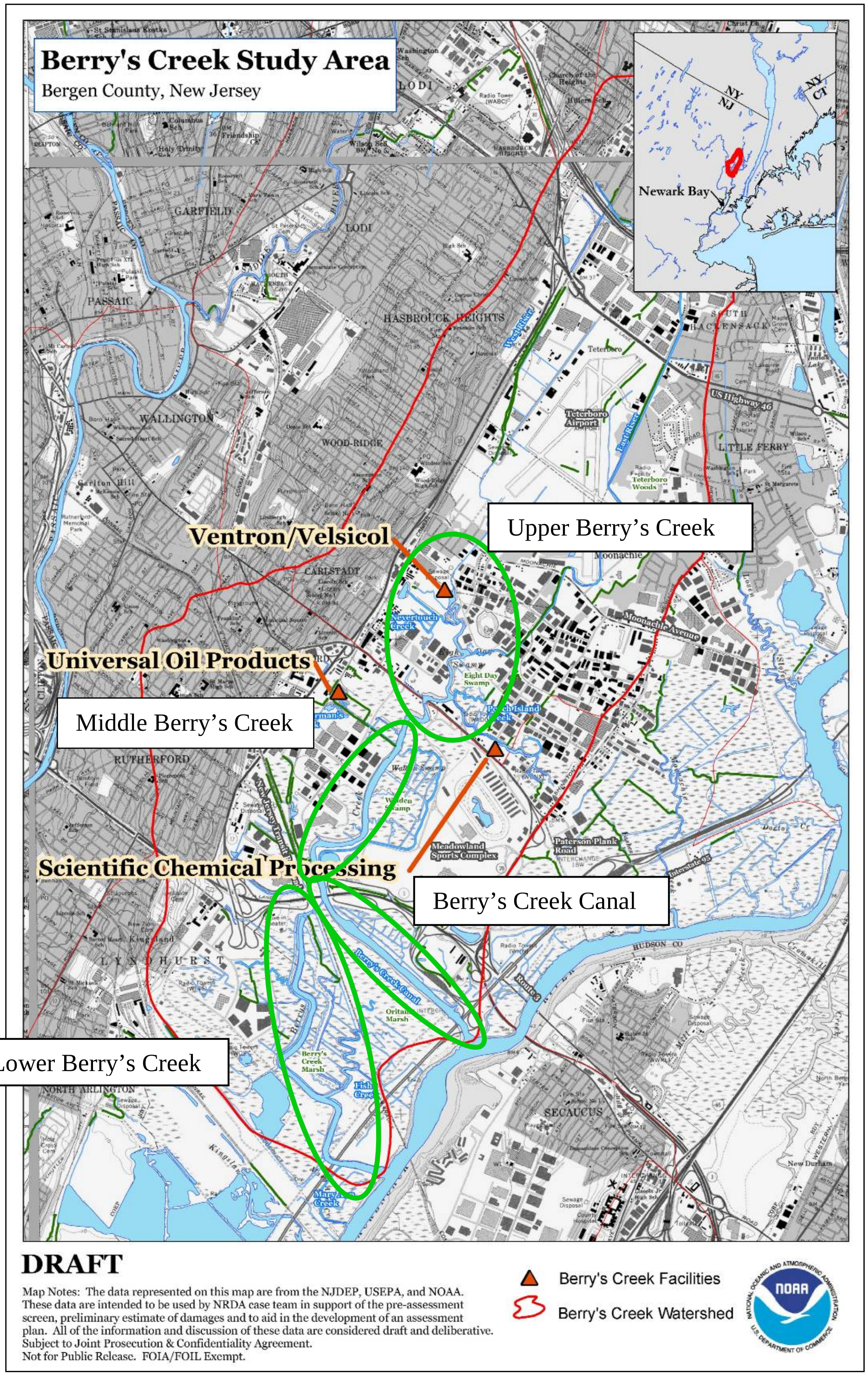

Figure 1: Map of Berry's Creek Watershed. The Watershed boundary is used to delineate the Berry's Creek Study Area being evaluated for remedial actions by the U.S.EPA. Green outlines indicate the approximate sampling areas of the BCSA defined in Geosyntec Consultants *et al.* (2010).

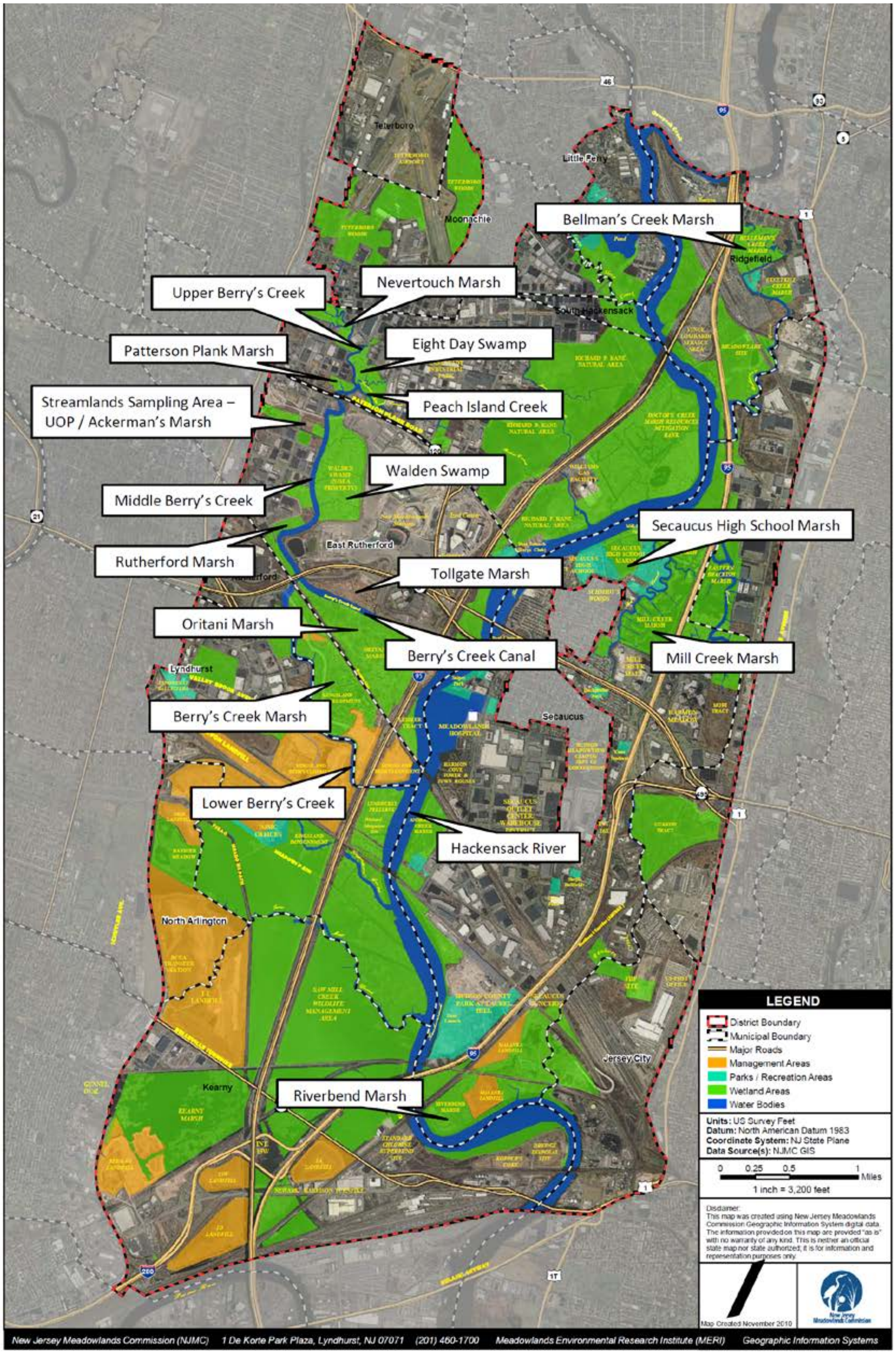

Figure 2. Swamps and Marshes of the Hackensack Meadowlands. Includes areas sampled during the BCSA and UOP Remedial Investigations. Adapted from NJMC (2010a).

the BCSA (Bonin and Wilson 2006; Stevens Institute of Technology 2007; Wilson and Bonin 2007).

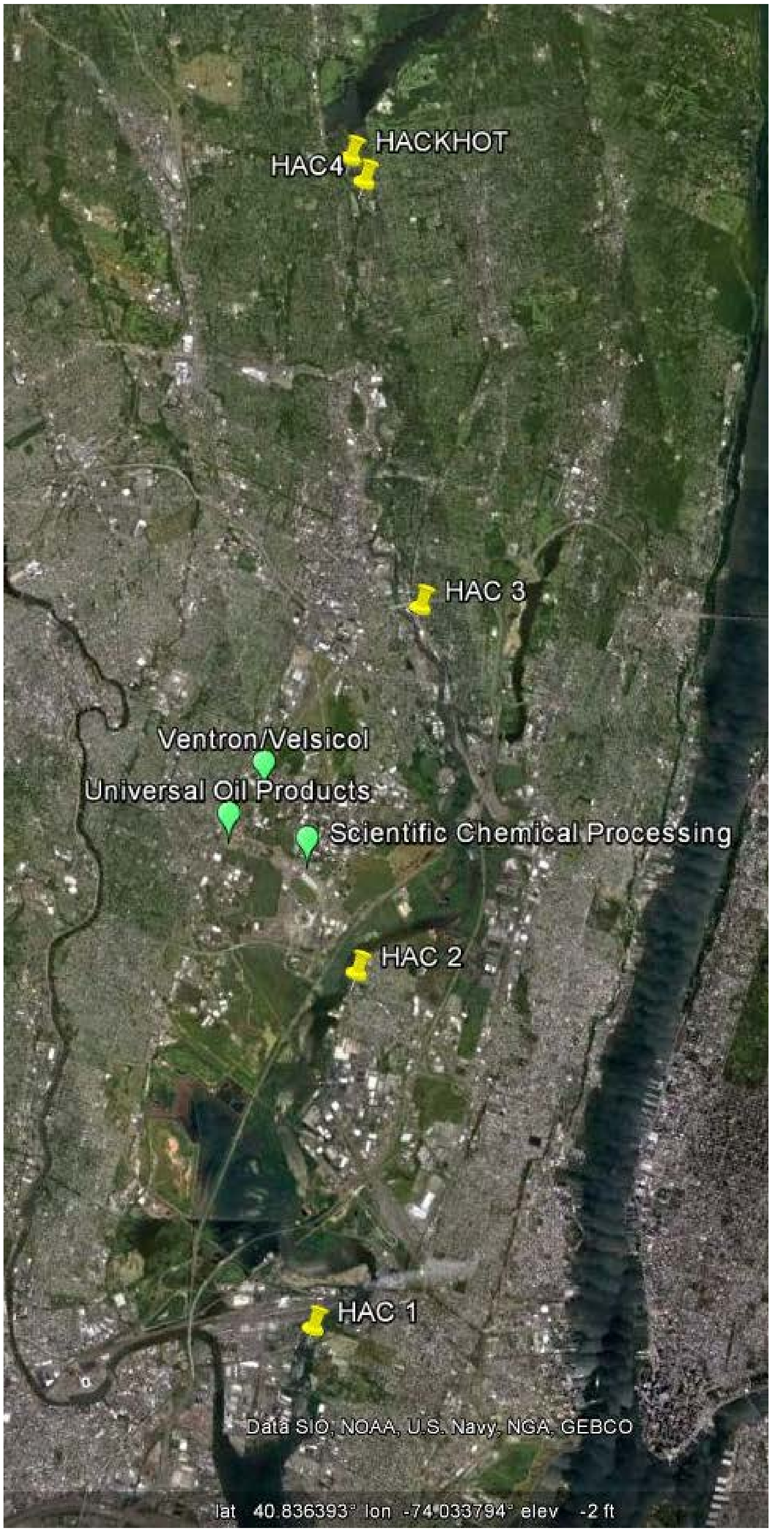

Figure 3. Locations Along the Hackensack River Sampled as Part of the Contaminant Assessment and Reduction Project (CARP) in Relation to Superfund Sites Located Within the BCSA (Bonin and Wilson 2006; Stevens Institute of Technology 2007; Wilson and Bonin 2007).

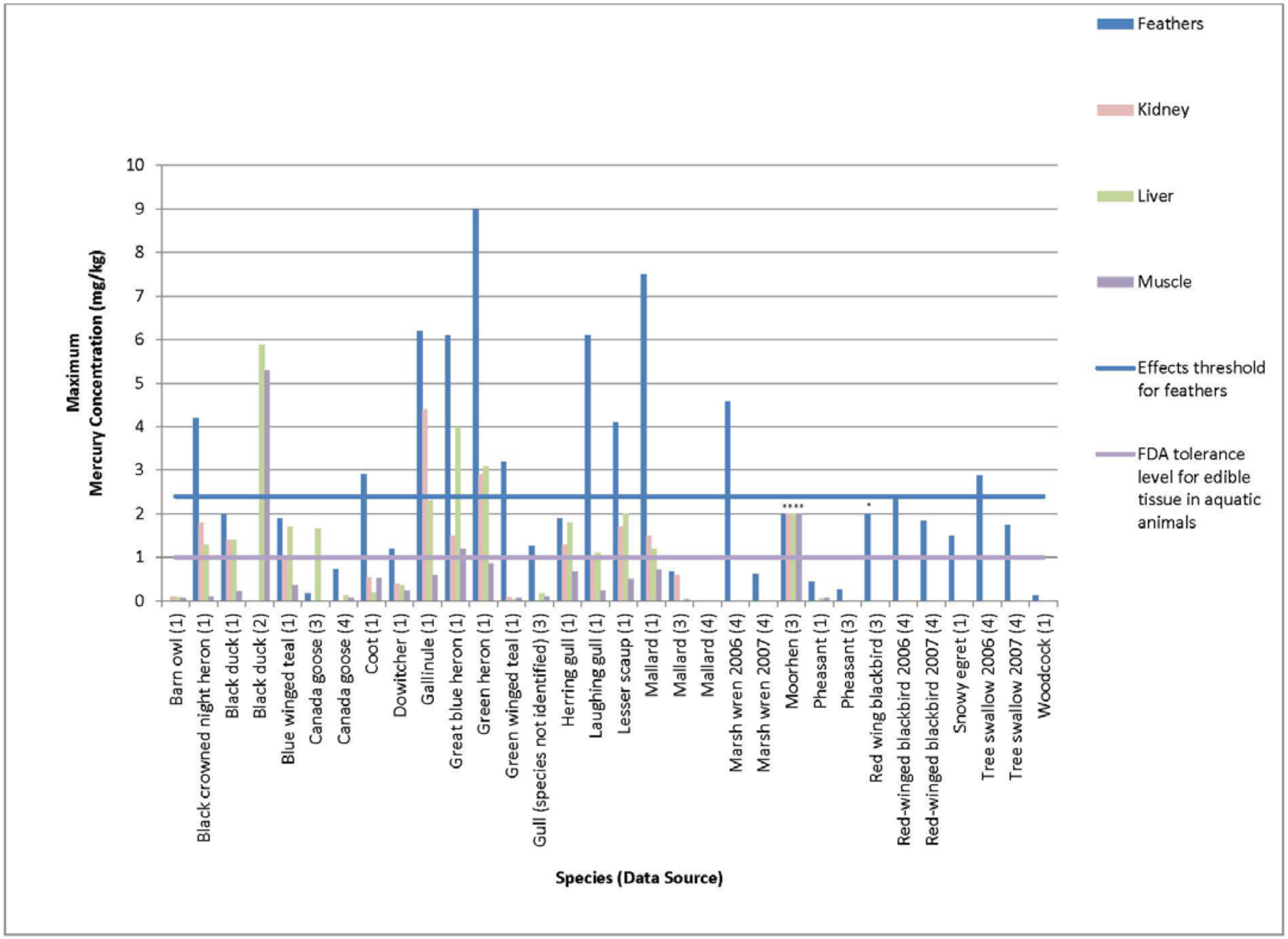

Figure 4. Maximum Mercury Concentrations Measured in Birds from the Meadowlands. The effects threshold for feathers is based on a 10% reduction in reproductive success in Carolina wrens and the correlation between blood and body feather concentrations (Jackson *et al.* 2011). The FDA tolerance level is for consumption of methylmercury in edible tissues of aquatic organisms (CPG Section 540.600; USFDA 2009). Asterisks reflect measured concentrations reported as “>” values; actual concentrations may be higher. Data sources are (1) HMDC (1978a); (2) NJDEP (1985) (as cited in ERM-Southeast Inc. 1985); (3) HMDC (1987a); and (4) Tsipoura *et al.* (2009).

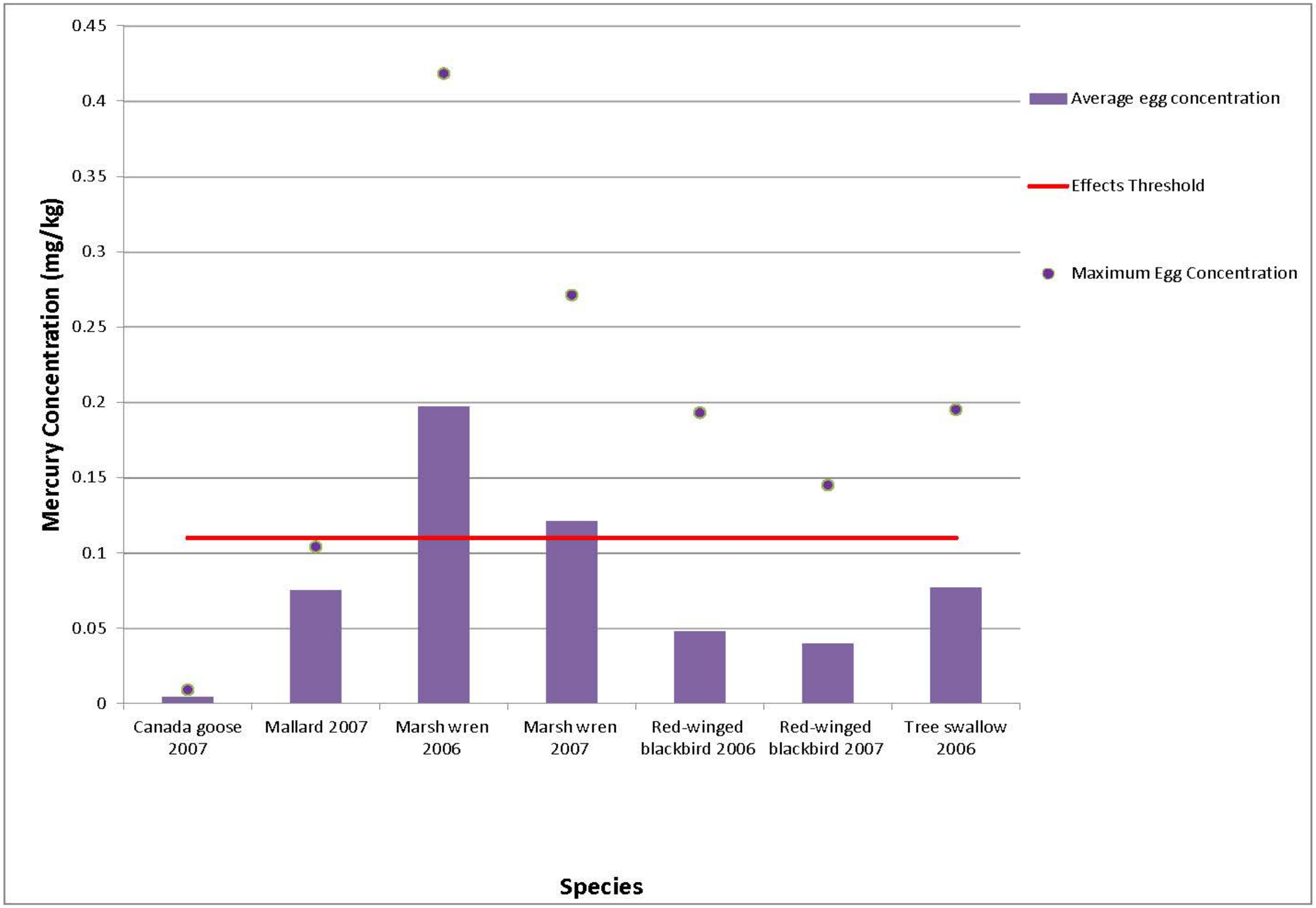

Figure 5. Average and Maximum Mercury Concentrations in Eggs of Birds from the Meadowlands. The effects threshold for eggs is based on a 10% reduction in reproductive success in Carolina wrens (Jackson *et al.* 2011). Data are from Tsipoura *et al.* (2009).

TABLES

Table 1. Maximum Measured Concentrations of Selected Contaminants of Concern in Groundwater in the Vicinity of the BCSA.

Compound	Maximum Concentration (µg/L)	Source	NJ GWQC (µg/L)[1]
Arsenic	3,100	2	3
Lead	280	3	5
Mercury (total, dissolved)	4,100	3	2
PCBs (total)	17,000	2	0.5
Trichloroethene	2,800	2	1
VOCs (total)	210,000	4	NC

[1] Criteria from NJDEP (2010). The practical quantitation limit (PQL) is listed if it is higher than the NJDEP criterion.
[2] Data from USEPA (2002)
[3] Data from USACE and USEPA (2005)
[4] Data from USEPA (2006)
BCSA: Berry's Creek Study Area
NJ GWQC: New Jersey Groundwater Quality Criterion
µg/L: micrograms per liter
NC: No criterion
PAHs: polycyclic aromatic hydrocarbons
PCBs: polychlorinated biphenyls
VOCs: volatile organic compounds
Numbers exceed water quality criterion

Table 2. Concentrations of Selected Contaminants in Surface Water in the Vicinity of the BCSA.

Sampling Period	Contaminant	Area	Maximum Concentration (µg/L)	Minimum Concentration (µg/L)	Average Concentration[a] (µg/L)	Acute Criterion[1] marine (µg/L)	Acute Criterion[1] fresh (µg/L)	Chronic Criterion[1] marine (µg/L)	Chronic Criterion[1] fresh (µg/L)	Wildlife Criterion[2] (µg/L)
1990-1999[3]	Cadmium[b]	Not Stated	8.2	0.44	1.97	40[c]	2.0[c,d]	8.8[c]	0.25[c,d]	NC
2009[4]	Cadmium[b]	BCSA	2.1	NR	0.601					
	Cadmium[c]		1.2	NR	0.518					
2010[5]	Cadmium[b]	Streamlands - UOP	ND	ND	ND					
	Cadmium[c]		ND	ND	ND					
	Cadmium[b]	Mill Creek	ND	ND	ND					
	Cadmium[c]		ND	ND	ND					
	Cadmium[b]	UBC/PI Stations/8 Day Swamp	ND	ND	ND					
	Cadmium[c]		ND	ND	ND					
1985-1987[6]	Chromium	Peach Island Creek	56	ND	42	NC[f] /1100[c,g]	570[c,d,f] / 15[c,g]	NC[f] / 50[c,g]	74[c,d,f] / 10[c,g]	NC
1990-1999[3]	Chromium[b,e]	Not Stated	145	1.2	12.4					
2009[4]	Chromium[b,e]	BCSA	23.6	NR	8.22					
	Chromium[c,e]		11.1	NR	1.94					
2010[5]	Chromium[b,e]	Streamlands - UOP	114	ND	17					
	Chromium[c,e]		ND	ND	ND					
	Chromium[b,e]	Mill Creek	16.8	ND	12.5					
	Chromium[c,e]		ND	ND	ND					
	Chromium[b,e]	UBC/PI Stations/8 Day Swamp	ND	ND	ND					
	Chromium[c,e]		ND	ND	ND					
1985-1987[6]	Copper	Peach Island Creek	100	2.1	39.6	4.8[b]	12.3[b,c]	3.1[b]	8.5[b,c]	NC
1990-1999[3]	Copper	Not Stated	104	2	12.1					
2009[4]	Copper[b]	BCSA	55.5	NR	8.87					
	Copper[c]		36	NR	3.32					
2010[5]	Copper[b]	Streamlands	72	ND	37					
	Copper[c]		ND	ND	ND					
	Copper[b]	Mill Creek	34.7	ND	31.8					
	Copper[c]		ND	ND	ND					
	Copper[b]	UBC/PI Stations/8 Day Swamp	30.7	21.5	27					
	Copper[c]		ND	ND	ND					
1990-1999[3]	Lead[b]	Not Stated	119	1.2	10.4	210[c]	38[c]	24[c]	5.4[c]	NC
2009[4]	Lead[b]	BCSA	12.6	NR	5.61					
	Lead[c]		1.9	NR	0.81					
2010[5]	Lead[b]	Streamlands - UOP	33	ND	6					
	Lead[c]		ND	ND	ND					
	Lead[b]	Mill Creek	9.8	ND	7.2					
	Lead[c]		ND	ND	ND					
	Lead[b]	UBC/PI Stations/8 Day Swamp	ND	ND	ND					
	Lead[c]		ND	ND	ND					

Table 2, continued. Concentrations of Selected Contaminants in Surface Water in the Vicinity of the BCSA.

Sampling Period	Contaminant	Area	Maximum Concentration (µg/L)	Minimum Concentration (µg/L)	Average Concentration[a] (µg/L)	Acute Criterion[1] marine (µg/L)	Acute Criterion[1] fresh (µg/L)	Chronic Criterion[1] marine (µg/L)	Chronic Criterion[1] fresh (µg/L)	Wildlife Criterion[2] (µg/L)
1980-1989[3]	Mercury[b,h]	Not Stated	114	0.003	4.09	1.8[c,h]	1.4[c,h]	0.94[c,h]	0.77[c,h]	0.00053[h]
1985-1987[6]	Mercury	Peach Island Creek	12	0.96	4.72					
1990-1999[3]	Mercury[b,h]	Not Stated	17.6	0.4	2.77					
2009[4]	Mercury[b,h]	BCSA	3820	NR	577					
	Mercury[c,h]		1150	NR	98.9					
2010[5]	Mercury[b,h]	Streamlands - UOP	5.6	ND	1.5					
	Mercury[c,h]		0.21	ND	NA					
	Mercury[b,h]	Mill Creek	ND	ND	ND					
	Mercury[c,h]		ND	ND	ND					
	Mercury[b,h]	UBC/PI Stations/8 Day Swamp	ND	ND	ND					
	Mercury[c,h]		ND	ND	ND					
1985-1987[6]	Nickel	Peach Island Creek	57	ND	32.3	470	52	74	8.2	NC
2009[4]	Nickel[b]	BCSA	30.1	NR	4.52					
	Nickel[c]		28.4	NR	3.52					
2010[5]	Nickel[b]	Streamlands	14.7	ND	10.7					
	Nickel[c]		12.9	ND	10.4					
1985-1987[6]	Zinc	Peach Island Creek	370	87	192	120	120	90	81	NC
2009[4]	Zinc[b]	BCSA	65.9	NR	30.1					
	Zinc[c]		64	NR	14.7					
2010[5]	Zinc[b]	Streamlands	127	ND	37.6					
	Zinc[c]		63.4	ND	29..2					
2009[4]	Aroclor 1242[b]	BCSA	ND	NR	ND	NC	NC	0.03[i]	0.014[i]	0.000072[i]
	Aroclor 1242[c]		ND	NR	ND					
2009[4]	Aroclor 1248[b]	BCSA	0.12	NR	0.00348	NC	NC	0.03[i]	0.014[i]	0.000072[i]
	Aroclor 1248[c]		ND	NR	ND					
2009[4]	Aroclor 1254[b]	BCSA	ND	NR	ND	NC	NC	0.03[i]	0.014[i]	0.000072[i]
	Aroclor 1254[c]		0.052	NR	0.00953					
2009[4]	Aroclor 1260[b]	BCSA	ND	NR	ND	NC	NC	0.03[i]	0.014[i]	0.000072[i]
	Aroclor 1260[c]		ND	NR	ND					
2010[5]	Aroclor 1242	Streamlands	1.6	NR	NR	NC	NC	0.03[i]	0.014[i]	0.000072[i]
	Aroclor 1248		1.5	NR	NR					

[1]Criteria from NJDEP (2011). With the exception of chromium VI and copper (freshwater only) and lead (both fresh water and marine), New Jersey Criteria are the same as USEPA NRWQC (USEPA 2009).
[2]Criteria from NJDEP *et al.* (2001).
[3]Data from USACE and USEPA (2005).
[4]Data from Geosyntec Consultants *et al.* (2010).
[5]Data from CH2MHill (2011).
[6]Data from USEPA (1990).
[a]Averages calculated using either only detected concentrations (USACE and USEPA 2005), 1/2 the detection limit for non-detects (Geosyntec Consultants *et al.* 2010), or the detection limit for non-detects (CH2MHill 2011).
[b]Total / unfiltered (includes dissolved and particulate fractions)
[c]Dissolved fraction / filtered
[d]Hardness dependent. Criterion calculated using a hardness value of 100 mg/kg calcium carbonate ($CaCO_3$).
[e]Total recoverable (includes both trivalent and hexavalent forms)
[f]Chromium III
[g]Chromium VI
[h]Total recoverable (includes both methylmercury and inorganic mercury)
[i]Value for total PCBs
BCSA = Berry's Creek Study Area
UBC = Upper Berry’s Creek
PI = Peach Island
UOP = Universal Oil Products
µg/L = micrograms per liter
NR = not reported
ND = not detected
NC = no criterion
See Figures 1 and 2 for Area Locations.
Numbers are greater than the more stringent of the fresh or marine chronic criterion.

Table 3. Concentrations of Selected Contaminants in Hackensack River Surface Water Measured for the Contaminant Assessment and Reduction Project (CARP).

Sampling Period	Contaminant	Area	Maximum Concentration (µg/L)	Minimum Concentration (µg/L)	Average Concentration[a] (µg/L)	Acute Criterion[1] marine (µg/L)	Acute Criterion[1] fresh (µg/L)	Chronic Criterion[1] marine (µg/L)	Chronic Criterion[1] fresh (µg/L)	Wildlife Criterion[2] (µg/L)
2000-2002[3]	Cadmium[b]	HR 0.5 mi N of confluence w/ NB (HAC1)	0.157	0.0607	0.1035					
	Cadmium[d]	HR 0.5 m. N of confluence w/ NB (HAC1)	0.204	0.0883	0.1345					
	Cadmium[b]	HR near Meadowlands Pkwy, Secaucus (HAC2)	0.171	0.0499	0.1048					
	Cadmium[d]	HR near Meadowlands Pkwy, Secaucus (HAC2)	0.185	0.105	0.1363					
	Cadmium[b]	HR at Bergen Turnpike (HAC3)	0.0556	0.0293	0.0405					
	Cadmium[d]	HR at Bergen Turnpike (HAC3)	0.243	0.118	0.1553	40[b]	2.0[b,c]	8.8[b]	0.25[b,c]	NC
2000-2002[4]	Cadmium[b,e]	HR (Head of Tide- freshwater)	0.0048	0.0045	0.0047					
	Cadmium[d,e]	HR (Head of Tide- freshwater)	0.0103	0.0045	0.0074					
	Cadmium[d,f]	HR (Head of Tide- freshwater)	0.005	0.005	NA					
	Cadmium[b,e]	HR (Head of Tide- tidal)	0.0378	0.0378	NA					
	Cadmium[d,e]	HR (Head of Tide- tidal)	0.0538	0.0538	NA					
	Cadmium[d,f]	HR (Head of Tide- tidal)	0.116	0.116	NA					
2000-2002[3]	Lead[b]	HR 0.5 mi N of confluence w/ NB (HAC1)	0.752	0.138	0.332					
	Lead[d]	HR 0.5 mi N of confluence w/ NB (HAC1)	5.34	1.68	3.416					
	Lead[b]	HR near Meadowlands Pkwy, Secaucus (HAC2)	2.52	0.453	1.048					
	Lead[d]	HR near Meadowlands Pkwy, Secaucus (HAC2)	5.68	2.02	4.5					
	Lead[b]	HR at Bergen Turnpike (HAC3)	0.916	0.429	0.72					
	Lead[d]	HR at Bergen Turnpike (HAC3)	9.66	6.19	7.965	210[b]	38[b]	24[b]	5.4[b]	NC
2000-2002[4]	Lead[b,e]	HR (Head of Tide - freshwater)	0.028	0.0142	0.0211					
	Lead[d,e]	HR (Head of Tide - freshwater)	0.396	0.298	0.35					
	Lead[d,f]	HR (Head of Tide - freshwater)	0.385	0.385	NA					
	Lead[b,e]	HR (Head of Tide- tidal)	0.509	0.509	NA					
	Lead[d,e]	HR (Head of Tide- tidal)	3.57	3.57	NA					
	Lead[d,f]	HR (Head of Tide- tidal)	1.02	1.02	NA					

Table 3, continued. Concentrations of Selected Contaminants in Hackensack River Surface Water Measured for the Contaminant Assessment and Reduction Project (CARP).

Sampling Period	Contaminant	Area	Maximum Concentration (µg/L)	Minimum Concentration (µg/L)	Average Concentration[a] (µg/L)	Acute Criterion[1] marine (µg/L)	Acute Criterion[1] fresh (µg/L)	Chronic Criterion[1] marine (µg/L)	Chronic Criterion[1] fresh (µg/L)	Wildlife Criterion[2] (µg/L)
2000-2002[3]	Mercury[b,g]	HR 0.5 mi N of confluence w/ NB (HAC1)	0.00086	0.0005	0.00067	1.8[b]	1.4[b]	0.94[b]	0.77[b]	0.00053[d,g]
	Mercury[d,g]	HR 0.5 mi N of confluence w/ NB (HAC1)	0.0622	0.0195	0.0434					
	Mercury[b,g]	HR near Meadowlands Pkwy, Secaucus (HAC2)	0.00542	0.00094	0.00225					
	Mercury[d,g]	HR near Meadowlands Pkwy, Secaucus (HAC2)	0.114	0.0355	0.0797					
	Mercury[b,g]	HR at Bergen Turnpike (HAC3)	0.00246	0.00021	0.00155					
	Mercury[d,g]	HR at Bergen Turnpike (HAC3)	0.387	0.124	0.1908					
2000-2002[4]	Mercury[b,e,g]	HR (Head of Tide - freshwater)	0.00064	0.00049	0.00057					
	Mercury[d,e,g]	HR (Head of Tide - freshwater)	0.00143	0.00117	0.0013					
	Mercury[d,f,g]	HR (Head of Tide - freshwater)	0.00133	0.00133	NA					
	Mercury[b,e,g]	HR (Head of Tide- tidal)	0.00202	0.00202	NA					
	Mercury[d,e,g]	HR (Head of Tide- tidal)	0.0104	0.0104	NA					
	Mercury[d,f,g]	HR (Head of Tide- tidal)	0.0268	0.0268	NA					
2000-2002[3]	Total PCBs[b,h]	HR 0.5 mi N of confluence w/ NB (HAC1)	0.005958	0.002347	0.003489	NC	NC	0.03[i]	0.014[i]	0.000072[i]
	Total PCBs[d,h]	HR 0.5 mi N of confluence w/ NB (HAC1)	0.018607	0.004175	0.01199					
	Total PCBs[b,h]	HR near Meadowlands Pkwy, Secaucus (HAC2)	0.006973	0.003588	0.005517					
	Total PCBs[d,h]	HR near Meadowlands Pkwy, Secaucus (HAC2)	0.029114	0.010304	0.016879					
	Total PCBs[b,h]	HR at Bergen Turnpike (HAC3)	0.004997	0.003269	0.004227					
	Total PCBs[d,h]	HR at Bergen Turnpike (HA 3)	0.030853	0.01784	0.023415					
2000-2002[4]	Total PCBs[b,h]	HR (Head of Tide - freshwater)	0.000896	0.000576	0.000736					
	Total PCBs[d,h]	HR (Head of Tide - freshwater)	0.00193	0.000835	0.0014					
	Total PCBs[b,h]	HR (Head of Tide- tidal)	0.0019	0.0019	NA					
	Total PCBs[d,h]	HR (Head of Tide- tidal)	0.00415	0.00415	NA					

[1]Criteria from NJDEP (2011). With the exception of chromium VI and copper (freshwater only) and lead (both fresh water and marine), New Jersey Criteria are the same as USEPA National Recommended Water Quality Criteria (USEPA 2009).
[2]Criteria from NJDEP *et al.* (2001).
[3]Data from Stevens Institute of Technology (2007). Data are blank-corrected; see source for details.
[4]Data from Wilson and Bonin (2007). Data are blank-corrected; see source for details.
[a]Averages calculated using the detection limit for non-detects (Wilson and Bonin 2007).
[b]Dissolved fraction
[c]Hardness dependent. Criterion calculated using a hardness value of 100 milligrams per kilogram $CaCO_3$.
[d]Total (includes dissolved and particulate fractions)
[e]Discrete grab sample (Wilson and Bonin 2007).
[f]Composite sample collected over hours to days; only total concentrations were measured (Wilson and Bonin 2007).
[g]Total mercury (includes both methylmercury and inorganic mercury).
[h]Calculated as the sum of the individual PCB congeners (Stevens Institute of Technology 2007; Wilson and Bonin 2007).
[i]Value for total PCBs.
µg/L = micrograms per liter
HR = Hackensack River
mi = mile
N = north
NB = Newark Bay
Pkwy = parkway
NC = no criterion
NA = not applicable
See Figure 3 for sampling locations.
Numbers are greater than the more stringent of the respective fresh or marine chronic criterion.

Table 4. Selected Contaminant Data in Surface Sediments[a] in the Vicinity of the BCSA.

Sampling Period	Contaminant	Area	Maximum Concentration (mg/kg)	Minimum Concentration (mg/kg)	Average Concentration[b] (mg/kg)	Screening Levels[1] Marine ERL (mg/kg)	Screening Levels[1] Marine ERM (mg/kg)	Screening Levels[1] Fresh TEC (mg/kg)	Screening Levels[1] Fresh SEL (mg/kg)
1980-1989[2]		UBC	8.2	8.2	NA				
		LBC	167	10.3	72.6				
1990-1999[2]		UBC	99	2.6	26.5				
		LBC	NR	NR	NR				
1997[3]		Mill Creek	ND	ND	ND				
2000-2004[2,4]		UBC	478	4.15	54.9				
		Oritani Marsh	39.3	7.5	20.3				
2000[5]		Secaucus High School Marsh	50	12	20.6				
2001[6]		Riverbend Wetland Preserve	84	ND	16.7				
2003[7]		Hackensack River	22.8	3.58	9.64				
2006-2007[8]		UOP Site	130	ND	32.13				
2009[9]	Arsenic	BCC waterway	38.5	2.3	11	8.2	70	6	33
		LBC waterway	75.1	3.1	13.8				
		MBC waterway	34.2	2.9	12				
		UBC waterway	133	1.5	14.5				
		BCC marshes	24.4	10.6	17				
		LBC marshes	29.7	12.1	19.2				
		MBC marshes	38.8	8.3	20.5				
		UBC marshes	44.8	13.4	23.9				
2010[10]		UOP Streamlands - Channel	146	ND	23.8				
		UOP Streamlands - Marsh	60.1	14.2	27.4				
		Mill Creek	23.1	11.3	15.5				
		UBC/PI Locations/8 Day Swamp	29.6	17.4	24.5				
1980-1989[2]		UBC	123	123	NA				
		LBC	2560	414	1110				
1990-1999[2]		UBC	930	18	241				
		LBC	887	7.26	305				
1997[3]		Mill Creek	545	27.7	268				
2000-2004[2,4]		UBC	9690	16	1260				
		Oritani Marsh	313	19.1	142				
2000[5]		Secaucus High School Marsh	1400	160	496				
2001[6]		Riverbend Wetland Preserve	470	ND	156				
2003[7]		Hackensack River	297	20.6	131				
2006-2007[8]		UOP Site	49,800	33.7	3160				
2009[9]	Chromium (total)	BCC waterway	301	33.1	146	81	370	26	110
		LBC waterway	1030	14	154				
		MBC waterway	1920	17.8	320				
		UBC waterway	4790	8.1	399				
		BCC marshes	293	128	208				
		LBC marshes	451	66.1	263				
		MBC marshes	984	102	421				
		UBC marshes	2480	162	701				
2010[10]		UOP Streamlands - Channel	17,800	28	1891				
		UOP Streamlands - Marsh	3280	282	964				
		Mill Creek	215	151	180.6				
		UBC/PI Locations/8 Day Swamp	646	369	514				

Table 4, continued. Selected Contaminant Data in Surface Sediments[a] in the Vicinity of the BCSA.

Sampling Period	Contaminant	Area	Maximum Concentration (mg/kg)	Minimum Concentration (mg/kg)	Average Concentration[b] (mg/kg)	Screening Levels[1] Marine ERL (mg/kg)	Screening Levels[1] Marine ERM (mg/kg)	Screening Levels[1] Fresh TEC (mg/kg)	Screening Levels[1] Fresh SEL (mg/kg)
1980-1989[2]	Lead	UBC	172	35	86.4	47	218	31	250
		LBC	407	279	343				
1990-1999[2]		UBC	2100	20.5	434				
		LBC	330	17.6	186				
1997[3]		Mill Creek	415	8.7	184				
2000-2004[2,4]		UBC	1470	20	348				
		Oritani Marsh	289	45.1	121				
2000[5]		Secaucus High School Marsh	280	130	211				
2001[6]		Riverbend Wetland Preserve	290	ND	125				
2003[7]		Hackensack River	287	22	130				
2006-2007[8]		UOP Site	617	11.4	204.8				
2009[9]		BCC waterway	159	12.3	82.9				
		LBC waterway	453	9.2	114				
		MBC waterway	326	9.4	92.8				
		UBC waterway	1570	11.2	116				
		BCC marshes	230	101	153				
		LBC marshes	419	70.5	226				
		MBC marshes	646	76.1	259				
		UBC marshes	551	102	273				
2010[10]		UOP Streamlands - Channel	948	5.6	155.5				
		UOP Streamlands - Marsh	936	93.7	316.3				
		Mill Creek	156	65.1	92.9				
		UBC/PI Locations/8 Day Swamp	213	77.8	138.4				
1980-1989[2]	Mercury	UBC	1730	1.16	146	0.15	0.71	0.174	2
		LBC	1490	0.484	65.7				
1990-1999[2]		UBC	11100	0.89	726				
		LBC	1.37	0.31	0.95				
1997[3]		Mill Creek	13.4	0.01	5.16				
2000-2004[2,4]		UBC	868	0.04	127				
		Oritani Marsh	8.9	0.19	3.56				
2000[5]		Secaucus High School Marsh	27	3.5	10.1				
2001[6]		Riverbend Wetland Preserve	4.6	ND	1.86				
2003[7]		Hackensack River	30.8	0.05	3.55				
2006-2007[8]		UOP Site	643	0.57	110.7				
2009[9]		BCC waterway	19.7	0.31	5.72				
		LBC waterway	23	ND	3.51				
		MBC waterway	170	ND	24				
		UBC waterway	1110	0.075	62				
		BCC marshes	9.8	2.8	6.2				
		LBC marshes	38.7	1.1	10.6				
		MBC marshes	75.4	4.7	28.5				
		UBC marshes	221	10	60.6				
2010[10]		UOP Streamlands - Channel	127	ND	21.8				
		UOP Streamlands - Marsh	85.6	10.1	32				
		Mill Creek	3	2.05	2.55				
		UBC/PI Locations/8 Day Swamp	54.7	44.7	50.1				

Table 4, continued. Selected Contaminant Data in Surface Sediments[a] in the Vicinity of the BCSA.

Sampling Period	Contaminant	Area	Maximum Concentration (mg/kg)	Minimum Concentration (mg/kg)	Average Concentration[b] (mg/kg)	Screening Levels[1] Marine ERL (mg/kg)	Marine ERM (mg/kg)	Fresh TEC (mg/kg)	Fresh SEL (mg/kg)
1997[3]		Mill Creek	0.585	ND	0.133				
2000[4]		Oritani Marsh	0.83	ND	0.277				
2000[5]		Secaucus High School Marsh	0.59	ND	0.204				
2001[6]		Riverbend Wetland Preserve	0.25	ND	0.0815				
2006-2007[8]		UOP Site	184	ND	12.2				
2009[9]		BCC waterway	1.5	ND	0.481				
		LBC waterway	1.5	ND	0.344				
	Aroclor 1248	MBC waterway	33	ND	3.56	0.03	NC	0.03	150
		UBC waterway	17	ND	2.4				
		BCC marshes	0.36	0.034	0.213				
		LBC marshes	0.57	ND	0.2				
		MBC marshes	3.1	ND	0.79				
		UBC marshes	6.2	0.13	1.67				
2010[10]		UOP Streamlands - Channel	77.2	ND	12.2				
		UOP Streamlands - Marsh	5.95	ND	1.66				
		Mill Creek	ND	ND	ND				
		UBC/PI Locations/8 Day Swamp	1.59	0.645	1.21				
1997[3]		Mill Creek	ND	ND	ND				
2000[4]		Oritani Marsh	0.18	ND	0.123				
2000[5]		Secaucus High School Marsh	ND	ND	ND				
2001[6]		Riverbend Wetland Preserve	ND	ND	ND				
2006-2007[8]		UOP Site	1.95	ND	0.875				
2009[9]		BCC waterway	0.44	ND	0.206				
		LBC waterway	0.87	ND	0.187				
		MBC waterway	9.1	ND	0.954				
	Aroclor 1254	UBC waterway	5.2	0.0073	0.889	0.06	NC	0.06	34
		BCC marshes	0.29	0.017	0.126				
		LBC marshes	0.33	ND	0.176				
		MBC marshes	2.1	0.06	0.508				
		UBC marshes	3.5	0.056	0.862				
2010[10]		UOP Streamlands - Channel	2.22	ND	0.336				
		UOP Streamlands - Marsh	1.94	ND	0.559				
		Mill Creek	ND	ND	ND				
		UBC/PI Locations/8 Day Swamp	ND	ND	ND				
1997[3]		Mill Creek	ND	ND	ND				
2000[4]		Oritani Marsh	0.34	ND	0.139				
2000[5]		Secaucus High School Marsh	0.14	ND	0.067				
2001[6]		Riverbend Wetland Preserve	0.2	ND	0.061				
2006-2007[8]		UOP Site	0.113	ND	NA				
2009[9]		BCC waterway	0.17	ND	0.0777				
		LBC waterway	0.22	ND	0.0662				
		MBC waterway	2.1	ND	0.2				
	Aroclor 1260	UBC waterway	0.97	ND	0.185	0.005	NC	0.005	24
		BCC marshes	0.098	0.014	0.05				
		LBC marshes	0.23	0.014	0.0921				
		MBC marshes	0.48	0.014	0.272				
		UBC marshes	0.71	0.022	0.172				
2010[10]		UOP Streamlands - Channel	0.147	ND	NA				
		UOP Streamlands - Marsh	0.204	ND	NA				
		Mill Creek	ND	ND	ND				
		UBC/PI Locations/8 Day Swamp	ND	ND	ND				
1990-1999[2]		UBC	31	2.24	15.1				
		LBC	14	3.4	8.7				
2000-2004[2]		UBC	0.111	ND	NA				
		LBC	1.17	0.13	0.515				
2003[7]	Total Aroclors	Hackensack River	0.734	0.027	0.45	0.023	0.18	0.0598	530
2006-2007[8]		UOP Site	184	ND	11.9				
2010[10]		UOP Streamlands - Channel	83.77	0.162	17.45				
		UOP Streamlands - Marsh	8.345	0.431	2.629				
		Mill Creek	0.35	0.305	0.335				
		UBC/PI Locations/8 Day Swamp	2.07	1.015	1.644				

[1]Ecological Screening Levels from NJDEP (2009).
[2]Data from USACE and USEPA (2005).
[3]Data from HMDC (1997).
[4]Data from The Louis Berger Group Inc. (2001).
[5]Data from TAMS Consultants Inc. (2001b).
[6]Data from TAMS Consultants Inc. (2001a).
[7]Data from Konsevick and Bragin (2007).
[8]Data from CH2MHill (2008).
[9]Data from Geosyntec Consultants *et al.* (2010).
[10]Data from CH2MHill (2011).
[a] Surface sediment is from 0-6 inch depth for data from USACE and USEPA (2005), The Louis Berger Group Inc. (2001), CH2MHill (2008), and CH2MHill (2011)); 0-8 inch depth for data from HMDC (1997); and approximately the top 3.5 inches for data from Konsevick and Bragin (2007) (based on PONAR grab sampling methodology). For data from Geosyntec Consultants *et al.* 2010, stream surface sediment is their defined biologically active zone (BAZ) of 0-10 centimeters (cm) in MBC, BCC, and LBC and 0-6 cm in UBC; marsh surface sediment samples are considered to be those from 0-5 cm or 10-15 cm below the marsh surface (samples were not collected between 5-10 cm).
[b]Averages were calculated using the method detection limit for non-detects when the detection limit was reported. If detection limits were not reported, averages were calculated excluding non-detects.
See Figures 1 and 2 for Area Locations.
mg/kg = milligrams per kilogram
BC = Berry's Creek
BCC = Berry's Creek Canal
UBC = Upper Berry's Creek
MBC = Middle Berry's Creek
LBC = Lower Berry's Creek
UOP = Universal Oil Products
PI = Peach Island
ER-L = effects range low
ER-M = effects range median
TEC = threshold effects concentration
SEL = severe effects level
NA = not applicable
NR = not reported
NC = no criterion
ND = not detected
PCBs = polychlorinated biphenyls
cm = centimeters
Numbers are greater than the more stringent of fresh or marine screening guidelines.

Table 5. Species of Concern Potentially Located in the Meadowlands[1].

Natural Resource Category	Species – Common Names
Aquatic Invertebrates	• triangle floater[2], creeper[3]
Amphibians	• Blue spotted salamander[4], Jefferson's salamander[3], marbled salamander[3], Fowler's toad[3], northern spring salamander[3].
Reptiles	• diamondback terrapin[3], eastern box turtle[3], spotted turtle[3], northern copperhead[3], wood turtle[2],
Fish	• summer flounder[5], bluefish[5], winter flounder[5], alewife[6], blueback herring[6], American shad[2], American eel[7].
Birds	• black-crowned night heron[2], American bittern[4], snowy egret[8], great blue heron[3], green heron[8], little blue heron[8], great egret[8], American black duck[8], osprey[2], eastern kingbird[8], gray catbird[8], spotted sandpiper[3,8], greater yellowlegs[8], peregrine falcon[4], bald eagle[4], common loon[8], red-throated loon[8], pied-billed grebe[4], tricolored heron[8], least bittern[4], yellow-crowned night heron[2], glossy ibis[8], northern pintail[8], canvasback[8], greater scaup[8], lesser scaup[8], hooded merganser[8], Cooper's hawk[2], sharp-shinned hawk[3], broad-winged hawk[3,8], red-shouldered hawk[4], northern harrier[4], Virginia rail[8], sanderling[3], red knot[2], semipalmated sandpiper[8], least tern[4], Forster's tern[8], short-eared owl[4], barred owl[2], red-headed woodpecker[2], willow flycatcher[8], great crested flycatcher[8], marsh wren[8], wood thrush[3,8], scarlet tanager[8], seaside sparrow[8], northern (Baltimore) oriole[8], northern goshawk[4], bufflehead[8], American golden-plover[8], black skimmer[4], long-eared owl[2], common barn owl[3], common nighthawk[3], sedge wren[4], savannah sparrow[2], bobolink[2], upland sandpiper[4], roseate tern[4], loggerhead shrike[4], vesper sparrow[4], king rail[3,8], whimbrel[3,8], common tern[3,8], black tern[3], Caspian tern[3], American kestrel[8], least flycatcher[3], horned lark[3], cliff swallow[3], winter wren[3], veery[3,8], gray-cheeked thrush[3], solitary (blue-headed) vireo[3], northern parula[3], blue-throated green warbler[3], eastern meadowlark[3], black-throated green warbler[3], black-throated blue warbler[3,8], northern flicker[8], American golden plover[8], American woodcock[8], black and white warbler[8], black-billed cuckoo[8], blue-winged warbler[8], brown thrasher[3,8], Canada warbler[8], cerulean warbler[3], chimney swift[8], eastern towhee[8], eastern wood pewee[8], field sparrow[8], grasshopper sparrow[2], Hudsonian godwit[8], indigo bunting[8], Louisiana waterthrush[8], prairie warbler[8], saltmarsh sharp-tailed sparrow[3,8], and wood duck[8].
Mammals	• Very rarely, harbor seal[9] and harp seal[9].

[1]Based on occurrence information from USFWS (1997); Kiviat and MacDonald (2002); Bragin *et al.* (2005); Mizrahi *et al.* (2007); NJMC (2010b); NJMC (2011); NJDEP (2012a); NJDEP (2012b); and NJDEP (2012c).
[2] New Jersey State listed as threatened (NJDEP 2012b).
[3] New Jersey State species of special concern (NJDEP 2012c).
[4] New Jersey State listed as endangered (NJDEP 2012b).
[5] Federally managed species for which essential fish habitat (EFH) is designated pursuant to the Magnuson-Stevens Act (16 U.S.C. 1801-1882) (NMFS 2011a, b).
[6] NMFS-identified species of special concern (NMFS 2012).
[7]Status is currently under review by USFWS to determine if listing of the species is warranted (USFWS 2011).
[8] Species identified in regional conservation plan(s) (i.e., regional priority species) (NJDEP 2012a).
[9]Protected under the Marine Mammal Protection Act of 1972 ((P.L. 92-522) (86 Stat. 1027; 16 U.S.C. 1361-1407, as amended).

Table 6. Mercury Concentrations in Fish Tissue from the Vicinity of the BCSA, Pre-2005.

Sampling Period	Organism	Tissue	# of Samples	Average Mercury (mg/kg)	Maximum Mercury (mg/kg)	Protective level[1] (mg/kg)
1976[2]	Alewife	fillet	1	NA	ND	0.3
		whole	1	NA	0.52	0.2
	American eel	fillet	1	NA	0.76	0.3
		whole	1	NA	0.16	0.2
	Goldfish	fillet	1	NA	0.87	NC
		liver	1	NA	1.37	NC
		heart	1	NA	14	NC
		brain	1	NA	3.2	NC
		eye	1	NA	2.1	NC
		viscera	1	NA	1	NC
		scales	1	NA	0.06	NC
	Mummichog	whole	15	1.34	3.3	0.2
		brain	2	5.1	6.1	NC
		liver	3	4.23	7.6	NC
		heart	3	27.7	59	NC
		gills	1	NA	1.2	NC
	Spot	heart	NR	25.2	NR	NC
		brain	2	10.9	21	NC
		gills	2	3.39	6.3	NC
		whole	1	NA	0.16	0.3
		fillet	NR	0.19	NR	0.3
		viscera	1	NA	0.54	NC
1977[3]	Alewife	kidney	1	NA	0.058	NC
		muscle	7	0.501	0.806	0.3
	American eel	kidney	1	NA	0.441	NC
		liver	2	1.96	3.8	NC
		muscle	2	0.402	0.54	0.3
	American shad	muscle	1	NA	1.6	0.3
	Atlantic silverside	muscle	1	NA	0.572	NC
	Bay anchovy	muscle	1	NA	0.708	NC
	Blueback herring	muscle	5	1.26	1.7	0.3
	Bluefish	kidney	1	NA	3	NC
		liver	1	NA	1.1	NC
		muscle	1	NA	0.72	0.3
	Bluegill sunfish	liver	1	NA	0.203	NC
		muscle	1	NA	0.122	0.3
	Carp	gill	1	NA	0.08	NC
		kidney	8	0.127	0.44	NC
		liver	7	0.398	1.2	NC
		muscle	9	0.261	0.528	0.3
	Mummichog	whole	157 (1)	0.226	0.898	0.2
		eggs	1	NA	0.064	NC
		tail	1	NA	0.048	NC
	Pumpkinseed	liver	2	0.205	0.212	NC
		muscle	2	0.219	0.231	0.3
	Striped sea robin	kidney	1	NA	ND	NC
		liver	1	NA	0.12	NC
		muscle	1	NA	0.157	0.3
	Sunfish	muscle	3	0.056	0.085	0.3
		tail	1	NA	0.061	NC
	Weakfish	kidney	5 (1)	2.38	3.2	NC
		liver	5	1.68	2.1	NC
		muscle	5	0.675	1	0.3
	White perch	kidney	7	0.161	0.386	NC
		liver	7	0.814	1.4	NC
		muscle	9	0.739	1.9	0.3

Table 6, continued. Mercury Concentrations in Fish Tissue from the Vicinity of the BCSA, Pre-2005.

Sampling Period	Organism	Tissue	# of Samples	Average Mercury (mg/kg)	Maximum Mercury (mg/kg)	Protective level[1] (mg/kg)
1978[4]	Alewife	NS	1	NA	0.04	0.3
	American eel	NS	1	NA	0.33	0.3
	Black crappie	NS	1	NA	0.04	0.3
	Bluegill sunfish	NS	4	0.29	0.34	0.3
	Carp	NS	1	NA	0.07	0.3
	Golden shiner	NS	1	NA	0.06	0.2
	Mummichog	whole	54	0.35	1.7	0.2
	Redfin shiner	NS	1	NA	0.16	0.2
	Striped bass	NS	1	NA	0.93	0.3
	White perch	NS	6	0.2	0.32	0.3
1978[5]	Mummichog	whole	19	0.16	0.32	0.2
1979-80[6]	Alewife	whole	NR	NR	0.72	0.2
	American eel	whole	1	NA	0.12	0.2
	American shad	whole	1	NA	0.21	0.2
	Bluegill sunfish	whole	NR	NR	0.22	0.2
	Brown bullhead	muscle	NR	NR	0.16	0.3
	Carp	whole	NR	NR	0.26	0.2
		muscle	1	NA	0.04	0.3
	Green sunfish	whole	1	NA	0.11	0.2
	Mummichog	whole	273	0.238	2.2	0.2
	Pumpkinseed	whole	NR	NR	0.31	0.2
	Weakfish	whole	NR	NR	0.33	0.2
	White perch	whole	NR	NR	0.58	0.2
		muscle	NR	NR	0.3	0.3
1983[7]	Mummichog	whole	9	0.91	3.08	0.2
	sunfish	whole	1	NA	0.38	0.2
1985[8]	Bluegill sunfish	skin	3 (1)	0.7	1.36	NC
		muscle	2	0.31	0.51	0.3
		liver	3 (1)	1.1	>2	NC
		gill	3 (3)	<0.02	<0.02	NC
	Brown bullhead catfish	muscle	7	1.2	>2	0.3
		liver	7	0.83	1.2	NC
		gill	7 (3)	0.46	0.81	NC
	Carp	skin	19 (1)	0.46	2	NC
		muscle	19	0.61	2	0.3
		liver	19 (3)	0.31	0.89	NC
		gill	18 (10)	0.07	0.14	NC
	Mummichog	whole	11 (1)	1.54	>2	0.2
		fillet	28 (3)	0.93	>2	NC
	White perch	skin	3	0.67	1.06	NC
		muscle	3	1.43	1.82	0.3
		liver	3	1.13	>2	NC
		gill	3	1.44	>2	NC
1988[9]	Carp	fillet	4	0.402	0.492	0.3
		kidney	3	0.238	0.372	NC
		liver	3	0.315	0.425	NC
1987-88[10]	Brown bullhead catfish	whole	1	NA	0.5	0.2
		whole	9	0.99	1.9	0.2
	Eel	whole	4	3.58	5.8	0.2
	Mummichog	whole	6	2.37	2.8	0.2
		whole	11	0.67	4.67	0.2
		whole (depurated)	20	1.01	4.67	0.2
	Pumpkinseed	whole	6	1.23	1.8	0.2
		whole	5	0.32	0.5	0.2
	White Perch	whole	13	2.79	6.2	0.2
NR[11]	Mummichog	liver	3	1.8	NA	NC
2001-2004[12]	Atlantic silverside	whole	8	0.48	NR	0.2
	Brown bullhead catfish	fillet	29	0.67	NR	0.3
	Carp	fillet	9	1.2	NR	0.3
	Mummichog	whole	30	0.25	NR	0.2
	White perch	fillet	168	1.75	NR	0.3

[1]Value for whole fish is the recommended protective value from Beckvar *et al.* (2005). Value for fish muscle or fillet is the recommended maximum concentration of methylmercury in edible tissue of fish and shellfish to protect human health (USEPA 2001).
[2]Data from JMA 1976 (as reported in ERM-Southeast Inc. 1985)
[3]Data from HMDC (1978b)
[4]Data from NJMSC bi-monthly reports 1-3, as reported in Lipsky *et al.* (1980)
[5]Data from NJMSC 1978 Special mummichog sampling, as reported in Lipsky *et al.* (1980)
[6]Data from NJMSC 1979-80 Sampling, as reported in Lipsky *et al.* (1980)
[7]Data from NJDEP 1985 (as reported in ERM-Southeast Inc. 1985)
[8]Data from HMDC (1987a)
[9]Data from HMDC (1988)
[10]Data from Konsevick (1989)
[11]Data from Weis *et al.* (2001)
[12]Data from Weis (2005)
= number
mg/kg = milligrams per kilogram
JMA – Jack McCormick and Associates
HMDC = Hackensack Meadowlands Development Commission
NJMSC = New Jersey Marine Sciences Consortium
NJDEP = New Jersey Department of Environmental Protection
NR = not reported
NA = not applicable
NC = no criterion
ND = not detected
Parentheses indicate the number of non-detects. Non-detects were not considered in calculations of average values.
Values exceed the protective level.

Table 7. Mercury Concentrations in Fish Tissue from the BCSA, Collected in 2009-2010.

Sampling Period	Organism	Location	Tissue	# of Samples	Average Mercury (mg/kg)	Maximum Mercury (mg/kg)	Protective level[1] (mg/kg)
2009[2]	Mummichog	BCC	whole/depurated	4	0.116	0.14	0.2
			whole/non-depurated	3	0.137	0.14	0.2
		LBC	whole/depurated	10	0.100	0.15	0.2
			whole/non-depurated	2	0.0955	0.098	0.2
		MBC	whole/depurated	13	0.172	0.32	0.2
			whole/non-depurated	5	0.177	0.23	0.2
		UBC	whole/depurated	15	0.201	0.36	0.2
			whole/non-depurated	3	0.230	0.31	0.2
	White Perch	BCC	whole/depurated	3	0.163	0.22	0.2
			fillet	3	0.343	0.45	0.3
			fillet[a]	3	0.297	0.48	0.3
		LBC	whole/depurated	3	0.240	0.25	0.2
			fillet	3	0.397	0.49	0.3
			fillet[a]	3	0.383	0.43	0.3
		MBC	whole/depurated	3	0.197	0.26	0.2
			fillet	3	0.450	0.66	0.3
			fillet[a]	3	0.360	0.4	0.3
		UBC	whole/depurated	3	0.267	0.41	0.2
			fillet	3	0.523	0.65	0.3
			fillet[a]	3	0.497	0.63	0.3
2010[3]	Mummichog	Streamlands	whole	9	0.167	0.21	0.2
		Mill Creek	whole	5	0.110	0.15	0.2
		Peach Island	whole	4	0.244	0.32	0.2

[1]Protective value for whole fish is the recommended threshold from Beckvar *et al.* (2005). Value for fish muscle or fillet is the recommended maximum concentration of methylmercury in edible tissue of fish and shellfish to protect human health (USEPA 2001).
[2]Data from Geosyntec Consultants *et al.* (2010)
[3]Data from CH2MHill (2011)
[a]Values represent methylmercury concentrations
mg/kg = milligrams per kilogram
BC = Berry's Creek
BCC = Berry's Creek Canal
UBC = Upper Berry's Creek
MBC = Middle Berry's Creek
LBC = Lower Berry's Creek
See Figures 1 and 2 for Area Locations.
Values exceed the protective level.

Table 8. Mercury Concentrations in Blue Crab Tissue from the Vicinity of the BCSA.

Sampling Period	Tissue	# of Samples	Average Mercury (mg/kg)	Maximum Mercury (mg/kg)	Protective level[1] (mg/kg)
1978[2]	carapace	3 (1)	0.019	0.032	NC
	muscle	10	0.253	0.761	0.3
	viscera	3	0.344	0.406	NC
1978[3]	NR	3 (1)	0.18	0.22	0.3
1979-1980[4]	whole	NR	NR	0.58	NC
	muscle	NR	NR	0.68	0.3
1983	kidney	1	NA	0.24	NC
	muscle	1	NA	0.23	0.3
1985[5]	hepatopancreas	23 (5)	0.492	>2	NC
	gill	23 (6)	0.183	0.5	NC
	claw	22 (2)	0.623	>2	0.3
2009[6]	muscle[a]	12	0.203	0.31	0.3
2010[7]	whole	7	0.105	0.13	NC

[1] Recommended maximum concentration of methylmercury in edible tissue of fish and shellfish to protect against human health effects (USEPA 2001).
[2]Data from HMDC (1978b)
[3]Data from NJMSC bi-monthly reports 1-3, as reported in Lipsky *et al.* (1980)
[4]Data from NJMSC 1979-80 Sampling, as reported in Lipsky *et al.* (1980)
[5]Data from HMDC (1987a)
[6]Data from Geosyntec Consultants *et al.* (2010)
[7]Data from CH2MHill (2011)
[a]Values represent methylmercury concentrations
mg/kg = milligrams per kilogram
NA = not applicable
NC = no criterion
NR = not reported
> = greater than
< = less than
JMA = Jack McCormick and Associates
NJDEP = New Jersey Department of Environmental Protection
HMDC = Hackensack Meadowlands Development Commission
NJMSC = New Jersey Marine Sciences Consortium
Parentheses indicate the number of non-detects. Non-detects were not considered in calculations of average values.
Values exceed the protective level.

Table 9. Concentrations of Dioxin-Like PCBs in Mummichog from the BCSA[1].

Dioxin-Like PCB congener	Fish TEF[2]	Streamlands (n = 9)			Mill Creek (n = 5)			Upper Berry's Creek - PI locations (n = 4)		
		Average TEQ (pg/g)	Minimum TEQ (pg/g)	Maximum TEQ (pg/g)	Average TEQ (pg/g)	Minimum TEQ (pg/g)	Maximum TEQ (pg/g)	Average TEQ (pg/g)	Minimum TEQ (pg/g)	Maximum TEQ (pg/g)
77	0.0001	0.657	2.640	0.197	0.091	0.115	0.060	0.649	0.686	0.605
81	0.0005	0.705	3.530	0.058	0.100	0.192	0.033	0.575	0.770	0.207
105	0.000005	0.215	0.675	0.102	0.045	0.063	0.029	0.306	0.328	0.282
106/118	0.000005	0.562	1.360	0.323	0.184	0.211	0.137	0.806	0.940	0.715
114	0.000005	0.017	0.046	0.008	0.003	0.005	0.002	0.021	0.023	0.020
123	0.000005	0.015	0.035	0.009	0.004	0.004	0.003	0.022	0.027	0.019
126	0.005	1.556	4.535	0.775	0.490	0.673	0.329	2.223	2.488	1.885
156	0.000005	0.022	0.045	0.016	0.013	0.016	0.008	0.036	0.038	0.034
157	0.000005	0.005	0.008	0.003	0.003	0.003	0.002	0.009	0.010	0.008
167	0.000005	0.010	0.017	0.007	0.008	0.009	0.005	0.019	0.020	0.017
169	0.00005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
189	0.000005	0.001	0.002	0.001	0.001	0.001	0.001	0.002	0.002	0.001

[1]Data from CH2MHill (2011).
[2]Fish TEFs from van den Berg *et al.* (1998).
[3]Effects concentration based on altered prey capture ability in mummichog (Couillard *et al.* 2011).
PCB = polychlorinated biphenyl
n = sample size
TEF = toxic equivalency factor
TEQ = toxic equivalent
PI = Peach Island
pg/g = picograms per gram
Concentrations are wet weight values. The average of duplicate values was used in calculations.
See Figures 1 and 2 for Area Locations.
Values indicate the PCB congener with the highest contribution to total TEQ.

Table 10. Predicted Total Toxic Equivalents for Dioxin-Like PCBs in Mummichog Eggs from the BCSA[1], Compared to an Egg Tissue Effects Concentration.

Streamlands (n = 9)						Mill Creek (n = 5)						Upper Berry's Creek - PI locations (n = 4)						Egg Tissue Effects Concentration[3] (pg/g)
Average TEQ (pg/g)	Minimum TEQ (pg/g)	Maximum TEQ (pg/g)	Average TEQ (pg/g)	Minimum TEQ (pg/g)	Maximum TEQ (pg/g)	Average TEQ (pg/g)	Minimum TEQ (pg/g)	Maximum TEQ (pg/g)	Average TEQ (pg/g)	Minimum TEQ (pg/g)	Maximum TEQ (pg/g)	Average TEQ (pg/g)	Minimum TEQ (pg/g)	Maximum TEQ (pg/g)	Average TEQ (pg/g)	Minimum TEQ (pg/g)	Maximum TEQ (pg/g)	
Whole body			Expected Egg Tissue Concentration (pg/g)[2]			Whole body			Expected Egg Tissue Concentration (pg/g)[2]			Whole body			Expected Egg Tissue Concentration (pg/g)[2]			
3.76	1.55	12.89	1013.93	156.52	5521.80	0.94	0.62	1.27	14.54	7.20	22.48	4.67	3.94	5.07	516.80	1319.22	113.69	1.25

[1]Data from CH2MHill (2011).
[2]Calculated based on the relationship between measured lipid and dioxin-like PCB concentrations in mummichog from the UOP Site and egg lipid concentrations for mummichog published in Bailey (1973). Sexes of sampled fish were unknown; differences between lipid concentrations in female and male fish are assumed to be insignificant and data for all fish were used.
[3]Effects concentration based on altered prey capture ability in mummichog (Couillard *et al.* 2011).
PCB = polychlorinated biphenyl
n = sample size
TEF = toxic equivalency factor
TEQ = toxic equivalent
PI = Peach Island
pg/g = picograms per gram
UOP = Universal Oil Products
PI = Peach Island
Concentrations are wet weight values. The average of duplicate values was used in calculations. TEQs were calculated using TEFs from van den Berg *et al.* (1998).
See Figures 1 and 2 for Area Locations.
Values exceed the effects concentration.

APPENDIX A
RESPONDENTS TO ADMINISTRATIVE SETTLEMENT AGREEMENT AND ORDER ON CONSENT FOR REMEDIAL INVESTIGATION AND FEASIBILITY STUDY, BERRY'S CREEK STUDY AREA

U.S. EPA Index No. II-CERCLA-2008-2011

1. 3M Company
2. ABB Inc. for Bailey Controls
3. Air Products and Chemicals, Inc.
4. Akzo Nobel Coatings Inc.
5. Alcoa Inc.
6. Allied Chemical (predecessor company to Honeywell)
7. Andersen Land Corp.
8. Arkema Inc.
9. Ashland Inc.
10. Avery Dennison Corporation, as successor to Paxar Corporation
11. Axsys Technologies, Inc. (Brevel Motors, Inc. and V Land Corporation)
12. BASF on its own behalf and on behalf of BASF Catalysts, LLC
13. Becton, Dickinson and Company
14. Bell Container Corp.
15. Belmont Metals, Inc.
16. Benjamin Moore & Co.
17. Ber Mar Manufacturing Corp.
18. Bristol-Myers Squibb Company
19. Browning-Ferris Industries of New Jersey, Inc.
20. CBS Corporation (f/k/a Viacom Inc., f/k/a Westinghouse Electric Corporation)
21. Chemcoat, Inc.
22. Ciba Corporation (f/k/a Ciba Specialty Chemicals Corporation)
23. CNA Holdings, Inc.
24. Cognis Corporation as successor to Henkel Corporation, for itself and on behalf of Henkel Corporation
25. Columbia University
26. Congoleum Corporation
27. Conopco, Inc (formerly d/b/a Day-Baldwin Inc.)
28. Conrail
29. Continental Holdings Inc., as successor in interest for certain limited purposes to Continental Can Company, Inc.
30. Cosan Chemical Corporation
31. Cycle Chem Inc.
32. D.F. Goldsmith Chemical & Metal Corp.
33. Dr. Pepper Snapple Group, Inc.
34. Dri-Print Foils, Inc. (subsidiaries and successors include: Beatrice Foods Co., Beatrice Companies, Inc., Beatrice Company, Hunt-Wesson, Inc., ConAgra Grocery Products Company, ConAgra Grocery Products Company, LLC, API-Foils, Inc.)

35. E.I. du Pont de Nemours and Company
36. Exxon Mobil Corporation on behalf of itself, its affiliates ExxonMobil Oil Corporation, formerly known as Mobil Oil Corporation, and Exxon Company, USA
37. Ford Motor Company
38. FUJIFILM Graphic Systems U.S.A., Inc.
39. Garfield Refining Company
40. General Electric Co.
41. General Motors Corporation
42. Greif, Inc.
43. Hartin Paint & Filler Corp
44. Hexion Specialty Chemicals, Inc. (f/k/a Borden Chemical, Inc.)
45. Hoffmann-La Roche Inc.
46. Honeywell International, Inc.
47. ISP Environmental Services Inc.
48. John L. Armitage & Co.
49. Johnson & Johnson
50. Kirker Enterprises, Inc.
51. L.E. Carpenter & Co.
52. LANXESS Corporation as successor in interest to Bayer solely for this matter
53. Lucent Technologies Inc.
54. Mack Trucks, Inc.
55. Mallinckrodt Baker, Inc.
56. Mallinckrodt Inc.
57. Manor Care, Inc. and all current and former subsidiaries, affiliates, predecessors, successors and all other entities, both current and former, affiliated with the above-referenced entities, including Manor Care of America, Inc., ManorCare Health Services, Inc. (f/k/a Manor Healthcare Corp.), and Portfolio One, Inc., (f/k/a and successor in interest to Chemline, Inc. and Almo Anti Pollution, Inc.)
58. Matheson Tri-Gas, Inc.
59. Merck & Co., Inc.
60. Monroe Chemical, Inc.
61. Morton International, Inc.
62. MTA New York City Transit
63. Nepera, Inc.
64. New England Laminates Co., Inc.
65. New Jersey Institute of Technology
66. NL Industries, Inc.
67. Northrop Grumman Systems Corporation on behalf of Litton Systems/Fitchburg Coated Products and Grumman Corp.
68. Occidental Chemical Corporation, as successor to Diamond Shamrock Chemicals Company
69. Olin Corporation
70. Osram Sylvania, Inc.
71. Pan Technology, Inc.
72. Permacel
73. Pfizer Inc.

74. Pharmacia Corp., by its Attorney-In-Fact Monsanto Corporation
75. President Container, Inc.
76. PSEG Fossil LLC
77. Rathon Corp.
78. Reckitt Benckiser Inc.
79. Reichhold, Inc. (as successor only to the New Jersey corporations known as Cellofilm Corporation and Cellofilm Properties, Inc., both incorporated on April 28, 1961)
80. Revlon Consumer Products Corporation
81. Rohm and Haas Company
82. Rohm and Haas Company, on behalf of Bee Chemical Company for this matter only
83. Scapa Tapes North America (Carlstadt), Inc.
84. Schawk, Inc.
85. Scientific Design Company, Inc.
86. Seagrave Coatings Corp. (a/k/a Chemray Coatings Corp.)
87. Sequa Corporation and its former subsidiaries Rutherford Machinery and Sequa Can Machinery, Inc.
88. SI Group, Inc.
89. Siegfried (USA), Inc. (formerly Ganes Chemicals)
90. Simon Wrecking Company, Inc., Simon Resources, Inc. and Mid-State Trading Co.
91. SmithKline Beecham Corporation
92. Spectra Energy Corp as successor to Halcon Catalyst Industries in this matter
93. Spectrum Brands o/b/o Rayovac
94. Stanbee Company Inc.
95. Stryker Corporation
96. Sumitomo Machinery Corporation of America
97. Sun Chemical Corporation
98. Tate & Lyle Ingredients Americas, Inc. (f/k/a A.E. Staley Manufacturing Company)
99. Technical Coatings Co.
100. Tennessee Gas Pipeline Company (f/k/a Tenneco, Inc.)
101. The Custodial Trust by and through LePetomane III, Inc., not individually but solely in its representative capacity as Custodial Trust Trustee
102. The Dow Chemical Company
103. The Gillette Company
104. The New York Times Company
105. The Port Authority of New York & New Jersey
106. The Wella Corporation
107. Trane U.S. Inc. (f/k/a American Standard Inc.)
108. Union Carbide Corporation
109. United Technologies Corporation on behalf of Inmont Corporation
110. United Wire Hanger Corp.
111. Universal Oil Products (subsidiary of Honeywell)
112. University of Minnesota
113. Veolia ES Technical Solutions, L.L.C., as successor by merger to Marisol, Incorporated
114. W.A. Baum Company, Inc.
115. Warner-Lambert Company LLC., a wholly-owned subsidiary of Pfizer Inc.

116. Waste Management of New Jersey, Inc.
117. Western Michigan University
118. Wyeth Holdings Corporation (f/k/a American Cyanamid Company)

APPENDIX B – ADDITIONAL RESPONDENTS

1. Conrail
2. Ford Motor Company
3. Schawk, Inc.

APPENDIX C – PRIOR SIGNATORIES

1. 3M Company
2. ABB Inc. for Bailey Controls
3. Air Products and Chemicals, Inc.
4. Akzo Nobel Coatings Inc.
5. Alcoa Inc.
6. Allied Chemical (predecessor company to Honeywell)
7. Andersen Land Corp.
8. Arkema Inc.
9. Ashland Inc.
10. Avery Dennison Corporation, as successor to Paxar Corporation
11. Axsys Technologies, Inc. (Brevel Motors, Inc. and V Land Corporation)
12. BASF on its own behalf and on behalf of BASF Catalysts, LLC
13. Becton, Dickinson and Company
14. Bell Container Corp.
15. Belmont Metals, Inc.
16. Benjamin Moore & Co.
17. Ber Mar Manufacturing Corp.
18. Bristol-Myers Squibb Company
19. Browning-Ferris Industries of New Jersey, Inc.
20. CBS Corporation (f/k/a Viacom Inc., f/k/a Westinghouse Electric Corporation)
21. Chemcoat, Inc.
22. Ciba Corporation (f/k/a Ciba Specialty Chemicals Corporation)
23. CNA Holdings, Inc.
24. Cognis Corporation as successor to Henkel Corporation, for itself and on behalf of Henkel Corporation
25. Columbia University
26. Congoleum Corporation
27. Conopco, Inc (formerly d/b/a Day-Baldwin Inc.)
28. Continental Holdings Inc., as successor in interest for certain limited purposes to Continental Can Company, Inc.
29. Cosan Chemical Corporation
30. Cycle Chem Inc.
31. D.F. Goldsmith Chemical & Metal Corp.
32. Dr. Pepper Snapple Group, Inc.
33. Dri-Print Foils, Inc. (subsidiaries and successors include: Beatrice Foods Co., Beatrice Companies, Inc., Beatrice Company, Hunt-Wesson, Inc., ConAgra Grocery Products Company, ConAgra Grocery Products Company, LLC, API-Foils, Inc.)
34. E.I. du Pont de Nemours and Company
35. Exxon Mobil Corporation on behalf of itself, its affiliates ExxonMobil Oil Corporation, formerly known as Mobil Oil Corporation, and Exxon Company, USA
36. FUJIFILM Graphic Systems U.S.A., Inc.
37. Garfield Refining Company
38. General Electric Co.
39. General Motors Corporation

40. Greif, Inc.
41. Hartin Paint & Filler Corp
42. Hexion Specialty Chemicals, Inc. (f/k/a Borden Chemical, Inc.)
43. Hoffmann-La Roche Inc.
44. Honeywell International, Inc.
45. ISP Environmental Services Inc.
46. John L. Armitage & Co.
47. Johnson & Johnson
48. Kirker Enterprises, Inc.
49. L.E. Carpenter & Co.
50. LANXESS Corporation as successor in interest to Bayer solely for this matter
51. Lucent Technologies Inc.
52. Mack Trucks, Inc.
53. Mallinckrodt Baker, Inc.
54. Mallinckrodt Inc.
55. Manor Care, Inc. and all current and former subsidiaries, affiliates, predecessors, successors and all other entities, both current and former, affiliated with the above-referenced entities, including Manor Care of America, Inc., ManorCare Health Services, Inc. (f/k/a Manor Healthcare Corp.), and Portfolio One, Inc., (f/k/a and successor in interest to Chemline, Inc. and Almo Anti Pollution, Inc.)
56. Matheson Tri-Gas, Inc.
57. Merck & Co., Inc.
58. Monroe Chemical, Inc.
59. Morton International, Inc.
60. MTA New York City Transit
61. Nepera, Inc.
62. New England Laminates Co., Inc.
63. New Jersey Institute of Technology
64. NL Industries, Inc.
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PREASSESSMENT SCREEN
FOR
BERRY'S CREEK WATERSHED
18 March 2014
PREPARED BY THE
United States Department of Commerce – National Oceanic and Atmospheric Administration
United States Department of the Interior – U.S Fish & Wildlife Service
REGARDING NATURAL RESOURCE DAMAGE ASSESSMENT & RESTORATION

NOAA:

By:______________________________

David Westerholm
Director
Office of Response and Restoration
National Oceanic and Atmospheric Administration
For the United States Department of Commerce

Date: 3/27/14

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REGARDING NATURAL RESOURCE DAMAGE ASSESSMENT & RESTORATION

U.S. Department of the Interior:

By: ______________________________

Wendi Weber
Regional Director
U.S. Fish & Wildlife Service, Region 5
For the United States Department of the Interior

Date: April 29, 2014