HUDSON-RARITAN ESTUARY
ENVIRONMENTAL RESTORATION FEASIBILITY
STUDY

LOWER RARITAN RIVER

STUDY AREA REPORT

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U.S. Army Corps
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I. INTRODUCTION

Background

1. The New York District of the Corps of Engineers (the District) is conducting a feasibility study for ecosystem restoration in the Hudson-Raritan Estuary (the Estuary) – the Hudson-Raritan Estuary Ecosystem Restoration Study, herein referred to as "HRE". The study area is delineated as the Port District, an area surrounding greater metropolitan New York City within an approximate 25-mile radius of the Statue of Liberty (Figure 1). However, for purposes of ecological continuity the actual study area may include additional portions of this system beyond the man-made Port District boundary.

2. The overall goal of the HRE is to restore ecological function and diversity that have been lost or degraded as a result of human activities. The HRE will rely on both existing and newly obtained natural resource data to identify areas to be restored or conditions that must be addressed to assure successful ecosystem restoration. The two primary components of the study are the preparation of a Comprehensive Restoration Implementation Plan (CRIP) and the implementation of restorations/enhancements at various locations in the Estuary.

3. The purpose of the CRIP is to serve as a master plan that lays out a comprehensive and coordinated strategy that, when implemented, will guide the ecological restoration of the Estuary. The CRIP will establish a framework within which the actions needed for successful restorations can be holistically evaluated and planned. The plan will address actions to enhance, expand, recreate, and diversify natural habitats, and actions to eliminate constraints to ecological functions, such as sediment contamination. The CRIP will describe the strategy for restoration efforts that will include immediate, mid-term, and long-range options. It will also provide a central focus for public input, data collection, restoration efforts, and management actions and policies, regardless of who might have authority, desire and/or funds to undertake any action.

Study Area Delineation of the Estuary

4. To get a more manageable and understandable picture of the Estuary, its history of degradation, local needs and desires, potential restoration opportunities, and current restoration efforts will be documented in eight Study Area Reports (SARs). The study area boundaries are typically delineated by major watersheds and/or major physical features, such as highways or waterways. By and large, each study area can be characterized by its ecological functions, history of degradation, and resulting needs and opportunities. For example, Jamaica Bay, a historically expansive wetlands complex, has been subject to extensive fill and loss of wetlands; the Hudson River system, to hardened shorelines and contaminated sediment; and the Lower Bay contains coastal and offshore environments, experiencing loss of dunes and benthic habitat. Separating the project area into smaller study areas will enable the study team and potential stakeholders to address study area-specific restoration needs as well as individual restoration opportunities within each study area, and to collect and characterize data in a more usable and understandable way, all under the ultimate umbrella of the CRIP, which links the study areas into one major plan.

5. The eight study areas to be included in the CRIP are as follows (see Figure 1):

1) Jamaica Bay,
2) Lower Bay,
3) Lower Raritan River,
4) Arthur Kill/Kill van Kull,
5) Newark Bay/Hackensack River/Passaic River,
6) Lower Hudson River,
7) Harlem River/East River/Western Long Island Sound,
8) Upper Bay.

Purpose of the Study Area Reports

6. The identification of potential restoration opportunities in each study area will be a two-fold process. First, the District will identify potential restoration sites based upon a preliminary needs and opportunities survey of various interested groups/agencies conducted by the Regional Planning

Association (RPA) and presented in their Needs and Opportunities Report. This information will be supplemented by additional analyses of restoration needs and opportunities on a more local level. Study area needs will be determined based upon the causes of ecosystem degradation and the condition of existing natural resources in each study area. This effort is already underway (but far from completed) and potential restoration sites in the Arthur Kill study area have been identified.

7. Second, the District will hold stakeholder meetings in each study area. The purpose of these meetings will be to incorporate additional comments from environmental organizations, community groups, and other individuals and stakeholders in each study area. This process will ensure the needs and opinions of as wide and diverse a group as possible is incorporated into the CRIP.

Format of the Report

8. This SAR addresses the Lower Raritan River study area (Figure 2). The **Study Area Description** section describes the setting, history of degradation, existing land/water usage, and existing natural resources in the study area. Restoration needs and existing restoration efforts are summarized in the **Ecosystem Restoration** section.

II. STUDY AREA DESCRIPTION

Setting

9. The Lower Raritan River study area includes the last six miles of the Raritan River before its confluence with Raritan Bay and the surrounding uplands extending into Middlesex and Morris Counties, New Jersey (Figure 2). The New Jersey Department of Environmental Protection (NJDEP) has designated watershed management areas throughout the state. The Lower Raritan River study area, as defined in this Study Area Report, is located with Watershed Management Areas (WMA) 6, 8, 9 and 10.

Study Area History

10. The New York Metropolitan Region is one of the most densely populated areas in the United States. The waterfront has been the center of shipping and industry for over 150 years. Residential, commercial, and recreational development has impaired ecosystem function within the Estuary.

11. Major changes to the natural landscape within the study area began with European settlement. Although the early European settlers relied heavily on the study area through the late 1700's, the study area's natural character was not greatly impacted. However, over the next two centuries the Raritan River watershed would become a center for commerce and manufacturing with dramatic effects. Urbanization, industrialization, and pollution have limited recreational opportunities in the Raritan River.

12. Much of the study area remained rural until the 1980s, except for some post World War II suburban development (Old Bridge, Piscataway, Woodbridge) in the Lower Raritan Watershed Management Area.

History of Degradation

13. With the introduction of European settlers, much of the forested land was cleared and converted to agricultural production, furthering detrimental effects on the study area by exposing soils to erosion and altering vegetation and habitats. Wheat, rye, potatoes, garden vegetables and fruits gave New Jersey the reputation as a "bread" colony and later the Garden State, further encouraging agricultural development. Agricultural and other products from the study area required a

transportation network for the movement of goods out of the region, allowing farmers to enjoy the close proximity of the large urban markets of Philadelphia and New York.

14. The river, streams and Native American trails that provided the basis of the transportation network in the study area gradually improved over time. In the early 1800s, the Delaware and Raritan Canal and railroads were built to facilitate such transportation. Later, highways and interstate roadways completed the transportation network. As is typical in areas surrounding most major rivers, industries evolved along the Raritan River, where water provided the power to run grist, saw, paper, and textile mills. In addition, iron forging, copper mining, brick and clay production, and whiskey distilling were developed as industries in the study area. Waste products from these industries were often stored in the flood plain or discharged directly into waterways with no understanding of the environmental consequences.

15. Many municipalities within the Basin experienced the majority of their housing development after 1980. Between 1986 and 1995 almost 57 square miles of land coverage was converted to urban land use. Almost 42 square miles of agricultural land were lost, as well as over eight square miles of forested land and 6.6 square miles of wetlands between 1986 and 1995.

16. Urbanization resulted in more impervious surface (roofs, sidewalks, parking lots, roads) in the watershed. Increasing the amount of impervious surface increases the volume of runoff from storm events, speeds the delivery of runoff to a waterway and increases the peak flow, and reduces infiltration to ground water.

Existing Land/Water Usage

17. The landscape surrounding the Raritan River is predominantly developed with some land used for agriculture. Agricultural land is located toward the upstream boundary of the study area, near the municipalities of Piscataway and Bridgewater. Along the waterfront, primary land and water uses include marinas, parkland, vacant disturbed land (wetlands and uplands), tidal wetlands, and residential land.

18. Water is withdrawn from the Raritan River and used as cooling water at power plants along the lower Raritan River (Sayreville and Werner power plants). One sewage treatment plant (the

Middlesex County Utilities Authority) discharges treated wastewater into the Raritan River via secondary outfall. The waterbodies in the study area are used for recreational navigation and secondary contact recreation includes water/jet skiing and fishing. There are no public bathing beaches on the Raritan River.

Natural Resources Conditions

19. A large proportion of the wetlands that were once present in the study area have been filled to construct industrial facilities along the waterfront and residential communities in other portions of the study area. Additionally, shorelines along the waterfront have been hardened to support the industrial facilities or other development. Many of the tributaries within the study area have been dammed, thus blocking passage for anadromous fish.

20. Many wetlands that remain have been degraded and invaded by non-native species such as common reed (*Phragmites communis*). Approximately 93% of all wetlands in the Lower Raritan River Basin have been converted to urban land uses (New Jersey Water Supply Authority 2002). A significant wetland system is located in Edison Township, near the Raritan Center. This wetland system is nearly 1,000-acres in size and consists of a complex of habitat types including emergent wetlands, freshwater ponds, and tidal creeks. This wetland complex provides important habitat for waterfowl, shorebirds, colonial waterbirds, mammals, and anadromous fish in an otherwise highly urbanized environment.

21. The study area is densely populated and few natural forests remain. In some portions of the upper study area, abandoned or fallow farmland characterized by old-field communities remain. These are comprised primarily of abandoned or fallow farm fields. Species commonly found in old-field communities include eastern red cedar (*Juniperus virginiana*), gray birch (*Betula lenta*), black locust (*Robinia pseudoacacia*), common mullein (*Verbascum thapsus*), orchard grass (*Dactylis glomerata*), and Canada thistle (*Cirsium arvense*).

22. Wildlife species that can be found in the study area are those that are commonly associated with or adapt well to human-altered environments. These species include opossum (*Didelphis virginiana*), gray squirrel (*Sciurus carolinensis*), striped skunk (*Mephitis mephitis*), and raccoon (*Procyon lotor*). Forested and old-field habitats that remain are important to a variety of species

because these fragments of habitat provide nesting and migratory stopover sites for a variety of landbirds including warblers and sparrows. Additionally, remaining wetland habitats provide foraging habitat for wading birds such great blue herons (*Ardea herodias*) and great egrets (*Casmerodius albus*).

III. ECOSYSTEM RESTORATION

Hudson-Raritan Estuary Ecosystem

23. The New York-New Jersey Harbor Estuary Program (HEP 1996) has identified five primary factors that have caused ecosystem impairments or otherwise degraded water or habitat quality in the Estuary. These factors are:

- Habitat Loss and Degradation: Recent wetland inventories estimate at least 80% of the Estuary's wetlands have been lost or significantly altered.

- Toxic Contamination: The presence of toxins in the Estuary's waters, sediments, and biota is the result of historic and residual contamination by industrial and non-point sources. Today, wastewater discharges, combined sewer overflows (CSOs), accidental releases, vehicle exhaust emissions, household chemicals, pesticides, atmospheric deposition, landfill leachate, urban runoff, and other non-point sources are continuing sources of toxic substances (HEP 1996).

- Pathogens: The primary sources of pathogens include CSOs, sewage treatment plant malfunctions, illegal connections to storm sewers, vessel sewage discharge, urban runoff, and other non-point sources.

- Floatable Debris: Floatable debris is made up of two primary components: trash or litter and harbor drift. Trash and litter enters the Estuary via runoff, storm sewer discharges, CSOs, beach and boat litter, and poor solid waste handling operations. Harbor drift composed primarily of material from dilapidated shoreline structures such as piers, bulkheads, and pilings, is a significant of floatable debris in the Estuary.

- Nutrient and Organic Enrichment: Eutrophication due to excessive discharges of nitrogen is a significant problem in the Estuary. Organic matter comprised primarily of carbon is decomposed as DO and used in the biochemical process. Nitrogen and carbon enter the Estuary through point and non-point sources such as sewage

treatment plants, runoff (primarily from over-fertilized lawns), rivers and tributaries and atmospheric deposition.

Primary Restoration Needs of the Hudson-Raritan Estuary

24. The overall goal of the HRE is to restore and enhance aquatic and nearshore terrestrial habitats that have been lost or degraded as a result of human activities. To achieve this goal, primary restoration needs of the Estuary have been established. These categories were identified in the document entitled *Restoration Opportunities in the Hudson-Raritan Estuary* (USACE 2001). These need are:

- Restore and create intertidal wetlands and mudflats,
- Restore benthic habitats and remediate "hot spots" of contaminated sediments,
- Restore and create freshwater/riparian wetlands,
- Restore fish habitat (remove impediments to fish passage; construct artificial reefs),
- Restore shellfish habitat,
- Restore and enhance shoreline/coastal fringe habitat (including upland areas),
- Create, restore, or enhance vegetated and non-vegetated shallow water habitat.

Restoration Needs of the Lower Raritan River

25. The natural ecosystems of the Lower Raritan River study area have been dramatically altered due to human activities. However, given the current use and level of development, the goal of ecosystem restoration may not always be to restore a given area to previous, "historic" conditions. More realistic goals may involve restoring what is left through the establishment of native vegetation or clean-up of contaminated sediments. Although restorations are being implemented in the study area under separate Congressional authorizations, e.g., the Continuing Authorities Program (CAP), and by other agencies (e.g., New Jersey Department of Environmental Protection), these could benefit from additional resources and the more unified study-area approach that the HRE will brings to the table.

Protect/Restore Existing Wetlands and Create New Wetlands

26. As mentioned above, significant wetland losses and modifications have occurred in the Lower Raritan River study area. Many of the wetlands that remain in the area have been modified or disturbed due to agricultural practices, the creation of utility right-of-ways, and other human activities. As a result, non-native, undesirable species, such as common reed, have become dominant in many wetlands. Invasion by non-native species reduces the value of these wetland habitats to native fish and wildlife species.

27. Intertidal wetland and mudflat areas should be restored to remove invasive species. Filled wetland sites should be regraded to restore tidal flow, eliminate common reed, and reestablish native salt marsh vegetation. Other blockages that restrict tidal flow should also be removed. Restoration of these habitats will improve foraging habitat for wading birds, waterfowl, raptors, and fish. Increasing the area of intertidal mudflats will improve habitat for benthic invertebrates and provide foraging habitat for shorebirds.

28. Like many of the tidal wetlands in the study area, freshwater and riparian wetlands have been degraded due to human disturbance and the placement of fill. Freshwater wetlands can be restored by removing fill, regrading, and planting native freshwater wetland vegetation. Managing stormwater runoff and restoring hydraulic connections between upland freshwater wetlands and riparian environments can enhance habitat in riparian zones. Restoration of freshwater wetlands will improve habitat for reptiles and amphibians (herpetofauna) as well as waterbirds.

29. Opportunities may also be present to increase the amount of wetlands within the study area by constructing new wetlands. Locations where it may be feasible to construct new wetlands include remediated brownfield sites, closed landfills, historic arsenals, or other vacant upland parcels.

Restore Stream/River Habitat

30. Riparian habitats in the study area have also been severely degraded. Changes in land use and direct alteration of stream channels have altered the hydrology of many streams and rivers. In addition, dams impede migration routes for anadromous fish such as striped bass (*Morone saxatilis*) and American shad (*Alosa sapidissima*). Removal of debris dams, together with efforts to improve water quality, could help restore historic fish runs to the Raritan River basin.

Remediate Leachate Sources, Persistent Oil Spill "Hotspots" and Contaminated Sediments

31. Efforts should be made to identify and remediate leachate sources in the study area. Leachate recovery and treatment systems could be installed or wetlands could be constructed to treat contaminated leachate from former landfills. Brownfield, historic arsenal, and industrial sites where groundwater contamination contributes to water quality problems.

32. Contaminated bottom sediments are a problem in the study area. Some areas are "sources," which contribute to contamination of other areas when the sediments are transported by littoral currents. Other areas are "sinks" for contaminated sediments. These "sinks" accumulate contaminated sediments that are moved by the currents within the waters of the study area. Several options exist for the remediation of contaminated sediments. One potential option is to cap areas of contaminated sediments using clean dredge material. Another option is to remove the contaminated sediments by dredging and replacing the sediments that were removed with clean dredged material. Contaminated sediments that are removed from waterbodies in the study area could be treated and then used in upland locations. These treated sediments could, for example, be used to cap landfills or brownfields.

Restore/Remediate Brownfield Sites

33. Many abandoned industrial and commercial facilities (brownfield sites) adversely affect adjacent habitats as well as the habitats present within individual sites. Contamination at existing brownfield sites could be remediated and the sites restored to more ecologically viable conditions. Abandoned, man-made structures could be removed and native vegetation could be re-established. In addition, depending upon their position in the landscape, brownfield sites could be used to establish buffers between existing industrial uses and natural communities and, in many cases, serves as parks and open space as well.

34. Superfund sites and Hazardous, Toxic, and Radioactive Waste (HTRW) sites are located within the study area. The remediation of these sites could incorporate a wide variety of remedial activities, ranging from relatively simple "cut and scrape" cleanups to highly complex long-term remediation activities. Prior to site-specific restoration efforts, data regarding the existing conditions relating to contamination must be obtained.

Restore Upland Habitats

35. Upland habitats are severely fragmented and degraded. Enhancement of shoreline habitat along the Raritan River will benefit nesting waterbirds, reduce habitat fragmentation, help shade and provide cover to stream systems, and provide additional upland habitat for reptiles and amphibians, mammals, and migratory and resident landbirds.

36. The study area contains pockets of undeveloped land across a highly developed landscape. In addition, many abandoned industrial sites exist. Opportunities may exist to restore these abandoned properties to a natural state and link sites that are currently isolated from other natural areas. Connections between isolated natural areas have the potential to provide important corridors for fish and wildlife. These corridors could also serve as parks, trails, or other public open space areas that would provide passive and active recreational opportunities, as appropriate.

Existing Restoration Efforts

37. Habitat restoration work in the Estuary has been underway for some time and various organizations, most notably, the Harbor Estuary Program (HEP) Habitat Workgroup, have identified potential sites and sought to promote restoration efforts. While the number of existing and ongoing restoration efforts in the study area are limited, potential for additional efforts does exist.

38. One on-going restoration effort within the study area is a component of the New York District's South River, Raritan Basin Hurricane and Storm Damage Reduction and Ecosystem Restoration project. For this project, the area under consideration for ecosystem restoration encompasses approximately 1,300 acres of wetlands and uplands along the Old South River and the Washington Canal. The wetlands within the area are degraded and dominated by common reed while the uplands are dominated by low-quality scrub-shrub habitat. The proposed ecosystem restoration portion of the project involves restoring nearly 400 acres of degraded wetlands to emergent marsh, forested wetlands, open water, and mudflat. In addition, upland forest and scrub-shrub habitat will be restored using more desirable vegetative species.

Potential Restoration Sites

39. Twenty-eight potential restoration sites have been identified in the Lower Raritan River study area and are listed in Table 1. Each site will be evaluated to determine which of the proposed restoration activities, if any, are feasible from an engineering and economic perspective. Also of special interest are sites that offer opportunities to connect and/or expand existing high-quality areas or create habitats that are in especially short supply or have suffered disproportionate losses in the past.

Table 1 - Potential Restoration Sites in the Lower Raritan River

HRE Site ID	Name	Restoration Opportunities[(1)]
1RR	South Plainfield Veterans Memorial Park	*
2RR	Cornell Dubilier Superfund Site	*
3RR	Chemsol, Inc.	*
4RR	Auxilic Air	*
5RR	Woodbrook Road	*
6RR	Renora, Inc.	*
7RR	Hatco Chemical	*
8RR	IT/El Paso/Tennaco Energy/Nuodex	*
9RR	Raritan Arsenal	*
10RR	National Lead	*
11RR	131 Jersey Avenue	*
12RR	Kents Neck	*
13RR	Disch Disposal Site	*
14RR	Chemical Insecticide Superfund Site	*
15RR	Silver Lake	*
16RR	Mill Brook Center	*
17RR	Iron Leaf	*
18RR	Kin-Buc Landfill	*
19RR	ILR	*
20RR	Edison Landfill	*
21RR	Fried Industries	*
22RR	Edgeboro Landfill	*
23RR	Raritan/South Rivers	1,6,7
24RR	Raritan Center	1,6
25RR	Raritan River Waterfront	*
26RR	Evor Phillips Leasing Company	*
27RR	CPS/Madison Industries	*
28RR	South Brunswick Landfill	*
29RR	Jones Industrial Service Landfill	*
30RR	Factory Lane	*
31RR	Middlesex Sampling Plant	*

HRE Site ID	Name	Restoration Opportunities[(1)]

(1) Restoration Opportunities:-
1 – Restoration/Creation of Intertidal Wetlands/Mudflats
2 – Benthic Habitat Restoration (Hotspot Removal)
3 – Restoration/Creation of Freshwater/Riparian Wetlands
4 – Restoration of Fishery Habitats (Anadramous Fish Migration, Artificial Reefs)
5 – Shellfish Habitat Restoration
6 – Restoration/Enhancement of Shoreline/Coastal Fringe Habitat (Dunes, Bird Habitat)
7 – Creation/Restoration/Enhancement of Shallow Water Habitat (including Eelgrass)
8 – Shoreline Enhancement/Bank Stabilization
9 – Water Quality Improvement
10 – Riparian Habitat Restoration
11 – Environmental Interpretation
* To be determined

IV. CONCLUSIONS

40. Based upon the history of degradation and the natural resource conditions, opportunities may exist to restore intertidal wetlands and mudflats, enhance fish habitat on the Raritan River and its tributaries, restore freshwater wetlands and riparian habitat, and enhance shoreline/upland habitat.

41. The study area encompassing the Raritan River is an important component of the Estuary because it is a significant source of freshwater. Dams on the river have impeded movement of anadromous fish. Intense development in the riparian zones has resulted in the loss of a significant proportion of wetlands and natural riparian habitats. Installation of fish ladders and/or dam removal will allow fish to access potential spawning habitat. Restoration of wetland, shoreline, and in-stream habitats will provide habitat for resident and migratory fish and birds. Such efforts may also increase habitat available to reptiles and amphibians. Restoration of riparian zones and wetlands also have the potential to contribute to flood control in the study area.

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FIGURES