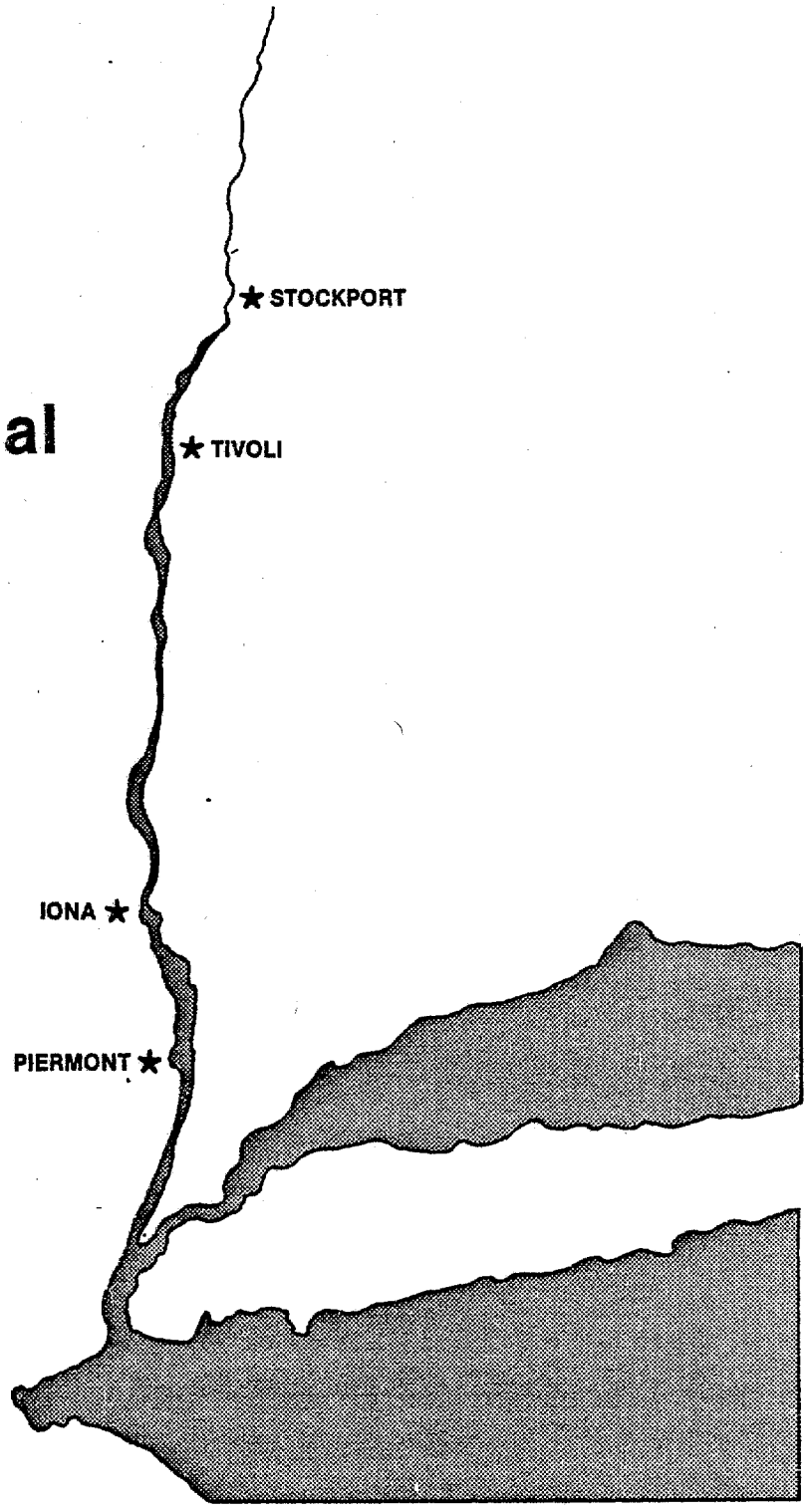
Management Plan

Hudson River National Estuarine Sanctuary



U.S. DEPARTMENT OF COMMERCE

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1985

THE HUDSON RIVER NATIONAL ESTUARINE SANCTUARY MANAGEMENT PLAN

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EXECUTIVE SUMMARY

In August 1984, after several years of state and local efforts to establish an estuarine sanctuary in New York with assistance from the National Oceanic and Atmospheric Administsration, the Hudson River National Estuarine Sanctuary became reality. Four components of the Sanctuary have been established, including Stockport Flats, Tivoli Bays, Iona Island, and Piermont Marsh. The primary goals for establishing and managing the various land ownerships within each of the four components as part of a single system are:

- o To establish and manage the area within the boundaries of the Hudson River National Estuarine Sanctuary as a natural field laboratory. to protect the natural resources of the wetlands, transitional areas, and adjacent uplands. To conduct and facilitate both short- and long-term estuarine research, education and interpretation.

- o To promote cooperative management by state and municipal agencies to ensure that the short and long-term uses of the Sanctaury carry out Sanctuary goals and policies as articulated in this Sanctuary Management Plan.

- o To provide for controlled multiple use of the Sanctuary to allow for the continuation of existing low intensity recreational and commercial fishing uses that are presently permitted and compatible with the Sanctuary's character as a natural field laboratory.

This management plan defines how these goals will be met through its articulation of Sanctuary objectives, policies, and programs.

The Department of Environmental conservation (DEC) administers the Sanctaury and is directly responsible for the expen-

diture of program funds and implementation of the research and educational programs. A state Sanctuary Steering Committee advises the Department on all matters relating to Sanctuary management; this committee is chaired by DEC and comprised of representatives from the Palisades Interstate Park Commission, the Office of Parks, Recreation and Historic Preservation, the Department of State, and the Office of General Services, and the National Oceanic and Atmospheric Administration on an ex-officio basis. Three local citizen's advisory groups provide advice, make recommendations, and channel public support and criticism to the Steering Committee.

Estuarine Sanctuary research and education programs will be closely coordinated with related programs on the Hudson River, particularly those of DEC's Hudson River Fisheries Unit and Fisheries Advisory Committee, the Hudson River Foundation for Science and Environmental Research, the Hudson River Sloop Clearwater, and the Hudson Valley's colleges and universities.

Research

The Sanctuary research program emphasizes long-term environmental monitoring, ecosystem studies, and applied problems in the management of estuary resources. Much research has been done on the Hudson River Estuary, but efforts have generally been fragmented and there are many serious gaps in the knowledge needed to effectively manage the Estuary, particularly with

respect to shorelines, shallows, and tidal wetlands. The Sanctuary research program will help to coordinate and unify Hudson River research, provide information to coastal managers at all levels of government and in the private sector, and improve the management of Hudson River estuarine resources. Research services and facilities at Tivoli Bays are being upgraded for these purposes.

Education

The Estuarine Sanctuary sites contain a variety of fauna and flora and estuarine habitats representative of the Hudson River Estuary located within easy reach of millions of New York State and greater New York City area residents. The Sanctuary provides an opportunity for many to learn more about the estuary's geology, ecology and resources. Sanctuary funds are being used to develop Hudson Estuary related exhibits at the Bear Mountain Trailside Museums complex near Iona Island Marsh; this complex is visited by over 600,000 people each year. Funds are also being used to set up facilities at Tivoli Bays for educational exhibits. In addition, several programs are being developed, such as guided field trips, self-guided trail brochures, and educational media available for public groups and schools on loan.

Recreation and Commercial Fishing

Although scientific research and education are the primary emphasis of the Sanctuary, existing low intensity recreational and commercial fishing uses will be allowed to continue, provided

that they are compatible with the Sanctuary's character as a natural field laboratory and are currently permitted. These include hiking, hunting, fishing, trapping, boating, wildlife observation, and other low intensity activities.

I. INTRODUCTION

The Hudson River flows through eastern New York State from the Adirondack high peaks south to New York City where it empties into New York Harbor, lower New York Bay, and the New York Bight. Along the 152 miles between the Federal Dam at Troy and Battery Park at the tip of Manhattan Island the Hudson is an estuary, an arm of the sea subject to both river currents and ocean tides. Brackish water may occur as far inland in the Hudson River as Hyde Park.

The Hudson Estuary is a remarkable system that continues to sustain an enormous productive potential. A wide variety of habitat types are present in the Hudson Estuary, including deep water, shallows, tidal marshes and swamps, upland forests, clay banks, and rock cliffs. These habitats support an impressively diverse array of flora and fauna, including a number of endangered species. The estuary is an invaluable fish and wildlife resource, which not only provides food, but also breeding habitats and nursery areas. Its commercial importance alone is staggering; estimates suggest that about 90 percent of the shell fisheries and 65 percent of the coastal fin fisheries directly depend on estuarine environments.

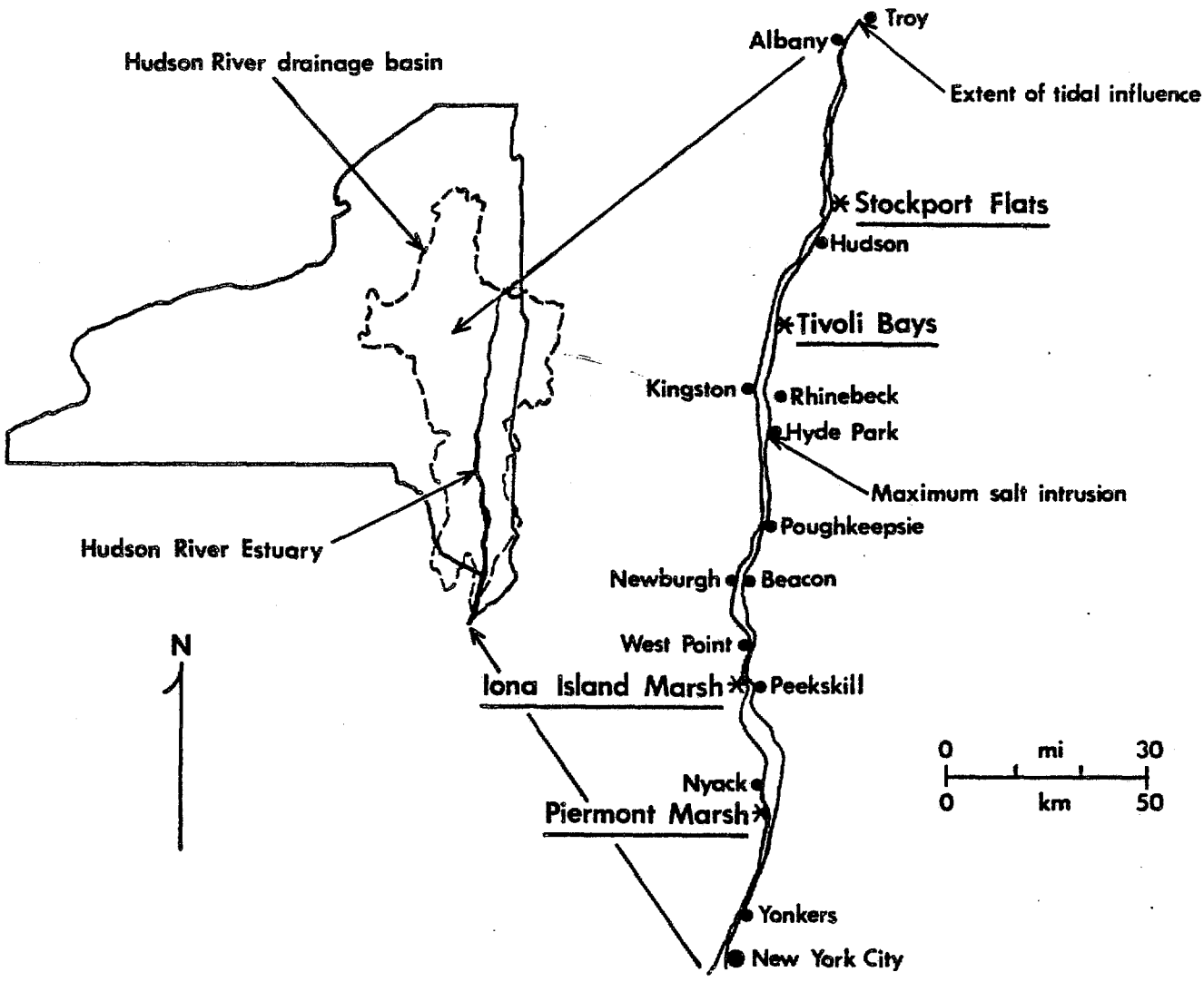
This estuarine system is used and enjoyed by millions of people, although human impacts on this productive and extremely complex system have generally been detrimental. Fortunately,

estuarine systems are highly resilient, and many of these human impacts are not permanent or irreparable. However now, more than ever, there is a need for wise, informed management.

The State of New York has demonstrated its commitment to maintaining the resource productivity of its coastal zone through its enactment and implementation of a wide range of state protective programs and by its participation in similar federal programs. State and federal cooperation on the establishment of the Hudson River National Estuarine Sanctuary ensures the availability of research sites for the study of natural processes and ecological relationships. These investigations will provide information that is essential to effective coastal resource management decisions. Information from research and monitoring will assist resource managers in developing effective programs for maintaining and improving the quality of estuarine resources. Results of the investigations will be presented in both scientific documents and public education materials. The on-going availability of these sites for educational activities is also ensured.

The Hudson River National Estuarine Sanctuary consists of four components (Figure 1) - Stockport Flats, Tivoli Bays, Iona Island Marsh, and Piermont Marsh - spanning an 84-mile stretch of the Mid and Lower Hudson shoreline from Columbia County south to Rockland County. These four natural areas are among the Hudson River's largest and most productive tidal wetland complexes,

FIGURE 1
THE HUDSON RIVER ESTUARY



	Stockport	Tivoli	Iona
Tivoli	19 mi 35 min		
Iona	67 mi 125 min	49 mi 90 min	
Piermont	84 mi 160 min	66 mi 125 min	18 mi 35 min

Distances (airline miles) and approximate driving times (minutes) between sites.

which encompass a variety of habitats in both salt water and freshwater environments. The four components are being managed as a unified system, but each area is representative of a different geologic segment of the estuary, and each has a unique character. They represent a salinity gradient which ranges from freshwater at Stockport and Tivoli to water that varies from fresh to 12 parts per thousand of salt at Piermont Marsh, the site nearest the Atlantic. As a system, they support plant and animal species characteristic of the National Estuarine Sanctuary System's Virginian Biogeographic Region. Furthermore, the four Sanctuary components all have histories of observation and research that greatly facilitate the initiation of research and education programs, and all are largely state-owned.

The Stockport Flats component (Figure 2) is the northernmost site. It is located on the east shore of the Hudson River in the Town of Stockport in Columbia County, 4 miles north of the City of Hudson and 22 miles south of Albany. Here the Hudson River is relatively narrow and shallow, with steep, low bluffs rising 100 feet above the shore.

A variety of land forms are assembled within the Stockport component, which comprises a four-mile series of peninsulas, islands, marshes, shallows, sand bars, minor stream channels, and the mouth of Stockport Creek, a tributary stream. Stockport Middle Ground, Gay's Point, and Fordham Point are to the north of Stockport Creek, while Unnamed Island, Priming Hook, and the main

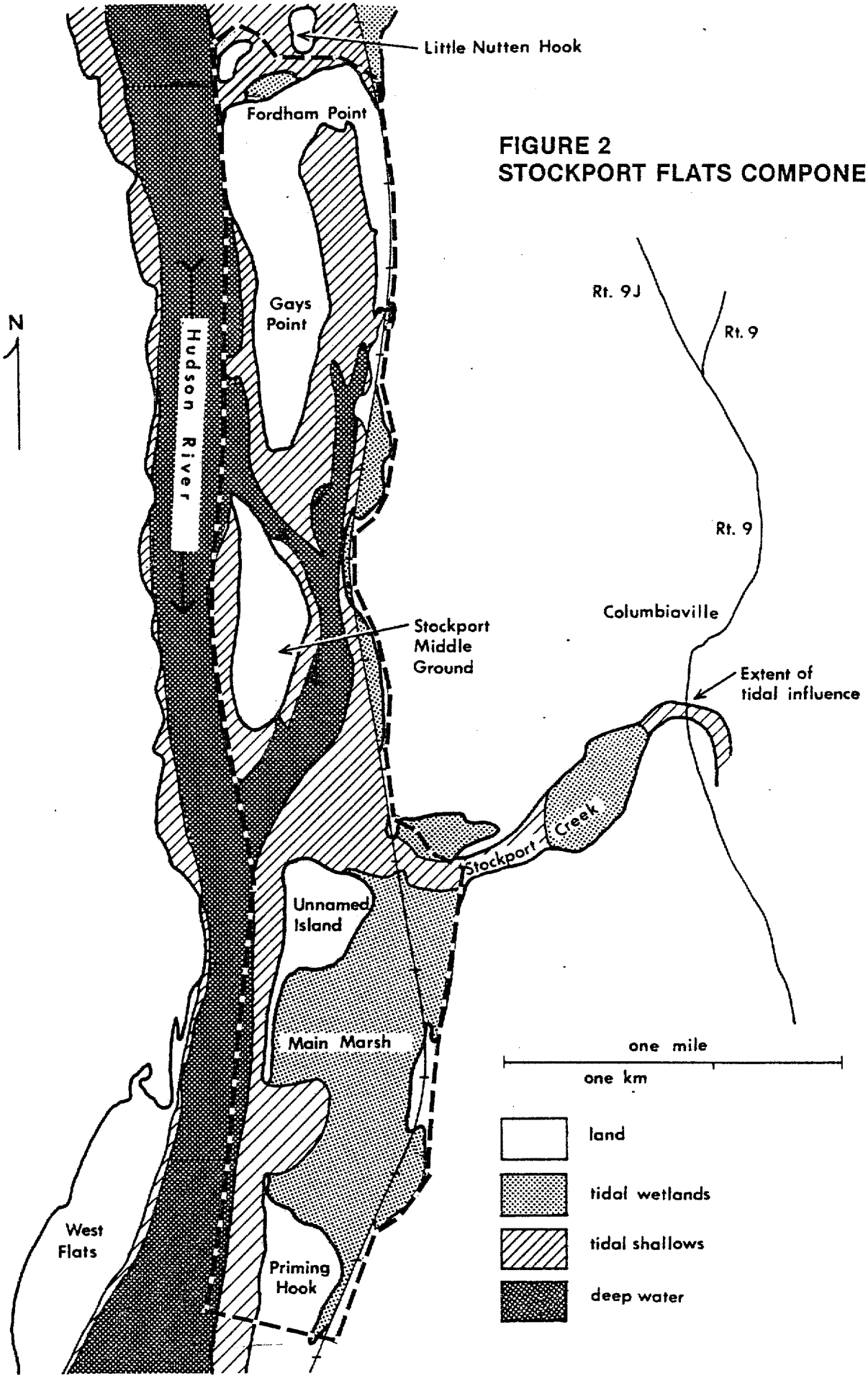


FIGURE 2
STOCKPORT FLATS COMPONENT

(Adapted from USGS Hudson North, N.Y. quadrangle.)

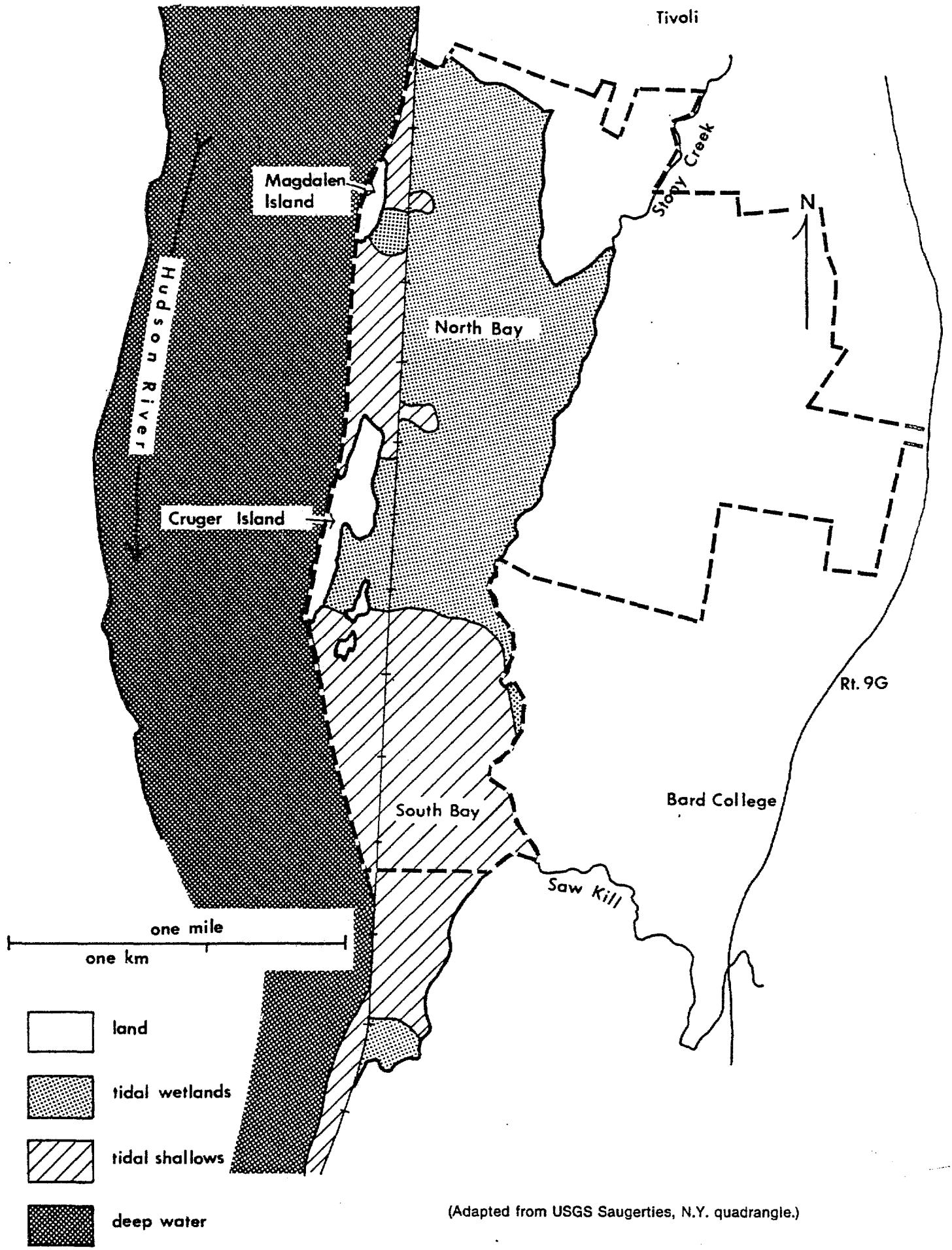
marsh, East Flats, lie to the south. Stockport Middle Ground and Gay's Point are included in the Hudson River Islands State Park.

The Stockport Flats site is noted for its wealth of biological resources, including what may be the most extensive wild rice stand anywhere on the Hudson.

The Tivoli Bays component (Figure 3) is in the northwest corner of Dutchess County between Tivoli and Barrytown in the Town of Red Hook. It is 7 miles north of Rhinebeck and 19 miles north of Poughkeepsie. This site is dominated by two large coves on the east shore of the Hudson River, North Bay and South Bay, and includes Cruger Island and Magdalen Island, their associated tidal shallows, and the mouths of two tributary streams, Stony Creek and Saw Kill. The Tivoli Bays state lands have been designated an Experimental Ecological Reserve by the Institute of Ecology at Butler University. The Tivoli Bays area is listed on the National Register of Historic Places and is included in the Mid-Hudson Historic Shorelands State Scenic Area, which extends from Clermont to Hyde Park.

The large complex of wildlands at Tivoli Bays possess a high natural diversity. North Tivoli Bay, created by a partial diking of a shallow estuary edge over a century ago, is a freshwater tidal marsh, while South Bay is principally freshwater mud flats and tidal shallows succeeding to marsh. The islands are rocky, wooded bluffs and ridges. This area stretches two miles, and is

FIGURE 3
TIVOLI BAYS COMPONENT



(Adapted from USGS Saugerties, N.Y. quadrangle.)

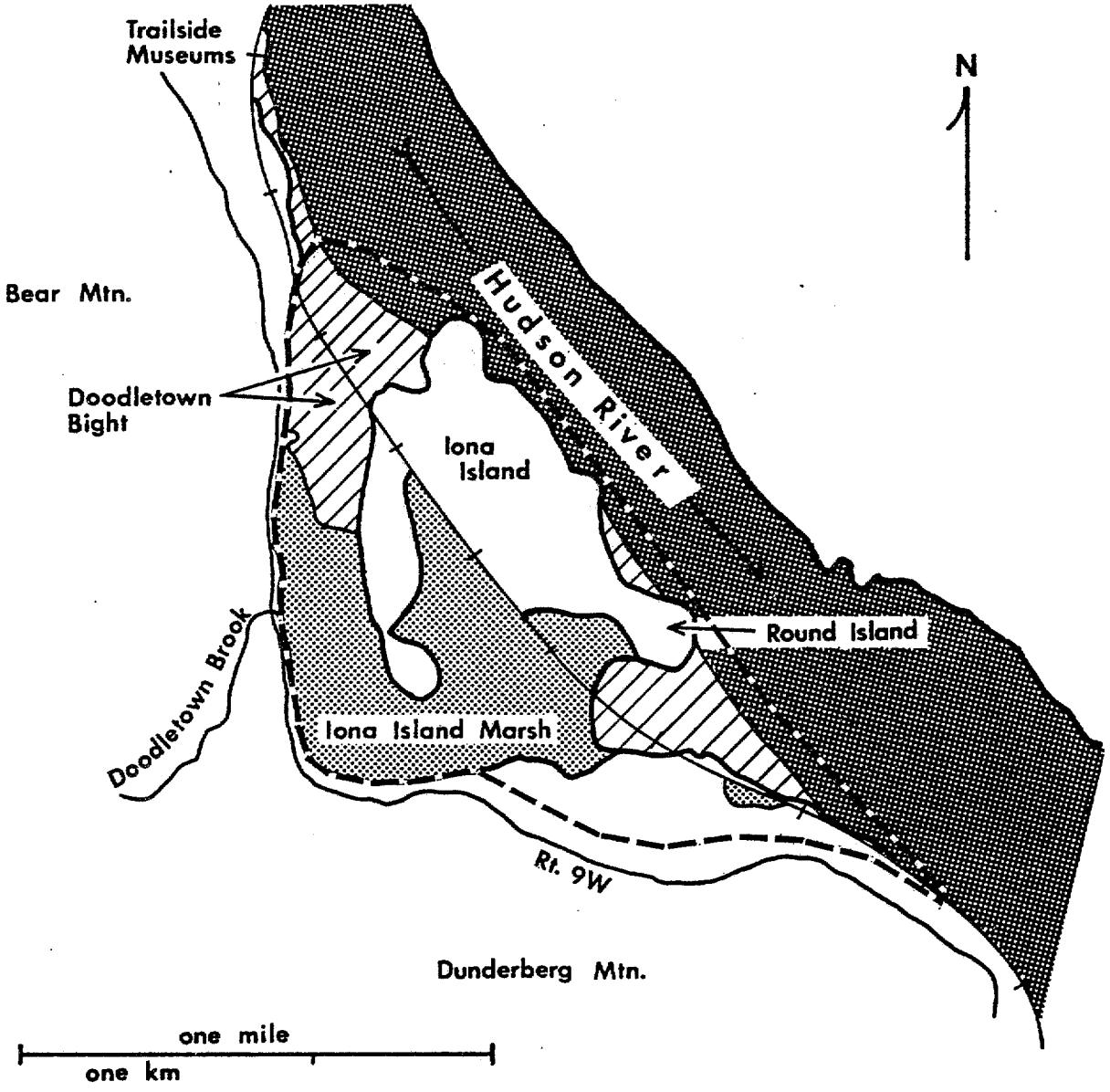
entirely bounded to the east by clay bluffs that support well developed and nearly undisturbed mixed forest. Tivoli Bays is an important migration stopover for birds.

The Iona Island Marsh component (Figure 4) lies 6 miles south of West Point in the Town of Stony Point, Rockland County. It is a dramatic site in the midst of the Hudson Highlands, set at the edge of one of the narrowest reaches of the Hudson Estuary. This Sanctuary site encompasses Iona Marsh (Salisbury Meadow), Iona Island, Round Island and its associated shallows, the mouth of Doodletown Brook and Doodletown Bight. The entire site is part of Bear Mountain State Park, an element of the Palisades Interstate Park System. Iona Marsh has been designated a National Natural Landmark by the U.S. National Park Service.

Iona Marsh began to form in the shelter of Iona Island over 6,000 years ago. This intertidal marsh is dominated by narrowleaf cattail and is laced with tidal creeks, while large areas of mud flats are exposed at low tide in adjacent Doodletown Bight. The causeway connecting the mainland to Iona Island facilitates access to this portion of the site, which is dominated by dry, deciduous forest. In recent years, several bald eagles have used Round and Iona Islands as a wintering area.

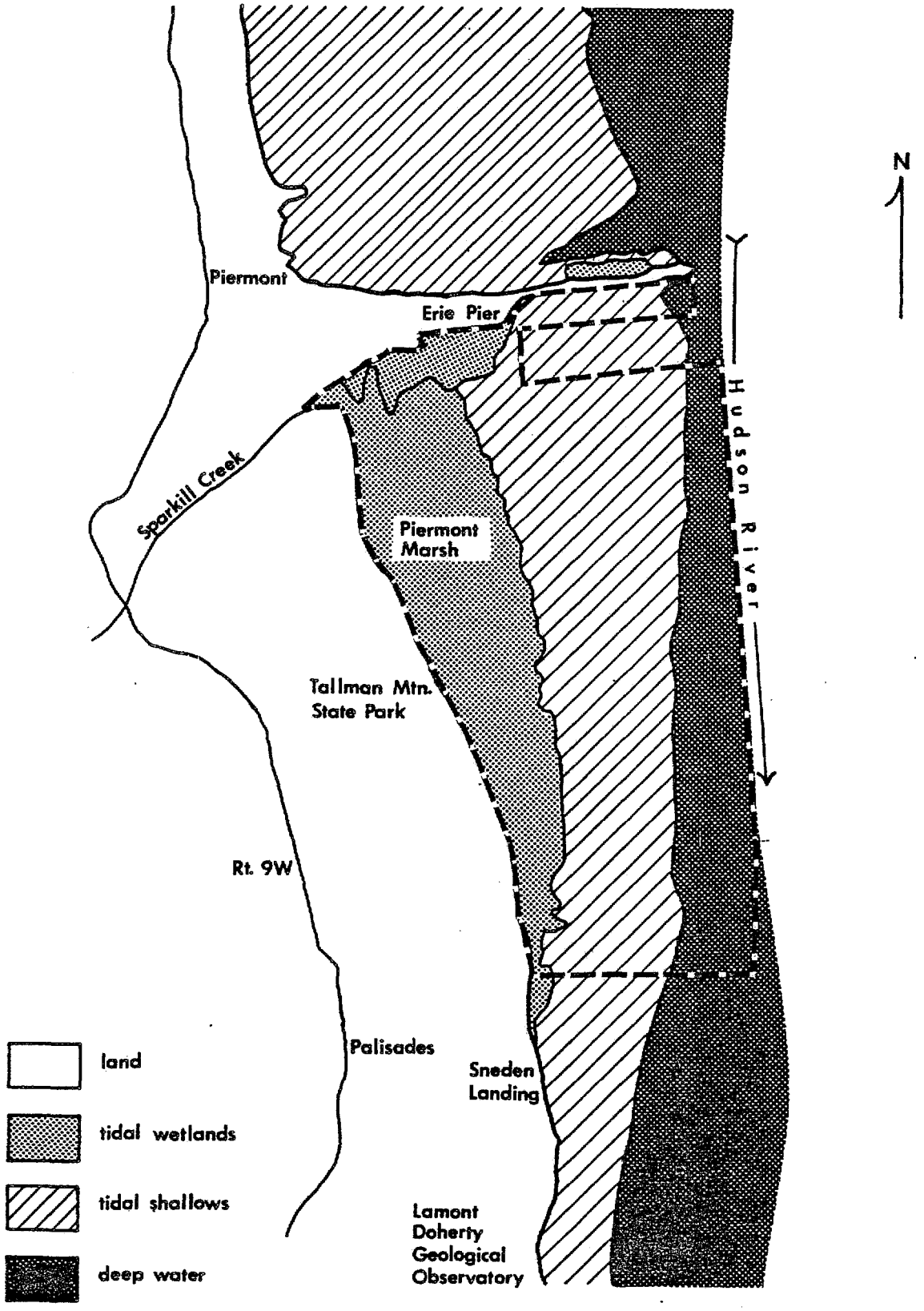
Piermont Marsh (Figure 5), in the Town of Orangetown, Rockland County, is the southernmost Sanctuary site. A section at the north end of this site is in the Village of

FIGURE 4
IONA ISLAND MARSH COMPONENT



(Adapted from USGS Peekskill, N.Y. quadrangle.)

FIGURE 5
PIERMONT MARSH COMPONENT



(Adapted fromUSGS Nyack, N.Y.—N.J. quadrangle.)
(Areas shown as 'tidal wetlands' and 'tidal shallows' are both considered tidal wetlands under the State Tidal Wetlands Act.)

Piermont. Piermont Marsh extends one-and-one-half miles south from Erie Pier in Piermont to Sneden's Landing along the west shore of the Hudson River. This site is largely a part of Tallman Mountain State Park, also an element of the Palisades Interstate Park System.

The Piermont Marsh overlooks the south end of the very broad and shallow section of the Hudson River estuary known as Haverstraw Bay and Tappan Zee. The marsh includes the mouth of Sparkill Creek, and is surrounded by very extensive tidal shallows, which are juxtaposed with a mature hardwood forest at the base of the Palisades Ridge. The Piermont Marsh site is one of the richest marsh areas on the Hudson River estuary.

The unique qualities of these sites -- their diversity and productivity -- warranted the establishment of a sanctuary to safeguard their integrity as prime examples of estuarine environments found along the Hudson River. These sites are being managed with advice from both local and state advisory committees. The local committees offer an unparalleled familiarity with each site -- the resources present there, their problems, and ways of managing them to meet the program's goals. The state Steering Committee provides administrative direction to general Sanctuary management and the implementation of research and education programs.

This management plan specifies both site and off-site management goals and objectives for the protection and use of

Sanctuary resources. To fulfill these goals, the plan establishes both general and site-specific policies that enable research projects, educational activities, and recreational pursuits to take place without hindering each other and without damaging the Sanctuary's resources. The plan outlines ways these policies will be carried out. It also defines the roles of the Sanctuary committees and staff.

This management plan is not intended to be a static document, but will be amended through deliberate and careful evaluation by the Steering Committee of changes proposed by members of the Steering Committee, the Sanctuary staff, the local advisory committees, NOAA's Office of Ocean and Coastal Resource Management, and the public. This must be a living document in order to be part of a vital, living estuary. The efforts and contributions of these groups ensure that the Hudson River National Estuarine Sanctuary is effectively managed as a valuable resource for the state and the nation.

II. BACKGROUND ON THE NATIONAL ESTUARINE SANCTUARY PROGRAM

The Hudson River National Estuarine Sanctuary is part of the National Estuarine Sanctuary Program which is supported by the U.S. Department of Commerce's National Oceanic and Atmospheric Administration (NOAA). Congress established the National Estuarine Sanctuary Program in response to disturbing trends in coastal areas throughout the country -- the pollution of coastal waters, the closing of shellfish beds, the draining of marshes, and other human-induced damages to valuable and productive estuarine systems. Fewer and fewer natural estuarine areas were available for scientific study and public education. At the same time, the need was growing for more information about the processes and functions of estuarine ecosystems, and human effects on them, to improve the management and development of the nation's coastal areas. The creation of estuarine sanctuaries was an important step toward addressing these information needs.

Section 315 of the Coastal Zone Management Act of 1972 (P.L. 92-583), as amended, established the National Estuarine Sanctuary Program and provided grants on a matching basis to states to acquire, develop, and operate estuarine areas to be set aside as natural field laboratories. In addition to providing a wealth of opportunities for basic and applied scientific research into the estuarine environment, these sanctuaries are places where students and the general public can learn about natural processes in

the coastal region and human effects on them. Other low-intensity uses of the sanctuaries can be allowed as long as they do not impede research and educational activities.

To ensure that the National Estuarine Sanctuary Program includes sites that adequately represent regional and ecological differences, the program regulations established a biogeographical classification scheme that reflects geographic and biological characteristics. Eleven biogeographic categories are defined in the program regulations. The Hudson River Estuary is representative of similar ecosystems found in the region that extends from Cape Cod to Cape Hatteras (the Virginian Biogeographic Region).

The National Estuarine Sanctuary Program regulations (15 CFR 921) authorize four kinds of 50 percent matching grants: (1) an optional, initial planning grant for such preliminary purposes as assessing the lands proposed for acquisition, preparing an environmental impact statement, and developing draft management, research and education plans; (2) grants for acquisition of the real property within the sanctuary boundaries and development of interpretive/research facilities; (3) operation grants for managing the established sanctuary's research and education programs; and (4) limited research funds on a competitive basis.

New York's involvement in the National Estuarine Sanctuary Program is not new, but has spanned a period of approximately

four years. An initial proposal for a sanctuary on Long Island was impracticable, and the State's alternative choice, a sanctuary on the Hudson River Estuary, was proposed. The U. S. Commerce Department, NOAA, awarded New York's Department of Environmental Conservation (DEC) a pre-acquisition grant of $50,000 in September, 1981, which was matched by DEC funds and services. Representatives of involved State agencies met to select sites on the Hudson, and DEC took the role of lead agency, with cooperation from the Palisades Interstate Park Commission (PIPC), the Office of Parks, Recreation and Historic Preservation (OPRHP), the New York State Department of State (DOS), and the Office of General Services (OGS).

On October 12, 1982, the Hudson River National Estuarine Sanctuary system was formally dedicated during a ceremony on the deck of the aircraft carrier Intrepid, now a floating naval museum docked on the Hudson River off 40th Street in New York City. New York State's Coastal Zone Management Program, which is under the direction of DOS, was also dedicated during those ceremonies. The dedication of the Hudson River National Estuarine Sanctuary came shortly after the awarding of a $375,000 Acquisition grant from NOAA's Office of Oceanic and Coastal Resource Management. This grant, matched by the State, provides for acquisition of some Sanctuary land, development of research and educational facilities, and administrative costs.

III. GOALS OF THE HUDSON RIVER NATIONAL ESTUARINE SANCTUARY

The Hudson River National Estuarine Sanctuary is a unique combination of lands and waters that have been set aside as a natural field laboratory in which to study the natural and human processes occurring within estuarine ecosystems. The Hudson River National Estuarine Sanctuary will be managed to meet the following goals:

- o To establish and manage the area within the boundaries of the Hudson River Naitonal Estuarine Sanctuary as a natural field laboratory. To protect the natural resources of the wetlands, transitional areas, and adjacent uplands. To conduct and facilitate both short and long-term estuarine research, education, and interpretation.

- o To promote cooperative management by state, interstate, and municipal agencies to ensure that the short and long-term uses of the Sanctuary contribute to carrying out Sanctuary goals and policies as articulated in this Sanctuary Management Plan.

- o To provide for controlled multiple use of the Sanctuary to allow for the continuation of existing low intensity recreational uses that are presently permitted, including fish and wildlife recreation (e.g. hunting, fishing, wildlife observation), which are compatible with Sanctuary's character as a natural field laboratory.

This Hudson River National Estuarine Sanctuary Management Plan charts how these goals will be met. It is a comprehensive management plan that provides direction and guidance for the operation of the Sanctuary to agency administrators and Sanctuary staff, and also serves as a guide for others to opportunities, programs, and facilities associatd with the Sanctuary.

IV. HUDSON RIVER ESTUARY AND SANCTUARY COMPONENT DESCRIPTIONS

The Hudson River flows 315 miles through eastern New York from Lake Tear of the Clouds on the southwestern slope of Mount Marcy in the Adirondacks south to New York City. Except for 20 miles near its mouth where New Jersey forms its western shore, the river lies entirely in New York State. The tidal Hudson stretches 152 miles from Troy to Battery Park on the southern tip of Manhattan Island where the river empties into New York Harbor, lower New York Bay, and the New York Bight.

The human history of the Hudson River is rich and varied. A wealth of archeological sites along the Hudson River Estuary corridor indicate that Native American cultures inhabited the region as much as 5,000 years ago. These peoples were particularly drawn to the region's variety and abundance of food supplies and natural resources, as were the European settlers that followed them. Large ocean-going vessels are able to navigate as far north as Albany, and the river has long been a great commercial artery, and a strategically important one. There has been a long history of artistic interest in and esthetic appreciation of the Hudson River's varied landscapes and scenic resources. The high levels of public concern for and interest in the Hudson Estuary in recent times is reflected in the designation of Stockport Flats, Tivoli Bays, Iona Island Marsh, and Piermont Marsh as components of the Hudson River National Estuarine Sanctuary.

The Hudson River watershed is one of the most geologically complex regions in the United States, and the shores of the estuary encompass a great variety of bedrock types, landforms, and soils. The bed of the estuary itself is filled with glacial and post-glacial deposits beneath recent estuarine sediments. Predominantly steep shores limit the extent of the river's floodplain, although extensive dikes were constructed below Troy in the 1930's to control the shifting flow through an area of broad flats.

The Hudson Estuary is unbranched and relatively narrow; it varies in width from one-sixth to two-and-one-half miles. Maximum river depths range from 13 to 200 feet. Tides penetrate upriver to the Federal Dam at Troy since the river bed is below sea level from Manhattan to Troy.

Vertical tide fluctuation or tide range is least in the middle of the Hudson River Estuary, about 2.8 feet at the Iona Island component, and greatest at the two ends of the estuary. Tide range increases to 3.2 feet at Piermont Marsh, 3.9 feet at Tivoli Bays, 4.0 feet at Stockport Flats, and 5.1 feet at Troy.

Salt water usually intrudes less than half the length of the estuary because of the river's substantial and relatively dependable freshwater flow. As salt water moves upriver from the ocean, it becomes increasingly dilute. The limit of salt water penetration is the "salt front", defined as the 0.1 parts per

thousand (ppt) salinity level. Depending on freshwater flow, the salt front occurs anywhere from Yonkers north to Hyde Park, but it usually lies between Nyack and Beacon. The water at Stockport Flats and Tivoli Bays is fresh, at Iona Island it is fresh to 6 ppt salinity, and at Piermont Marsh it is fresh to 12 ppt. Salinity is normally 30 ppt at New York City.

Salt water has a higher density than freshwater, and a vertical salinity gradient develops in many estuaries as lighter outflowing freshwater encounters denser incoming saline water and moves up in the water column. These vertical salinity gradients are small in the Hudson estuary, largely due to the river's turbulent flow.

The climate of the Hudson River estuary is humid continental and the moderating influence of the ocean is important in the Iona Island and Piermont Marsh components. January average air temperatures range from 23° to 29°F. along the estuary, and July averages range from 71° to 73°F. Average temperatures are slightly higher to the south. Growing seasons range from 150 to 200 days along the estuary, with slightly longer seasons occurring in the southern reaches. Precipitation is moderately well distributed, and annual averages range from 37 to 46 inches. Climate tends to be slightly wetter to the south where moist coastal air masses move into the lower estuary. Annual snowfall averages range from 39 to 50 inches.

Prevailing winds are north or northwest in winter, and south or southwest in summer. Average wind speeds are highest in March

and lowest in August. Winds are highly variable, and summer thunderstorms, sudden squalls, and occasional hurricanes affect the river. Weather in the estuary is quite variable and shoreline areas and wetlands are exposed to extremes of temperature, freezing and thawing, wind, waves and spray, and other factors. Temperature inversions with night and morning fogs occur frequently in summer and fall.

A wide variety of habitat types are present in the Hudson River estuary and represented in the estuarine sanctuary. These include deep water, shallows, intertidal wetlands, tidal freshwater and low-salinity marshes, and tidal swamps. Terrestrial habitats along the estuary are also diverse. A list of the vascular plants found in the four Sanctuary components is in Appendix 1. Endangered, threatened and rare plants found in the Sanctuary are listed in Table 1.

A host of animal species rely on Hudson River estuarine habitats as migration and dispersal pathways, stopover habitats, seasonal homes, or permanent residences. Many animals move between two or more habitat types in tidal, daily, or seasonal cycles in order to fulfill their life requirements. These habitats support an abundance of animal species, including amphibians (Appendix 2), reptiles (Appendix 3), nearly 70 fishes (Appendix 4), over 250 birds (Appendix 5), and about 50 mammals (Appendix 6).

TABLE 1. Plants of the Hudson River National Estuarine Sanctuary Listed in "Rare and Endangered Vascular Plant Species in New York State" (Mitchell et al., 1980)

Species	Site	Significance (NY[a])
Spatulate arrowhead, *Sagittaria spatulata*	Stockport	HAB
Ovate spikerush *Eleocharis ovata*	Stockport Tivoli, Iona	R, SERL
Cylindrical bulrush, *Scirpus cylindricus*	Iona, Piermont	SPOR
Parker's pipewort, *Eriocaulon parkeri*	Stockport, Tivoli	R, VULN
Sea Pink, *Sabatia dodecandra*	Iona	EXT?, NRL, SNYS?
Nuttall's micranthemun *Micranthemum micranthemoides*	Tivoli	*EXT?, R, SYNS, SPOR, VULN
Heartleaf Plantain, *Plantago cordata*	Stockport, Tivoli	*R, DECL, SPOR
Eaton's bur-marigold, *Bidens eatonii*	Tivoli	R, HAB, END
Estuary beggar-ticks, *Bidens hyperborea*	Tivoli	SRL

[a]DECL = Observed to be declining in New York State
EXT? = Possibly extirpated in New York State
HAB = Restricted to habitats rare in the State
R = Rare throughout its range
SYNS = Single New York station
SPOR = Sporadic: scattered populations
VULN = Vulnerable to commercial or private exploitation or imminent land development
SRL, SERL, NRL = Southern, southeastern, or northern range limits or nearing the periphery of their distributions

*Listed in the Federal Register (proposed for Federal Endangered or Threatened listing).

Thirty endangered, threatened, and special concern amphibians, reptile, fish, bird, and mammal species have been recorded at or near the Sanctuary sites and are recorded in Table 2.

The four component sites included in the Hudson River National Estuarine Sanctuary comprise approximately 4,165 acres, of which 2,860 acres are tidal wetlands and shallows. The bulk of this property is already state-owned (Table 3), although approximately 400 acres are privately owned and efforts are underway to acquire them (see Administration section). These parcels are identified in Table 4.

A. Stockport Flats Component

Stockport Flats is the northernmost and second largest Sanctuary component, with approximately 1,150 acres on the east shore of the river, located between Albany and Hudson in the Town of Stockport (Figure 2).

History

Artifacts indicate that Native American cultures inhabited the area surrounding Stockport, Kinderhook, and Claverack creeks where there was ready access to both the Hudson River and to terrestrial and estuarine natural resources. Dutch settlers first arrived in the early 1600s and established a lively trade in beaver skins; one record indicates that 4,000 skins were shipped from one trading station in 1657.

TABLE 2. Endangered, Threatened and Special Concern Animal Species of the Hudson River National Estuarine Sanctuary.

"Endangered" listings are annotated as Federal or State; "Threatened" and "Special Concern" listings are State only. Site annotations in parentheses indicate records near but not in the site indicated.

Species	Site	Status
Shortnose sturgeon, *Acipenser brevirostrum*	all	Endangered (US, NY)
Jefferson salamander, *Ambystoma jeffersonianum*	all	Special Concern
Blue-spotted salamander, *Ambystoma laterale*	all	Special Concern
Spotted salamander, *Ambystoma maculatum*	Tivoli, Iona Stockport, Piermont	Special Concern
Cricket frog, *Acris crepitans*	Iona	Threatened
Mud turtle *Kinosternon subrubrum*	Iona, Piermont	Threatened
Spotted turtle, *Clemmys guttata*	Tivoli	Special Concern
Bog Turtle, *Clemmys muhlenbergi*	Iona	Endangered (NY)
Wood Turtle, *Clemmys insculpta*	Stockport, Tivoli	Special Concern
Diamondback terrapin, *Malaclemys terrapin*	Iona, Piermont	Special Concern
Hognose snake, *Heterodon platyrhinos*	Iona	Special Concern
Common loon, *Gavia immer*	all	Special Concern
Least bittern, *Ixobrychus exilis*	all	Special Concern
Cooper's hawk, *Accipiter cooperii*	all	Special Concern
Red-shouldered hawk, *Buteo lineatus*	all	Threatened

Species	Site	Status
Golden eagle, *Aquila chrysaetos*	Tivoli, Iona Piermont	Endangered (NY)
Bald eagle, *Haliaeetus leucocephalus*	all	Endangered (NY)
Marsh hawk, *Circus cyaneus*	all	Threatened
Osprey, *Pandion haliaetus*	all	Threatened
Peregrine falcon, *Falco peregrinus*	Iona, Piermont	Endangered (US, NY)
Common tern, *Sterna hirundo*	Tivoli, Iona Piermont	Threatened
Black tern, *Chlidonias niger*	Tivoli, Piermont	Special Concern
Short-eared owl, *Asio flammeus*	Piermont	Special Concern
Common nighthawk, *Chordeiles minor*	Tivoli, Iona Piermont	Special Concern
Sedge wren, *Cistothorus platensis*	Piermont	Special Concern
Eastern bluebird, *Sialia sialis*	Tivoli, Iona Piermont	Special Concern
Common Raven, *Corvus corax*	Tivoli	Special Concern
Grasshopper sparrow, *Ammodramus savannarum*	Tivoli Piermont	Special Concern
Henslow's sparrow *A. henslowii*	Tivoli	Special Concern
Vesper sparrow *Pooecetes gramineus*	Tivoli Iona	Special Concern

TABLE 3. Ownership and Size of Parcels Within the Hudson River National Estuarine Sanctuary Boundaries (see Figures 2-5)[a]

	Acres
Stockport Flats:	
New York State Office of General Services	692-804[b]
New York State Office of Parks, Recreation and Historic Preservation	193
Private (see Table 4)	187-299[b]
Tivoli Bays:	
New York State Department of Environmental Conservation	707
New York State Office of General Services	729
Private (see Table 4)	45
Iona Island Marsh:	
Palisades Interstate Park Commission	556
Piermont Marsh:	
Palisades Interstate Park Commission	871
Private (including the Nature Conservancy, see Table 4)	73

Stockport Flats	approximately 1,516 acres
Tivoli Bays	approximately 1,481 acres
Iona Island Marsh	approximately 556 acres
Piermont Marsh	approximately 944 acres
Total	approximately 4,165 acres

[a]The following ownerships are adjacent to, but will not be part of the Sanctuary: corridors approximately 75 feet wide passing through or adjacent to Stockport Flats, Tivoli Bays and Iona Island Marsh and owned by Consolidated Rail Corporation; a Y-shaped corridor (undeveloped) 200 feet wide crossing part of the Tivoli Bays State lands and owned by Cruger Development Corporation of Central Hudson Gas and Electric Corporation; the Erie Pier properties at the north end of Piermont Marsh owned by the Village of Piermont, Clevepak Corporation, and Federal Paper Board Company.

[b]The ranges of acreage given are due to the incompletely determined size of the private holding on the unnamed island, the rest of which is owned by OGS.

TABLE 4. Parcels Proposed for Acquisition
(not in priority order; see Figures 6, 7 and 8)

At Stockport Flats:

Parcel 1: An approximately 5-acre sandy islet owned by Joseph Nostrand between Fordham Point and Little Nutten Hook.

Parcel 2: An approximately 57-acre area of shallows and shoreline, a water grant known as the "Gay Grant", owned by Irving Domnitch.

Parcel 3: An approximately 18-acre area of water, marsh and shoreline, a water grant known as the "Judson Grant," owned by Irving Domnitch.

Parcel 4: An approximately 10-acre area of water and marsh, a water grant known as the "Alvord Grant." owned by Robert L. Pierson.

Parcel 5: An approximately 1-acre area of madeland adjacent to the railroad and the mouth of Stockport Creek with an unimproved parking area and landing, owned by Consolidated Rail Corporation.

Parcel 6: Portions of the "unnamed island" lying off the mouth of Stockport Creek owned by Porter Fearey, Jr. The extent of Mr. Fearey's ownership is believed to be between 7 and 119 acres, and to this extent the State is negotiating with him.

Parcel 7: An approximately 54-acre area of water, marsh and shoreline, a water grant known as the "French Grant," owned by Algis C. Saurusaitis.

At Tivoli Bays:

Parcel 8: Approximately 45-acres of land including the approximately 9-acre Magdalen Island and additional area of upland at the north end of North Bay, owned by Tivoli Properties, Inc. This acquisition is under negotiation by the State and the exact size of the parcel has not been agreed upon.

At Piermont Marsh:

Parcel 9: An approximately 71-acre area of water and marsh now owned by DEC. This parcel consists of approximately 65-acres donated to this village of Piermont by Continental Group, Inc. and about 6-acres then owned by the village, both transferred to the Nature Conservancy and then to DEC.

Parcel 10: An approximately 0.04-acre area in the northwest corner of Piermont Marsh, owned by Louis Hurban, Jr.

Parcel 11: An approximately 2-acre area in the northwest corner of Piermont Marsh owned by James J. MacMurray.

Several plaster, paper, cotton and woolen mills were subsequently built in the vicinity of Stockport Flats by European settlers. These peaked in activity in the early 1800's, but many continued operating into the 20th century. In 1850 the Hudson River railroad crossed the mouth of Stockport Creek, near where large vineyards, many over 40 acres, produced more than 100 tons of grapes annually.

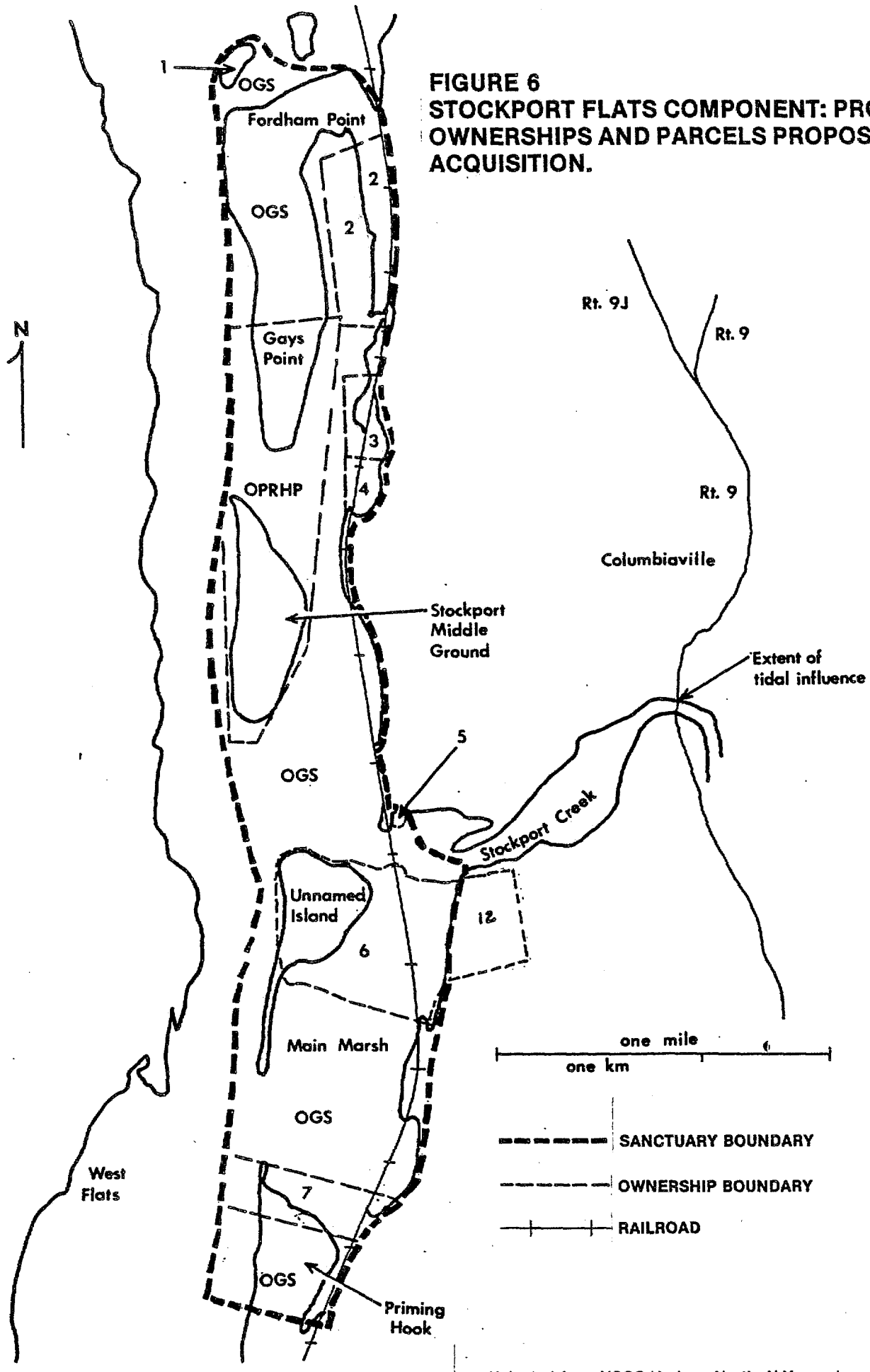
Gay's Point and Stockport Middle Ground were created when the U.S. Corps of Engineers deposited dredged material from channel deepening efforts begun during World War I. Squatters have inhabited the islands at Stockport Flats in recent years.

Ownership and Access

The Office of Parks, Recreation, and Historic Preservation owns Stockport Middle Ground and the southern end of Gay's Point, and the Office of General Services owns the remainder of the state lands in the Stockport component (Figure 6). Seven parcels have been targeted for acquisition (Table 4).

The main access point to the Stockport component is on ConRail property at the railroad crossing of Stockport Creek where there are unimproved parking and boat landing facilities. Efforts are underway to acquire this parcel for public access. Land access to this component has traditionally been along railroad service roads, although these may be closed off by the railroad in the future. All parts of the component are

FIGURE 6
STOCKPORT FLATS COMPONENT: PROPERTY OWNERSHIPS AND PARCELS PROPOSED FOR ACQUISITION.



(Adapted from USGS Hudson North, N.Y. quadrangle.)

accessible by boat; Stockport Middle Ground and Unnamed Island may be reached only by boat. Three improved public boat launching sites at Coxsackie, Hudson, and Athens are within two miles of the Sanctuary, and several private marinas are also within easy reach.

Current Use

Hunting, trapping and fishing have been popular activities at the Stockport Flats component for years. Waterfowl hunting is the most popular type of hunting at Stockport, although deer and small game are also taken. Muskrat is the primary furbearer sought by trappers, although small numbers of raccoon, mink and red and gray fox are also trapped.

Most of the recreational fishing takes place from railroad and highway bridges, although small craft are used to fish the river side of Stockport Middle Ground and Gay's Point. The tidal mouth of Stockport Creek is an excellent recreational fishing area for striped bass. Some commercial fishing for shad occurs near this component.

Natural Environment

The Stockport Flats component includes the mouth of Stockport Creek and a four-mile series of peninsulas, islands, marshes and shallows along the east shore of the Hudson River.

The river is narrow and shallow, bordered on both sides by steep bluffs that rise to an elevation of 100 feet, and there the land levels off.

The bluff north of the mouth of Stockport Creek is Cambrian shale with thin layers of interbedded quartzite, and there are clay deposits farther inland. The bluff south of the creek is clay. Terrestrial soils of the site are derived from clay, sand and till.

The mouth of Stockport Creek is dotted with islands of floodplain and tidal swamp at elevations up to 3 feet above high tide level, and these islands are interspersed with areas of tidal marsh, subsidiary stream channels, and the main creek channel. The main marsh lies just south of the creek mouth, between the unnamed island and Priming Hook. The marsh bottom varies from fine sand to shallow or deep soft muck. The large islands and peninsulas are sandy and composed in part of old dredged material. Extensive shallows lie between Gay's Point and the mainland.

Water celery (Vallisneria americana)is very abundant in the shallows. The intertidal marshes are dominated by narrowleaf cattail (Typha angustifolia), wild-rice (Zizania aquatica), spatterdock (Nuphar advena), and pickerelweed (Pontederia cordata).

Tidal swamps and floodplain swamps at Stockport Flats are dominated by mature mixed deciduous forest characteristic of

river bottoms, while oaks (Quercus spp.) and localized stands of white pine (Pinus strobus) are common on the dryer bluffs. The sandy islands and points are dominated by more rapidly growing tree species that quickly take hold in the dredge spoil deposits. The endangered heartleaf plantain (Plantago cordata) is also present at the Stockport site.

A large variety of aniamls rely on the habitats, and frequently on a combination of habitats present at Stockport Flats to fulfill their life requirements (Appendices 2-6). It is interesting to note the presence of a newly-described crayfish (Orconectes kinderhookensis) so far found only in Kinderhook Creek, a tributary of Stockport Creek.

B. Tivoli Bays

Tivoli Bays is the largest component of the estuarine sanctuary comprised of nearly 1,500 acres of islands, tidal wetlands, and surrounding uplands, including Cruger and Magdalen Islands, the North and South Bays, and the mouths of Stony Creek and Sawkill (Figure 3). This component is located in the Town of Red Hook, in Dutchess County.

History

Artifacts dating back several thousand years indicate Native American occupation of the area, particularly near the mouths of

the tributary streams. A variety of mills and factories were erected along Stony Creek and Sawkill during the 1700s by European settlers.

Ferry service up and down the Hudson was available in the late 18th Century from a dock in North Bay. In 1851 Tivoli was linked to Albany by the Hudson River Railroad. A drawbridge was opened at Tivoli in 1907 by the New York Central Railroad to allow ships to unload cargo at a North Bay pier. Train service was discontinued in 1960.

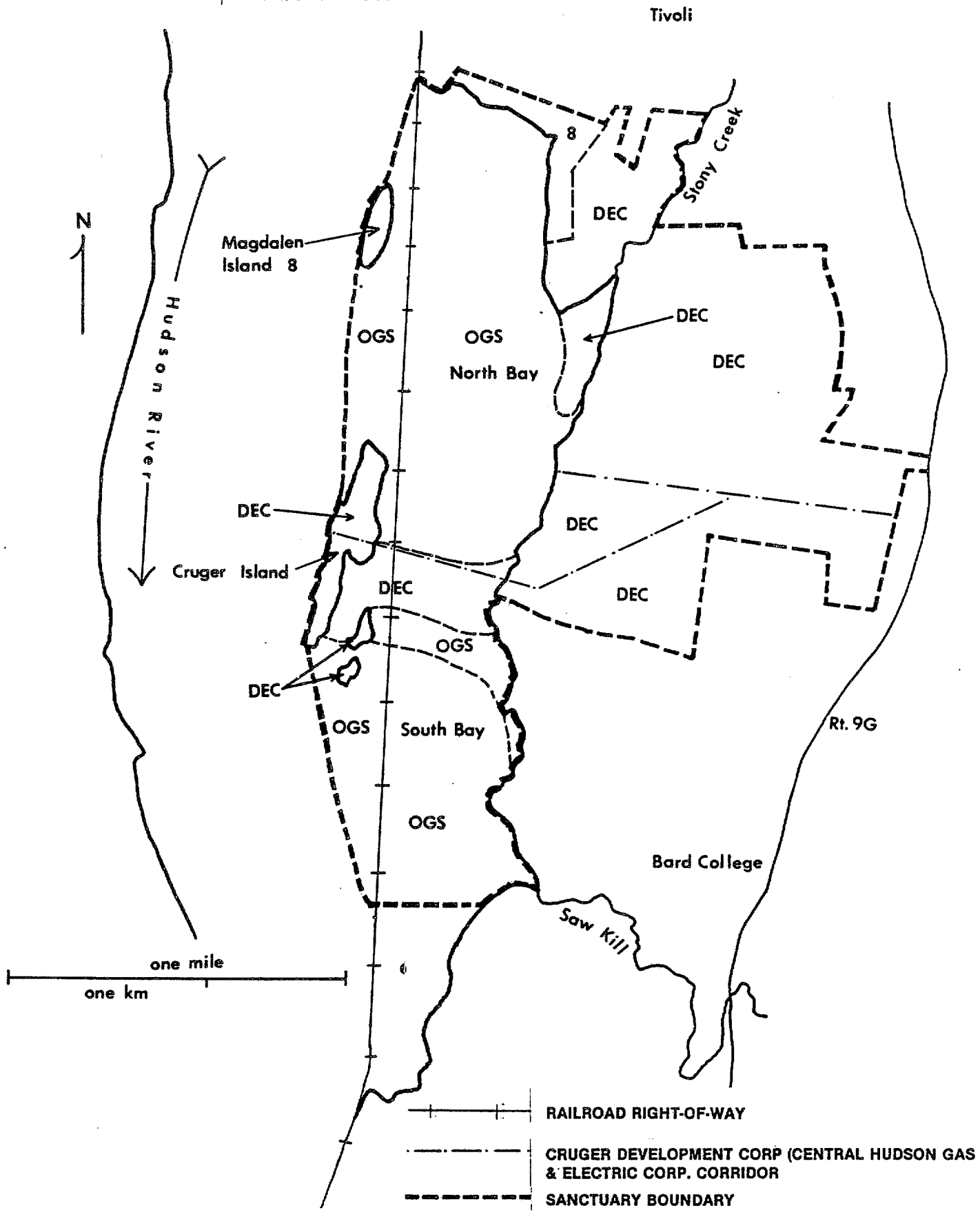
Cruger Island gets its name from John Church Cruger, whose island estate included artificial ruins built around 1840 to simulate the romantic atmosphere of Thomas Cole paintings.

Property east of South Bay which was originally owned by L. G. Hamersley and Robert Boyd Ward passed to Bard College in 1960. A large parcel including Cruger Island was purchased that same year by Central Hudson Gas and Electric Company for later development, although when plans for a nuclear power plant on Cruger Island were abandoned, most of the land was transferred to the Department of Environmental Conservation.

Ownership and Access

Ownership of the Tivoli Bays component is nearly evenly split between the New York State Office of General Services and the Department of Environmental Conservation (Figure 7).

FIGURE 7
TIVOLI BAYS COMPONENT: PROPERTY OWNERSHIPS AND PARCELS PROPOSED FOR ACQUISITION



Approximately 45 acres, including Magdalen Island and an uplands area at the north end of North Bay, are privately owned and under negotiation for state acquisition (Table 4).

Kidd Lane and Cruger Island Road run west from Route 9G and provide access along the north and south boundaries of the uplands area east of North Bay; Ward Manor Road bisects this area and provides access to the interior of the upland. There is access to the Sanctuary field station from Bard College roads.

The most heavily used access route to the Tivoli Bays tidal wetlands is via the railroad service road that runs both north and south from Cruger Island Road, although public users of this route are subject to federal trespass law.

Both private and public landings, including an unimproved river landing at the Village of Tivoli north of the North Bay provide access to the component from the river.

Several improvements to the access system are planned, including renovation of an existing trail system around the east side of North Bay, construction of several primitive parking lots, and development of two unimproved boat landings.

Current Use

The Tivoli Bays component draws people from New York City, Albany, Kingston, Poughkeepsie, and from many smaller communities. It has provided the public with hunting, fishing, trapping,

hiking, nature study, research and bird watching opportunities for years.

Hunting is allowed on all species for which there is an open season, although waterfowl hunting is by far the most popular. Trapping under general state regulations is permitted, and fox, raccoon and muskrat are commonly taken.

Recreational fishing for alewife, striped bass, white and yellow perch, largemouth bass, white sucker, catfish, and eel takes place at this component, and is concentrated at the stream mouths. Little commercial fishing occurs at the Tivoli Bays, although considerable shad fishing takes place a few miles south in the Kingston Flats area.

Old trails on the state-owned and Bard College lands at the Tivoli Bays are well used for walking, cross-country skiiing, and some snowshoeing and running. Bird watching is very popular at the Tivoli Bays, and estimates indicate that bird watching use rivals hunting activities at this component. These lands are also frequently used for other nature studies and research activities.

A variety of recreational boats frequent the Tivoli Bays, and ice boating occurs during periods of smooth, solid ice on the main river near the Tivoli Bays and occasionally on South Bay.

Natural Environment

The Hudson River that flows by the Tivoli Bays is deep, of medium width, and bordered by bluffs. The bluffs east of the bays are composed of clays deposited as thin alternating layers of clay and slit in a postglacial lake. Bedrock at this site is ordovician gray sandstone and shale.

North Bay is predominately intertidal marsh, with a well-developed network of tidal creeks and pools. A similar network of creeks and pools is beginning to form in South Bay, which is primarily mudflats and shallows near low tide level. The bottom in the bays is largely soft muck, as much as 25 feet deep. The tidal swamp between North Bay and South Bay has 8 feet of peat overlying silt.

Extensive tidal shallows lie north and south of Cruger Island, although just west of the island the main river is 50 feet deep.

Water-celery, watermilfoil (Myriophyllum spicatum), and water chestnut (Trapna natans) are the most abundant plants in the shallows. The intertidal marshes are dominated by narrowleaf cattail, spatterdock, and purple loosestrife (Lythrum salicaria). The tidal swamps are mixed deciduous swamp communities which have a very well-developed shrub layer and an abundance of moss species.

The clay bluffs and rocky islands support well-developed mixed forests dominated by oak, hickory (Carya spp.), hemlock

(Tsuga canadensis), and pine. A grove of particularly large oaks and hemlocks borders the mouth of Stony Creek.

Tivoli Bays is the only recorded station in New York of the very rare nuttall's micranthemum (Micranthemum micranthemoides), a tidal freshwater plant species last seen in 1936, but possibly still surviving at this sanctuary component. Heartleaf plantain is also present at Tivoli Bays.

The primary wintering area for the Hudson River estuary population of shortnose sturgeon (Accipenser brevirostrum) is approximately 2 to 9 miles south of the Tivoli Bays in the vicinity of Esopus Meadow-Kingston Flats.

C. Iona Island Marsh Component

Iona Island Marsh is the smallest sanctuary component comprised of 556 acres on the west side of the Hudson River, and it includes Iona Island Marsh, Iona Island, and Round Island, which is connected to the southern end of Iona Island (Figure 4). This site is in the Town of Stony Point in Rockland County, and is part of the Bear Mountain State Park.

History

In the mid 1800s, orchards and vineyards were developed on Iona Island by horticulturist C. W. Grant for the experimental culture of a variety of fruits, including the Iona Grape. This property subsequently became a fashionable resort attracting the likes of prize fighter John L. Sullivan, who trained on the island. The railroad line along the west shore on the Hudson was constructed around 1880, and it has remained in service.

The land and buildings on Iona Island west of the railroad were acquired by the federal government in 1900 to house a key arsenal and supply depot. The U. S. Naval Ammunition Depot was in operation from the early 1900s through World War II. The Palisades Interstate Park Commission acquired lands west of the railroad in 1965 and removed railroad sidings, docks, several roads, and all but five of the island's 140 buildings. Many of the formerly occupied areas have been restored to field and brushlands.

Ownership and Access

The Iona Island Marsh component is entirely owned by the Palisades Interstate Park Commission (PIPC).

A dirt causeway connecting Route 9W and Iona Island provides access to Iona Island for researchers and certain other users, provided the appropriate permits have been acquired from PIPC. There is access to the marsh from both Route 9W and the causeway. The Trailside Museums complex north of the site and the Sanctuary education facility it houses are accessible from the highway. No dock facilities or boat landings are available to the public on Iona Island and none are planned. Public access to Bear Mountain Park via buses and tour boats is excellent.

Current Use

Most of Iona Island is being allowed to revert to a wild condition and the uplands and marshes are being maintained as a wildlife sanctuary. Hunting and trapping are prohibited on all PIPC lands. Although fishing is prohibited in the marsh, limited fin fishing and crabbing take place along the railroad. Bird watching is a very popular activity, particularly in the spring and fall. Animals ranging from white-tailed deer to a variety of reptiles and amphibians are also observed in the interesting and unique wetlands.

Other recreational activities near Iona include hiking and skiiing. An occasional group may camp on the island itself under

special permit; otherwise the island is closed to the public. A network of hiking trails connects Tallman Mountain State Park and Bear Mountain State Park, effectively linking the Piermont and Iona marshes, and the Appalachian Trial passes through Bear Mountain Park within a mile of Iona, on its way from Georgia to Maine. A bicycle trail parallels the west shore of the estuary, and borders the Iona Island Marsh.

PIPC uses the five remaining buildings on Iona Island near Doodletown Bight as a base for part of its maintenance and storage operations.

Natural Environment

The highly resistant Precambrian gneiss bedrock forms both the rocky knobs of Iona Island and the steep surrounding hills. These same steep slopes continue under the marsh where sediments are more than 100 feet deep. The Hudson Highlands is the only location where the Old Appalachians are breached by an estuary.

The Iona Island Marsh formed in the shelter of the island in a side channel of the Hudson that was enlarged by glacial erosion and meltwaters. The marsh began to form at least 6,000 years ago, although some of the deepest sediments are 12,500 years old. The marsh surface is peat, but sediments become increasingly silty beneath. Winding tidal creeks lace the marsh, and large areas of mud flats are exposed at low tide in Doodletown Bight. The main river channel east of Iona Island is quite deep and narrow.

Water-celery is very abundant in the shallows at this component. The intertidal marshes are dominted by narrowleaf cattail, with small amounts of common reed (Phragmites communis) and swamp rose mallow (Hibiscus palustris). There is a healthy stand of crack willow (Salix fragilis) in one small area of tidal swamp. The island and mainland slopes are covered with dediduous forest, with abundant red oak (Quercus borealis), chestnut oak (Q. prinus), and pignut hickory (Carya glabra).

A few bald eagles (Haliqeetus leucocephalus) have been wintering on Iona and Round Islands in recent years, and there are indications that the Hudson River population is growing.

D. Piermont Marsh Component

Piermont Marsh is the southermost component of the Sanctuary, comprised of approxiamtely 944 acres of tidal wetlands between Erie Pier and Sneden Landing, thirty miles north of New York City (Figure 5). The site is largely a part of Tallman Mountain State Park, an element of the Palisades Interstate Park system.

History

Piermont Marsh has historically been rich in natural resources that attracted a variety of inhabitants. Native Americans seined the marsh for a large variety of salt and freshwater fish.

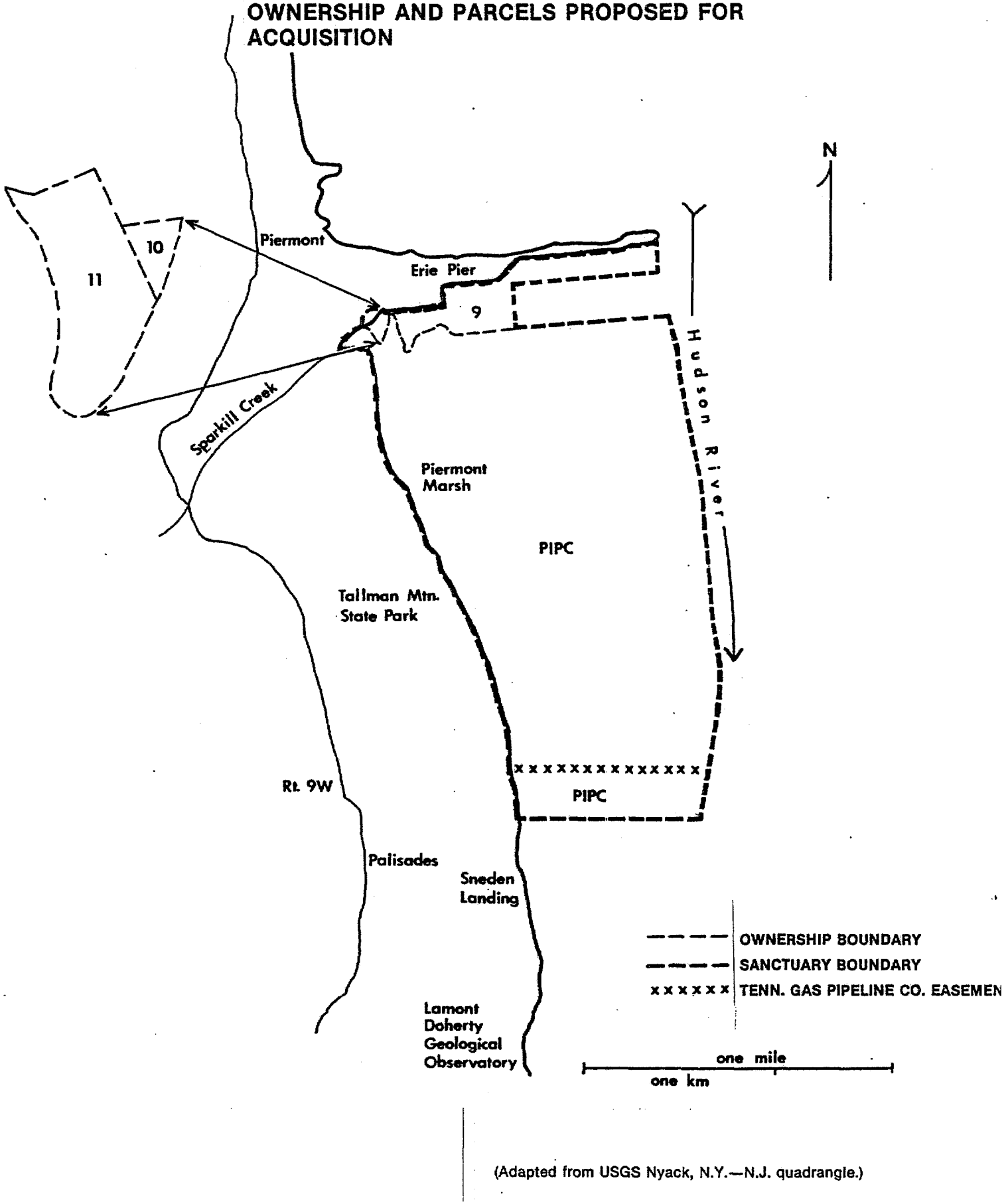
In addition, the marsh yielded an abundance of beaver, otter, mink and muskrat as well as ducks, geese, swans and oysters. The Dutch were the first Europeans to establish fur trading posts, although they were soon followed by English, Scottish, Irish, German and French Huguenot settlers. In the early 1800s a saw mill, a grist mill and a woolen blanket factory were constructed along the Slote (the mouth of the Sparkill Creek) which is now called "Taulman's Landing". A public road and a 500-foot pier necessary to accommodate larger ships were built through the marsh just north of Sparkill Creek in 1824.

A new era born with the building of the Erie Railroad was accompanied by the construction of an iron factory, shops and roundhouses in 1838, and in 1850 Piermont was the eastern terminus of the Erie Railroad. The raiload era, however, was short-lived and by 1861 all freight and passenger service was discontinued, with the exception of one local train to Jersey City.

Ownership and Access

The Palisades Interstate Park Commission owns nearly all of Piermont Marsh with the exception of 71 acres recently transferred from private owners to the New York State Department of Environmental Conservation and two privately owned acres of the mouth of Sparkill Creek which are under negotiation for state acquisition (Table 4).

FIGURE 8
PIERMONT MARSH COMPONENT: PROPERTY OWNERSHIP AND PARCELS PROPOSED FOR ACQUISITION



(Adapted from USGS Nyack, N.Y.—N.J. quadrangle.)

The Erie Pier, owned by the village of Piermont, is used for launching boats and has parking space for about 40 vehicles. The pier also provides access to the marsh for fishing and bird watching. The pier is infrequently used for docking by the Lamon Doherty Geological Observatory oceangoing research vessel, but not for other large craft.

A network of hiking trails connects Tallman Mountain State Park and Bear Mountain State Park and effectively links Piermont and Iona marshes. The hub of this trail system is the Long Path which begins at the George Washington Bridge in New Jersey, passes near Piermont Marsh and west of Bear Mountain, and will eventually extend to the Adirondacks.

A bicycle trail paralleling the west shore of the estuary passes by the Piermont Marsh partly on highways and partly on old roads reserved for bicycle and pedestrian use. This trail provides an excellent view of the marsh.

Current Use

Piermont Marsh is actively enjoyed by large numbers of bird watchers and hikers throughout the seasons. Recreational boating is also popular at Piermont Marsh.

Hunting and trapping are not permitted on PIPC lands at Piermont. Hunting and trapping policies on lands DEC may acquire have not yet been established.

Commercial shad fishermen operate in the shallows near Piermont Marsh. There is recreational fishing for blue crab and fin fish (including tomcod in winter) off the end of the Erie Pier and by boat near the marsh and in the mouth of Sparkill Creek.

Natural Environment

The west shore of Piermont Marsh is formed by part of the Palisades Ridge where an abrupt flat-topped, 150-foot cliff and sliderock formation occurs close to the marsh. The cliff is Triassic diabase, and the ridge is underlaid by Triassic sandstone and shale which outcrop in small areas near the marsh. Soils on the shore near Piermont Marsh are derived from glacial till and are shallow and acid.

The marsh sediments are peat and organic silt. These deposits are deepest in the western part of the marsh which has been developing for nearly 5,000 years. A few well-defined but relatively shallow tidal creeks cut the marsh. Piermont Marsh is located a the south end of the very broad and shallow segment of the estuary, and very extensive shallows border the east side of the marsh.

The intertidal marshes are dominated by narrowleaf cattail and common reed, with lesser amounts of tall cordgrass, (Spartina cynosuroides), saltwater cordgrass (S. alterniflora), salt meadow cordgrass (S. patens), saltgrass (Distichlis spicata), swamp rose

mallow, and purple loosestrife. There is no appreciable area of tidal swamp.

The mainland forest at the base of the Palisades Ridge has abundant and large beech (Fagus grandifolia), tulip tree (Liriodendron tulipifera), red oak, black birch (Betula lenta), and flowering dogwood (Cornus florida).

V. ADMINISTRATION

The New York State Department of Environmental Conservation (DEC) has lead responsibility for implementing the Hudson River National Estuarine Sanctuary management plan through its coordination and oversight of research, education, and monitoring activities. DEC is responsible for the expenditure of program funds and for assuring that Sanctuary goals are met.

A memorandum of understanding (Appendix 7) among five New York State agencies involved in the Sanctuary outlines interagency arrangements and expresses each landowning agency's agreement to manage the lands it owns within the Sanctuary in accordance with the management plan. The management plan must be unanimously approved by the five agencies before it is adopted. These agencies include:

- Department of Environmental Conservation including Central Office and Regions 3 and 4 -- lead agency;
- Office of Parks, Recreation and Historic Preservation, Saratoga-Capital District State Park and Recreation Commission (OPRHP);
- Palisades Interstate Park Commission (PIPC);
- Office of General Services (OGS);
- Department of State (DOS) -- responsible for New York State's Coastal Management Program.

Sanctuary Steering Committee

One representative from each of the five state agencies serves on the Sanctuary Steering Committee, chaired by DEC. A delegate from the National Oceanic and Atmospheric Administration's Office of Ocean and Coastal Resource Management and the chairperson from each of three local Sanctuary advisory committees will serve as ex-officio, non-voting representatives to the Steering Committee.

The Steering Committee will review the management plan annually; any amendments to the plan are subject to the unanimous approval of the five participating agencies. The Steering Committee will also advise DEC on management plan implementation and the expenditure of program funds, and will assist in resolving any conflicts that may arise.

Interagency coordination will be achieved through the activities of the Steering Committee. Cooperative and coordinated management of the Sanctuary by these agencies will improve consistency, reduce conflicts, and provide better service to the public.

Local Sanctuary Advisory Committees

Three local Sanctuary advisory committees will be appointed by DEC to represent the three counties in which the Sanctuary components are located (Columbia, Dutchess and

Rockland). These local advisory committees represent local governments, user groups, conservation organizations, researchers, educators, funding organizations, and adjoining landowners. A list of the proposed local committee memberships is included in Table 5.

The purpose of the local Sanctuary advisory committees is to achieve coordination among the public and private groups participating in the Sanctuary program, and to assist and advise the state agency Sanctuary Steering Committee. The local committees will help in securing funding from the private sector, organizing volunteer efforts in education and management work, soliciting and channeling public input to the Sanctuary planning process, reviewing any proposed changes in the management plan, and enhancing communication and cooperation among all interests involved in the Sanctuary. The chairperson of each local advisory committee will forward recommendations to the Sanctuary Steering Committee.

Sanctuary Manager

The Estuarine Sanctuary's programs will be coordinated through DEC by a full time Sanctuary Manager based at the Bard College Ecology Field Station at Tivoli Bays. The Manager will be an individual experienced in natural area management, environmental education and/or the environmental sciences, and grant proposal preparation.

The Sanctuary Manager will report directly to the Hudson River Coordinator, who was appointed by DEC Commissioner Williams in 1984 to supervise the development of the Hudson River National Estuarine Sanctuary and to coordinate other programs relating to the Hudson River. The Manager will be assigned to the DEC Office of Natural Resources. Because the Sanctuary has sites in both DEC Regions 3 and 4, the Natural Resource Directors from both regions will provide programmatic direction for the Manager in matters relating to their respective regions. Support staff and services will be provided to the Sanctuary Manager through the DEC Region 3 office in New Paltz. The five agency delegation memorandum established the necessary institutional arrangements.

TABLE 5

PROPOSED LOCAL SANCTUARY ADVISORY COMMITTEE MEMBERSHIPS

1. Stockport (Columbia County)

Town Government
County Environmental Advisory Group
Sportsmen's Group
Commercial Fisherman
Conservation Group or Nature Club
Adjoining Landowner
Scientific Researcher
Educator
Business Representative

2. Tivoli (Dutchess County) (This committee will be the same as the Tivoli Bays State Lands Advisory Committee)

Town Government
Village of Tivoli Representative
Town Conservation Council
Dutchess County Trappers' Association
Ralph T. Waterman Bird Club
Adjoining Landowner
Scientific Researcher
Bard College Educator
Business Representative
Local Waterfowl Hunter
Dutchess County Federation
Dutchess County Environmental Management Council
Regional Field Trialers
Regional FWMA Board
Department of Environmental Conservation

3. Piermont and Iona (Rockland County)

Local Government
Municipal Environmental Advisory Group
Sportsmen's Representative
Commercial Fisherman
Conservation Group or Nature Club
Adjoining Landowner
Scientific Researcher
Educator
Business Representative

The Sanctuary Manager will be immediately responsible for implementing this management plan and for coordinating research, monitoring, and education programs with the agencies having jurisdiction over respective Sanctuary sites. The Sanctuary Manager will:

- Coordinate research and environmental monitoring within or related to the Sanctuary by publicizing research sites, facilities, and opportunities; by organizing a research review process; by facilitating research that is in keeping with Sanctuary goals; and by developing liaisons with other organizations interested in Hudson River estuarine research and issues.

- Disseminate technical research results to DEC and other interested government agencies and disseminate research findings to the public in a non-technical, accessible form.

- Coordinate the Sanctuary education program by working with educational institutions and DEC's Environmental Education Program and Public Affairs staff to develop public education opportunities, materials, and programs; by developing relationships with local media sources; and by developing and presenting lectures and slide shows on the Sanctuary program.

- Work with the state agency Sanctuary Steering committee and the three local Sanctuary advisory committees to facilitate a coordinated, cooperative implementation of this management plan consistent with Sanctuary goals.

- Maintain an effective Sanctuary program by managing Sanctuary finances; preparing proposals for grants to enhance the Sanctuary program; acting as a liaison among participating agencies; coordinating with related programs on the Hudson River; hiring and training volunteers and any other staff; overseeing state, local, and research review-committees; and advising municipal and county governments on local issues and projects that will have impacts on the Sanctuary.

The Sanctuary Manager will report directly to the Hudson River Coordinator, who was appointed by DEC Commissioner Williams in 1984 to supervise the development of the Hudson River National Estuarine Sanctuary and to coordinate other programs relating to the Hudson River. The Manager will be assigned to the DEC Office of Natural Resources. Because the Sanctuary has sites in both DEC Regions 3 and 4, the Natural Resource Directors from both regions will provide programmatic direction for the Manager in matters relating to their respective regions. Support staff and services will be provided to the Sanctuary Manager through the DEC Region 3 office in New Paltz. The five agency delegation memorandum established the necessary institutional arrangements.

Land Holding Agencies

The four public agencies holding land in the Sanctuary are Department of Environmental Conservation (DEC), Office of Parks, Recreation, and Historic Preservation (OPRHP), Palisades Interstate Park Commission (PIPC), and Office of General Services (OGS). These agencies, with the exception of OGS, will exercise ownership and management responsibilities and prerogatives to achieve implementation of the plan. They are responsible for reviewing and approving all projects on lands within their jurisdiction, and for enforce-

ment of conservation and management goals. OGS lands will be managed according to an interagency memorandum of understanding which will be developed with the agency (DEC, PIPC or OPRHP) having jurisdiction over the adjoining Sanctuary lands.

Existing laws and regulations will be used to ensure that conservation goals are met. Land holding agencies will enforce allowable uses on the lands over which they have jurisdiction, unless interagency memorandums of understanding provide otherwise. The jurisdictions of and supporting legislation for federal, state, county, town and village agencies are identified in Appendix 8; a number of these are discussed in the Site Management section.

Coordination with the Coastal Management Program

Implementation of the Hudson River National Estuarine Sanctuary will be coordinated with the State's Coastal Management Program through three separate mechanisms. First, CMP staff will serve on the Steering Committee, whose most important function initially is to assist with the development and approval of the management plan for the Hudson River National Estuarine Sanctuary. Secondly, the Department of State (DOS), as the State's lead agency for the Coastal Management Program, is responsible for review of federal consistency determinations to be made by federal agencies relative to their direct actions. By this mechanism, the DOS will help assure that the objectives of the Sanctuary Management Plan are not pre-empted by the actions of federal agencies. Third, coordination of these two programs will be reinforced by the state consistency provisions found in regulations (19 NYCRR, Part 600) pursuant to the Waterfront Revitalization and Coastal Resources Act (Executive Law, Article 42). The direct actions of state agencies within Sanctuary boundaries must be found to be consistent with the policies set forth in those regulations.

Facility Management

The Bard College Ecology Field Station serves as the research facility for the Hudson River National Estuarine

Sanctuary, in acordance with the memorandum of understanding developed between the Department of Environmental Conservation and Bard College for a joint Estuarine Sanctuary Research Center (Appendix 9). The Department, through the Sanctuary Manager, has responsibility for administering Sanctuary research programs and facilities.

The main education facility for the Sanctuary is the Bear Mountain State Park Trailside Museums complex. Palisades Interstate Park Commission, through the Museum Curator, is responsible for managing this Sanctuary education facility in cooperation with the Sanctuary Manager.

All other facilities built on Sanctuary lands will be maintained by the agency with jurisdiction over such lands, unless an agreement is made with another state agency (DEC or OPRHP) to assume responsibility.

Conflict Resolution

The Sanctuary Manager is responsible for bringing any violations of the management plan or potential conflicts with it to the attention of the agency with management responsibility for action. If such conflict cannot be resolved, it will be brought up for discussion by the Steering Committee. The Steering Committee will be the principal forum for resolving any conflicts which cannot otherwise be resolved between the Sanctuary Manager and the

agency with management responsiblity. This discussion shall result in either a) corrective action by the agency with management responsibility, b) revision of the management plan, c) withdrawal of the Sanctuary designation for the area in which the conflict occurs, or d) agreement on an alternative course of action to resolve the conflict. Any member of the Steering Committee may bring a conflict to the Committee's attention and, if necessary, to the Commissioner of DEC. The Commissioner of DEC is the ultimate arbiter of Sanctuary conflicts.

Land Acquisition

Lead responsibility for completing acquisition of land parcels within the Sanctuary will be assumed by the jurisdictional agency involved, either the Department of Environmental Conservation (DEC) or the Office of Parks, Recreation and Historic Preservation (OPRHP). These agencies will receive assistance from appropriate state agencies, including Division of Budget and DEC Real Property Section. In some instances, land transactions will occur with the assistance and cooperation of private agencies such as the Nature Conservancy. Techniques that may be used to acquire land include fee simple acquisition (by purchase or donation), easements, reserved life certificates, and any other available techniques. Parcels targeted for acquisition are identified in Table 4 and in Figures 6, 7, and 8.

Definitive surveys and maps of relevant Sanctuary lands and riparian uplands contracted by DEC (Region 4) will be completed by the end of August, 1984. Title searches for the parcels have been completed by DEC. Once the mapping is completed, the State Attorney General's office will make a determination of title on those lands where ownership is disputed. Appraisals of land value will then be made and negotiations will be undertaken by DEC.

The highest priorities at Stockport are to protect the main marsh (Stockport Flats), to protect the endangered heartleaf plantain, and to acquire the de facto public access point at the mouth of Stockport Creek through the acquisition of Parcels 1 to 7 shown in Figure 6.

Because of their central locations, their biological character, and their role in protecting the main marsh, the acquisition of Parcels 5, 6, and 7 is of higher priority for the Sanctuary than the acquisition of parcels 1 to 4. The eastern New York Chapter of the Nature Conservancy is assisting DEC in the acquisition of Parcel 6 (The unnamed island).

The owner of Parcels 2 and 3 has already expressed unwillingness to sell. DEC will make an offer, and if this offer is turned down, the acquisition of Parcels 2 and 3 will be evaluated to determine if eminent proceedings are

warranted. If not, the acquisition will be suspended until either the owner changes his mind, or title passes to another owner, in which case negotiations will be resumed. Other landowners have thus far been receptive to plans for State acquisition of their lands for inclusion in the Sanctuary.

The Office of General Services (OGS) will retain its current jurisdiction over State of New York lands in the Stockport area. Management will be coordinated between OPRHP and DEC, although OPRHP is the only agency that will have staff located in this area. Parcel 12 is no longer under consideration for acquisition.

The completion of negotiations with the private owner of Parcel 8 (Figure 7) at the north end of the site (Tivoli Properties, Inc.) is of highest priority at Tivoli. Acquisition of Magdalen Island and a small area of shoreline at the north end of North Bay are essential for assembling a functional ecological and management unit at the Tivoli component. Tivoli Properties, Inc. has claimed ownership of underwater lands in the north end of North Bay. However, the State Attorney General's office issued an opinion that these underwater lands belong to OGS since they were not granted to a private owner. If this issue should go to court and the court decides that Tivoli Properties indeed owns lands underwater east of the railroad, DEC would also want to acquire that interest.

No acquisition is planned at the Iona component. All lands important to the Sanctuary and its surroundings are owned by PIPC.

At the Piermont component, DEC is pursuing acquisition of Parcels 10 and 11 (Figure 8) in the northwest corner of the marsh. Parcel 9 was transferred from the Nature Conservancy to DEC in 1984.

VI. SITE MANAGEMENT

A number of policies have been established to guide activities in the Hudson River National Estuarine Sanctuary. Research, education, recreation, and commercial fishing are addressed in sections elsewhere in this management plan. All activities will be managed to ensure the protection of the Sanctuary's unique resources and natural areas in order that they will be available to future generations. Consistency with other Hudson River management plans and government programs is reviewed in Appendix 10.

A. Protection of Natural Features

Modification of water movements and dredging

Policy: Water movements will not be blocked, reduced, or otherwise modified in either the estuarine environment or in upland streams, ponds and pools.

Water control structures, dams, impoundments, breakwaters or canals will not be built, with the exception of minor temporary structures for scientific experiments, such as weirs for measuring water flow or collecting samples.

Railroad bridges and culverts will be maintained clear of obstructions, and these drainage structures may be enlarged to return artificially constricted wetland circulation to a more nearly natural condition. Although the existing dikes within

Sanctuary boundaries have modified water movements considerably, these dikes have created a new set of "natural" conditions which will be perpetuated. Apart from the railroad drainage structures, snag removal in the tidal creeks and upland streams will be kept to the minimum necessary to maintain safe access to streams for Sanctuary purposes.

Dredging is prohibited in the Sanctuary. Minor exceptions may be made in small areas that have been dredged in recent years, or if dredging is required to clear obstructed existing drainage structures, or if the benefits of access for Sanctuary purposes will outweigh disruptions caused by minor dredging (e.g., clearing a small segment of a tidal creek).

Disturbance to soils

Policy: Disturbance to soils will be minimized in estuarine environments and in adjoining uplands within the Sanctuary boundaries to reduce unnatural silting of water courses, to protect soil-vegetation systems, and to protect native vegetation from unnecessary invasion of introduced species both directly into mechanically disturbed soil and indirectly into unnaturally silted areas.

Particular care will be taken to avoid disturbance of soils in areas prone to soil movement, including shallow subtidal habitats, the intertidal zone, the floodplain and the upper edges of

the intertidal zone, non-tidal wetlands and watercourses, and forests and other plant communities on steep slopes (over 10-15% slope) adjoining or draining directly into estuarine environments.

Appropriate precautions will be taken in the construction and maintenance of roads and trails to ensure minimal disturbance of vegetation and soils. Trail construction and improvement will be largely confined to existing or former roads and trails, and steep slopes and poorly drained soils will be avoided. Construction equipment will not be operated on wetland sediments or soils. Disturbed areas will be restored to stabilize soil, retain natural plant communities, and maintain pre-disturbance water flow.

Drainage to soils resulting from heavy trail and off-trail traffic will be minimized through appropriate preventive and restorative measures. All Sanctuary users will be encouraged to minimize disturbance by using existing trails. Access to trails and off-trail areas will be limited if necessary to protect soil and soil-vegetation systems.

Soil movements resulting in areas that are eroding from natural causes (e.g., slumping of clay bluffs, shifting of sandbars) will not be stabilized unless rare species, other rare natural features, or structures such as buildings and roads are threatened.

Disposition and removal of fill, dredge spoil and other wastes

Policy: Depositing fill, dredge spoil, or wastes of any kind in the Sanctuary is prohibited. Existing waste will be removed and future dumping will be discouraged.

Minor exceptions to this policy may occasionally be made if very small areas of fill are needed to ensure the protection of resources or to enable the use of the Sanctuary. However, any such exceptions will be assessed very carefully, and floating, piling-supported, or land-based structures will be preferred to structures on fill. Existing dredge spoil deposits will be left in place unless they become hazardous.

Small dumps and derelict vehicles will be removed as soon as possible. Appropriate signs, trash receptacles, and/or fencing will be installed to discourage future dumping.

Plant and animal species protection

Policy: No plants or animals will be removed from Sanctuary sites without permits from the landowning agency and other appropriate agencies. Special efforts will be made to protect endangered, threatened, "special concern", regionally rare, or otherwise valuable plants, animals, and natural communities.

Sanctuary staff will consult with then Botany office of the New York State Museum, the DEC Division of Lands and Forests, and

the Nature Conservancy ti develop specific management guidelines for plants on the State Museum's list of endangered and threatened species (Table 1). The State Museum botany staff and DEC Lands and Forests staff will be consulted before the collection of any endangered plants.

Sanctuary staff will consult with the National Marine Fisheries Service and the Department of Environmental Conservation (DEC) Division of Fish and Wildlife about the endangered shortnose sturgeon; and with DEC Division of Fish and Wildlife about management of the bald eagle, osprey, and other endangered or threatened animals listed in Table 2. Appropriate permits will be obtained before research on these animals is approved or initiated.

Areas closed to public use may be designated by a landowning agency to minimize habitat disturbance and to protect breeding or wintering grounds. Heartleaf plantain populations on the west shore of the unnamed island near the mouth of Stockport Creek are particularly vulnerable to habitat disturbance, for example, and bald eagles have only recently begun to use Iona Island as a wintering ground. Individual species management needs identified to date are discussed in Appendix 11.

Policy: Natural or accidental vegetation fires will be put out using a minimum of chemical fire retardants and a minimum of digging.

Control of exotic and pest species

Policy: Use of chemicals such as insecticides, herbicides, fungicides and other pesticides is strongly discouraged and will be minimized. Chemicals will be used only where their use does not threaten non-target organisms.

Regulatory agencies may decide to control water chestnut, purple loosestrife or other exotic and pest species in the future, and Sanctuary staff will participate in the decision-making process to ensure minimal impact on non-target organisms. Chemicals may be applied in small quantities to experimental plots for scientific purposes if it can be demonstrated that these chemicals pose no threat to organisms off the plots. Broadcast use of herbicides is prohibited. Herbicides may be applied directly to individual plants as a manual basal spray or as pellets in cases where local vegetation management is deemed necessary, if such herbicide application will not affect non-target species of plants or animals.

Chemicals will not be used for control of mosquitos or other pest animals unless there is a demonstrated public health emergency and all non-chemical means of management have been found to be ineffective. Poison-ivy will not be controlled except along trails and close to buildings, and the mildest chemicals that are effective will be used (e.g., ammonium sulfamate).

Manipulative management

Policy: Manipulative management, including prescribed burning, use of fertilizers or other chemicals, and use of other techniques to preferentially perpetuate species or habitats is discouraged in the Sanctuary. Manipulative management will be allowed on a very limited basis to preserve species or communities which would otherwise disappear from the Sanctuary, to conduct research which addresses questions directly related to management of coastal resources, and to control exotic and pest species.

Prescribed on a limited basis burning may be conducted where evidence indicates that this technique is necessary to perpetuate certain valued habitats and species or for experimental purposes. Zones where natural fires will not be controlled may also be designated for the same reasons. These practices will only be allowed where there are no threats to buildings or jpersons; permits will be required.

Introduction of exotic plants and animals will not be allowed in the Sanctuary. Stocking of native fish and wildlife by DEC's Division of Fish and Wildlife is compatible with the Sanctuary program, however.

B. Archeologic, Historic, and Scenic Resources

Policy: Significant archeologic, historic, and scenic resources within the Sanctuary will be identified, protected, and managed in keeping with Sanctuary goals.

The Sanctuary Steering Committee will consult with the appropriate personnel of the State Museum's archeological survey, the Office of Parks, Recreation, and Historic Preservation, DEC, and private groups such as the Hudson River Shorelands Task Force, to gain assistance in identifying and protecting archeologic, historic, and scenic resources at the Sanctuary sites. Advice from these agencies will be sought when planning and routing trails, improving roads, and siting other facilities.

The 19th century artificial "ruins" on South Cruger Island at Tivoli Bays will be left as is for their historic value. The circa 1930 masonry barn on South Cruger Island will also be retained, and a cost effective public or private use for it will be sought.

Derelict buildings or unapproved cabins or camps will be removed unless the structure can be adapted to serve Sanctuary purposes or the structure has significant historic value. Existing buildings which are used for agency purposes such as storage or maintenance may remain. The Office of General Services has inspected and posted about half a dozen seasonally occupied cabins on Stockport Middleground. Squatters have been advised to remove personal belongings and to vacate the premises.

Any derelict cement, brick, stone or wooden docks will be left in place unless there is clear evidence of either a hazard or an ecological problem.

C. Facilities

Policy: Facilities in the Sanctuary will be improved or developed to enhance research and educational opportunities, and to improve safety, access, and opportunities for other public uses.

The main research facility for the Hudson River National Estuarine Sanctuary is the Bard College Field Station at Tivoli Bays. The Bear Mountain Trailside Museums near Iona Marsh serves as the Sanctuary's main education facility, although small exhibits, interpretive trails, and educational brochures and activities will be available at Stockport Flats, Tivoli Bays, and to a limited extent, Piermont Marsh. Developments to enhance safety, public access, and recreational opportunities are occurring at all Sanctuary components. Administrative and interpretive signs will be posted at Sanctuary sites, and phone numbers on these signs will allow visitors to contact program managers.

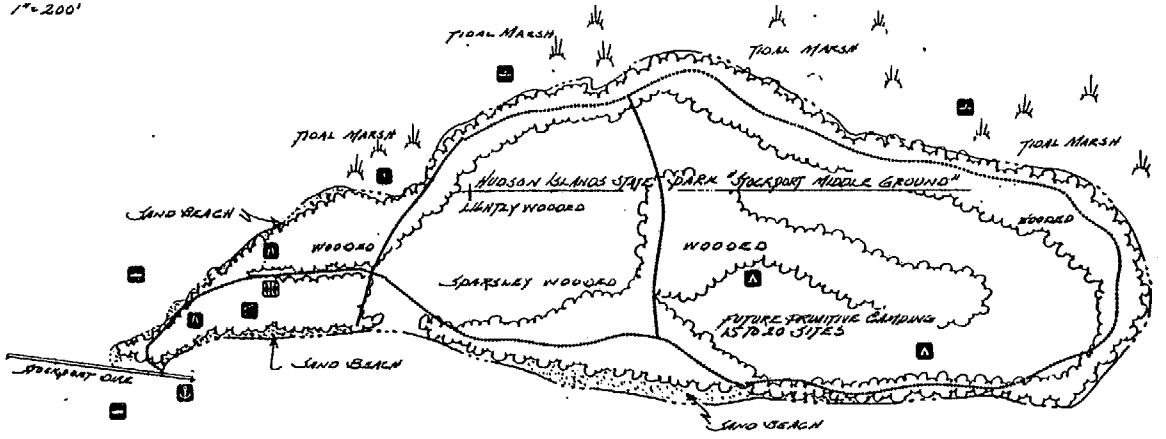
Stockport

Trails have been developed and/or improved on the old dredge spoil sites at Stockport Middle Ground and Gay's Point penninsula (Figures 9 & 10), and one will be designed as an interpretive

* SPECIAL NOTE:
TRAILS ... HIKING AND NATURE TRAIL TO CIRCUMVENT THE ENTIRE ISLAND & LOCATED ON TOP OF EXISTING BERM.
BOATING ... SMALL BOAT (ROWBOAT & CANOE) ACCESS AT ALL POINTS OF SHORE AROUND ISLAND. SMALL POWER BOATS BEACHING ACCESS NORTH & WEST SHORE ONLY.

N

APPROXIMATE SCALE 1"=200'



HUDSON RIVER

KEY:
- HIKING & NATURE TRAIL
- ENVIRONMENTAL STUDY AREA
- BOAT DOCK
- PICNIC AREA
- PICNIC SHELTER
- PRIMITIVE CAMPING
- POWER BOAT ACCESS
- ROWBOAT CANOE ACCESS
- SHORE LINE

FIGURE 9
STOCKPORT MIDDLE GROUND master plan

the Saratoga Capital District State Park and Recreation Commission
OFFICE OF PARKS · RECREATION · HISTORIC PRESERVATION
NEW YORK STATE
box w
saratoga springs
new york
12866

HUDSON RIVER ISLANDS STATE PARK STOCKPORT MIDDLE GROUND
project title

PARK DEVELOPMENT PLAN
sheet title

revisions

H. EARLE designed	H. EARLE drawn
checked	7/30/84 date
1"=200'-0" scale	1 sheet

SP-HI 8402
project number

SP-HI 8402.001
drawing number

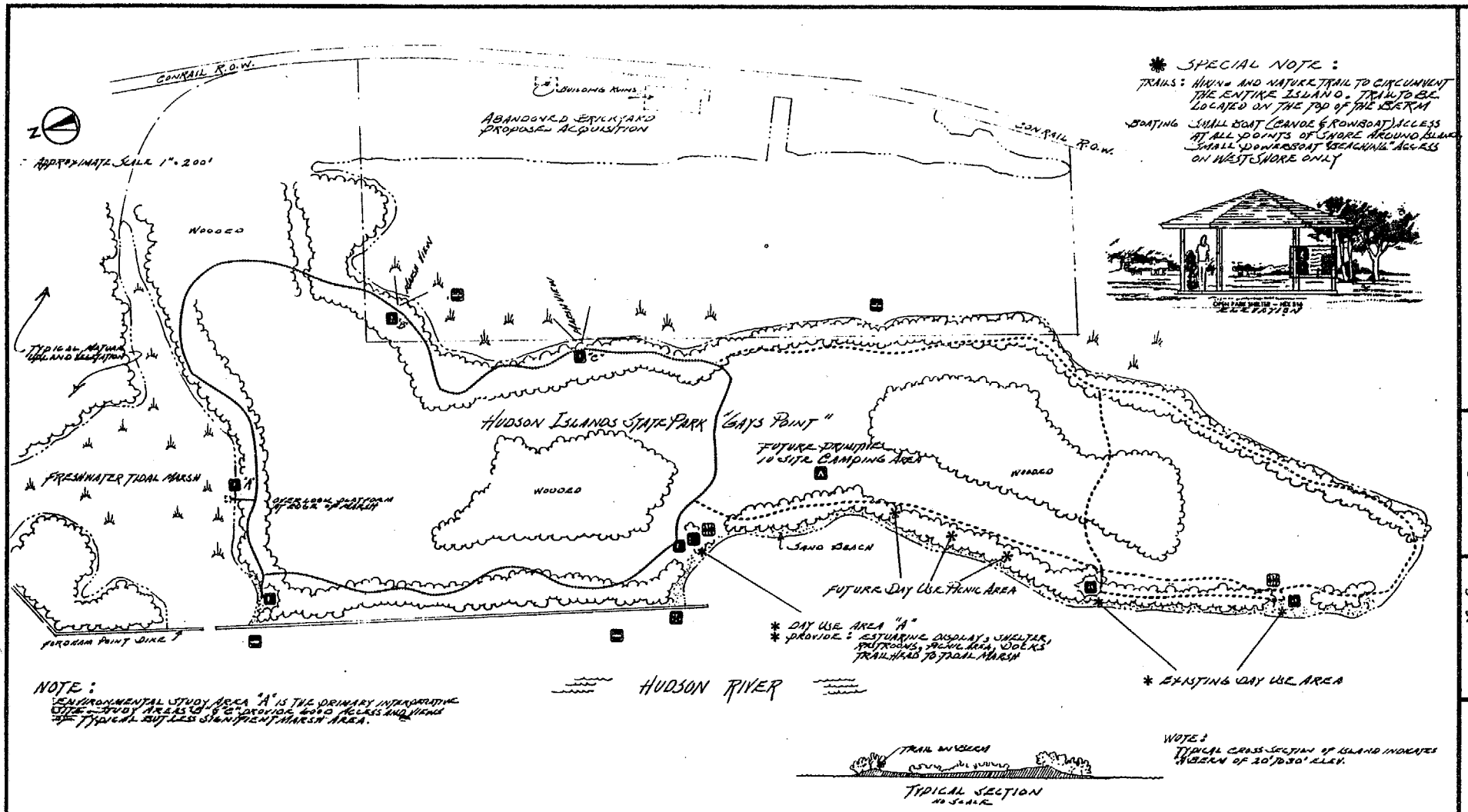


FIGURE 10

GAY'S POINT master plan

the Saratoga Capital District State Park and Recreation Commission

box w
saratoga springs
new york
12866

HUDSON RIVER ISLANDS STATE PARK GAY'S POINT
project title

PARK DEVELOPMENT PLAN
sheet title

revisions

H.EARLE designed	H.EARLE drawn
G. TILLER checked	7-25-84 date
1"=200' scale	1 sheet

SP-HI-8401
project number

SP HI 8401.001
drawing number

619

trail for the Sanctuary. All trails will be restricted to dry land, but wetlands, shallows, and deep water will be visible along the trail.

A creek mouth and/or railroad pedestrian crossing which would provide safe access to the Sanctuary for persons without boats is under study. Any proposals will be discussed with Consolidated Rail Corporation.

The Office of Parks, Recreation, and Historic Preservation (OPRHP) is considering the development of a new facility at Coxsackie for maintenance of their Hudson River Islands State park, portions of which are within the Stockport component. This facility would also be used for Sanctuary purposes. Alternative arrangements would be made with a nearby private residence for storage of boats and any other small equipment necessary for research and monitoring the site.

After acquisition of the Stockport Creek mouth site (Parcel 5, Figure 6), improvements will be made to the boat landing, a parking area will be constructed near the landing, and a safety fence will be built between the landing and the railroad (Figure 11). Old pilings and other obstructions will be removed from under the railroad bridge and culverts.

When land acquisition is completed, any camps or cabins remaining that cannot be used for Estuarine Sanctuary purposes will be removed, and all dumps will be cleaned up. Special care

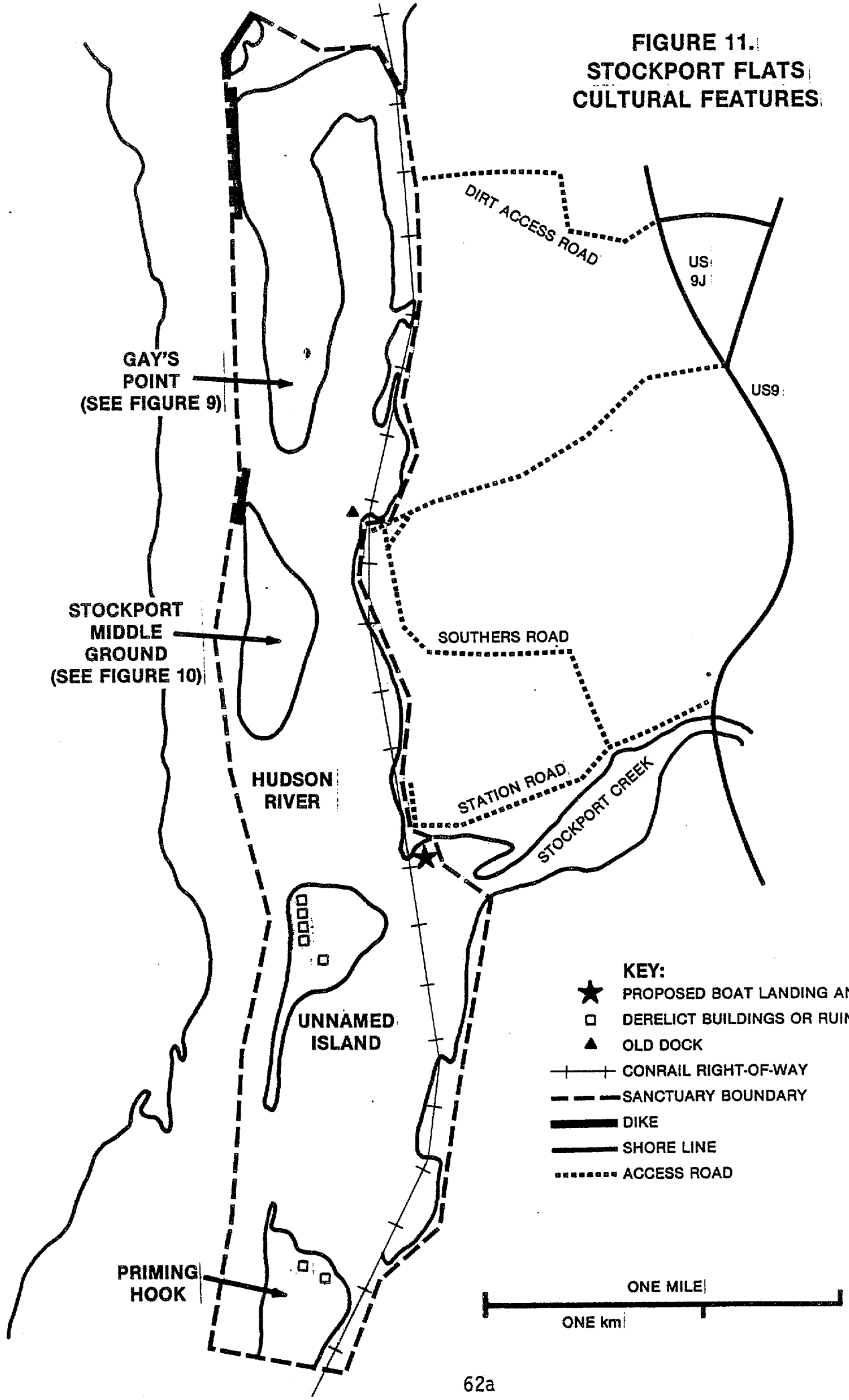


FIGURE 11.
STOCKPORT FLATS
CULTURAL FEATURES
DIRT ACCESS ROAD
US 9J
US9
GAY'S POINT (SEE FIGURE 9)
STOCKPORT MIDDLE GROUND (SEE FIGURE 10)
SOUTHERS ROAD
HUDSON RIVER
STATION ROAD
STOCKPORT CREEK
UNNAMED ISLAND
PRIMING HOOK
KEY:
PROPOSED BOAT LANDING AND PARKING AREA
DERELICT BUILDINGS OR RUINS
OLD DOCK
CONRAIL RIGHT-OF-WAY
SANCTUARY BOUNDARY
DIKE
SHORE LINE
ACCESS ROAD
ONE MILE
ONE km

will be taken to avoid disturbance of endangered plants in the vicinity of derelict buildings.

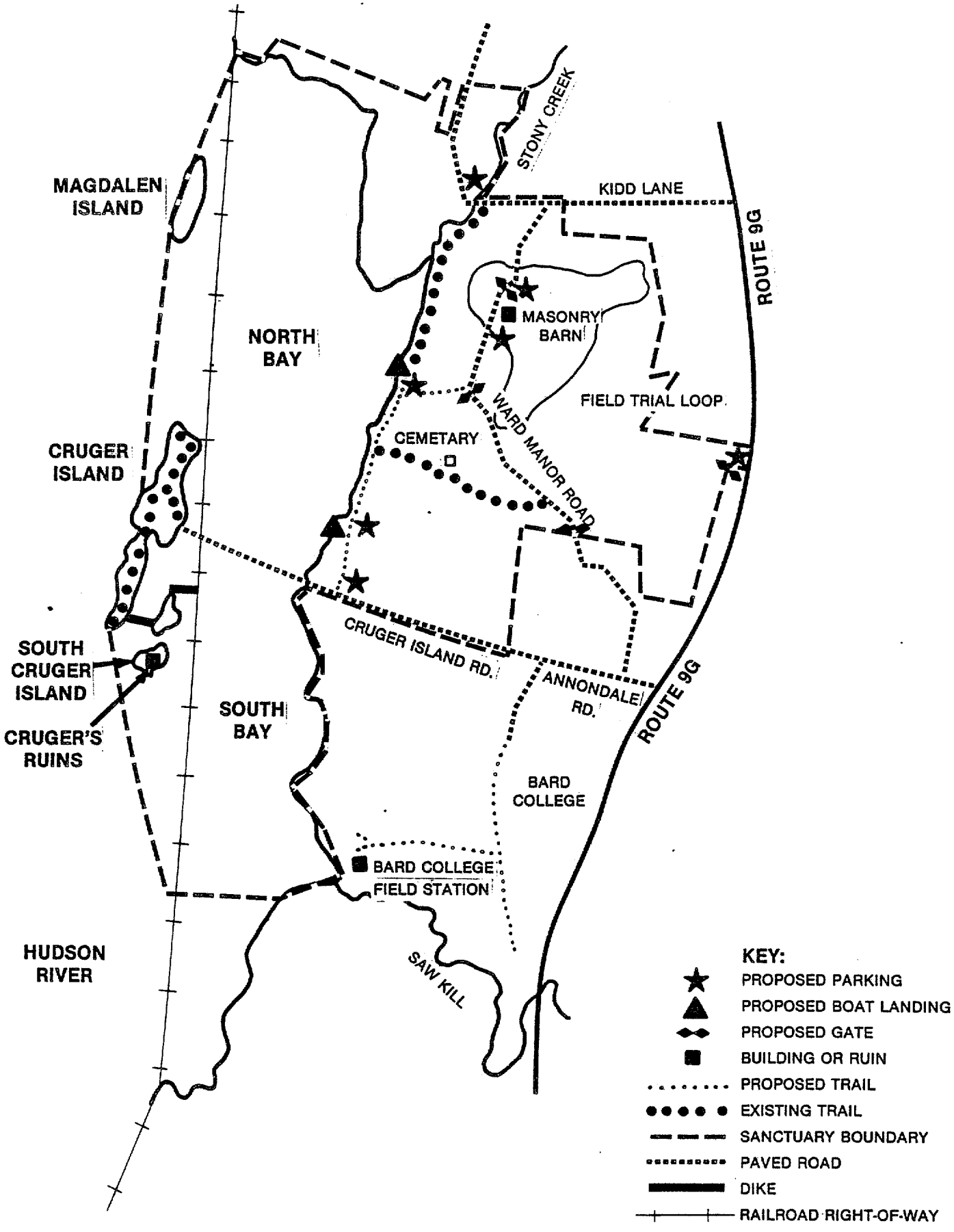
Tivoli

The Sanctuary's main research facility will be housed at Tivoli Bays in the renovated and expanded Bard College Ecology Field Station, located 100 yards inland from South Bay and a short distance north of Saw Kill (Figure 12). These agreements are discussed in a memorandum of understanding between the Department of Environmental Conservation and Bard College (Appendix 9).

The Field Station will be used to support research at all four Sanctuary components, and will be available to scientists from other institutions and to agency personnel for work in the area. Scientists will also have limited access to existing scientific laboratories at Bard College. Facilities and services available through the Field Station are described in the research section of this plan.

Renovation and expansion of the Field Station will be accomplished with Sanctuary funds, and no structures will be built closer to South Bay than the existing building. Improvements will be made to the existing primitive road and landing, which will remain closed to the general public, except those on foot.

FIGURE 12.
TIVOLI BAYS CULTURAL FEATURES



The South Cruger Island "ruins" and masonry barn will remain as historic resources, and uses for these structures will be sought. The well houses, cinder block garage, and other derelict buildings will be removed if no public use for them can be found.

The Cruger Island Road and the Ward Manor Road will be repaired for administrative, research, and recreational access. Gates or fencing for control of public use will be installed at all access points to the DEC upland property and at selected points along the two roads. Small parking lots (Figure 12) will be built at several locations not adjoining the estuarine habitats. These will provide access to two cartop hand-carry boat landings and to selected upland sites. Tentative sites for the boat landings are in the southeastern corner of North Bay, and on the east shore of North Bay just north of the mouth of Stony Creek.

An interpretive trail will be built paralleling the east edge of North Bay between Cruger Island Road and Stony Creek. Existing spur trails on Cruger Island and the uplands will be pruned and repaired.

All gates, roads, parking areas, trails, and landings will be located where some form of development existed previously. Sites and routes are currently being studied to determine feasibility of development and environmental impact. All construction will be done with special care to protect rare species or com-

munities, archeologic resources, and erodible soils.

Iona

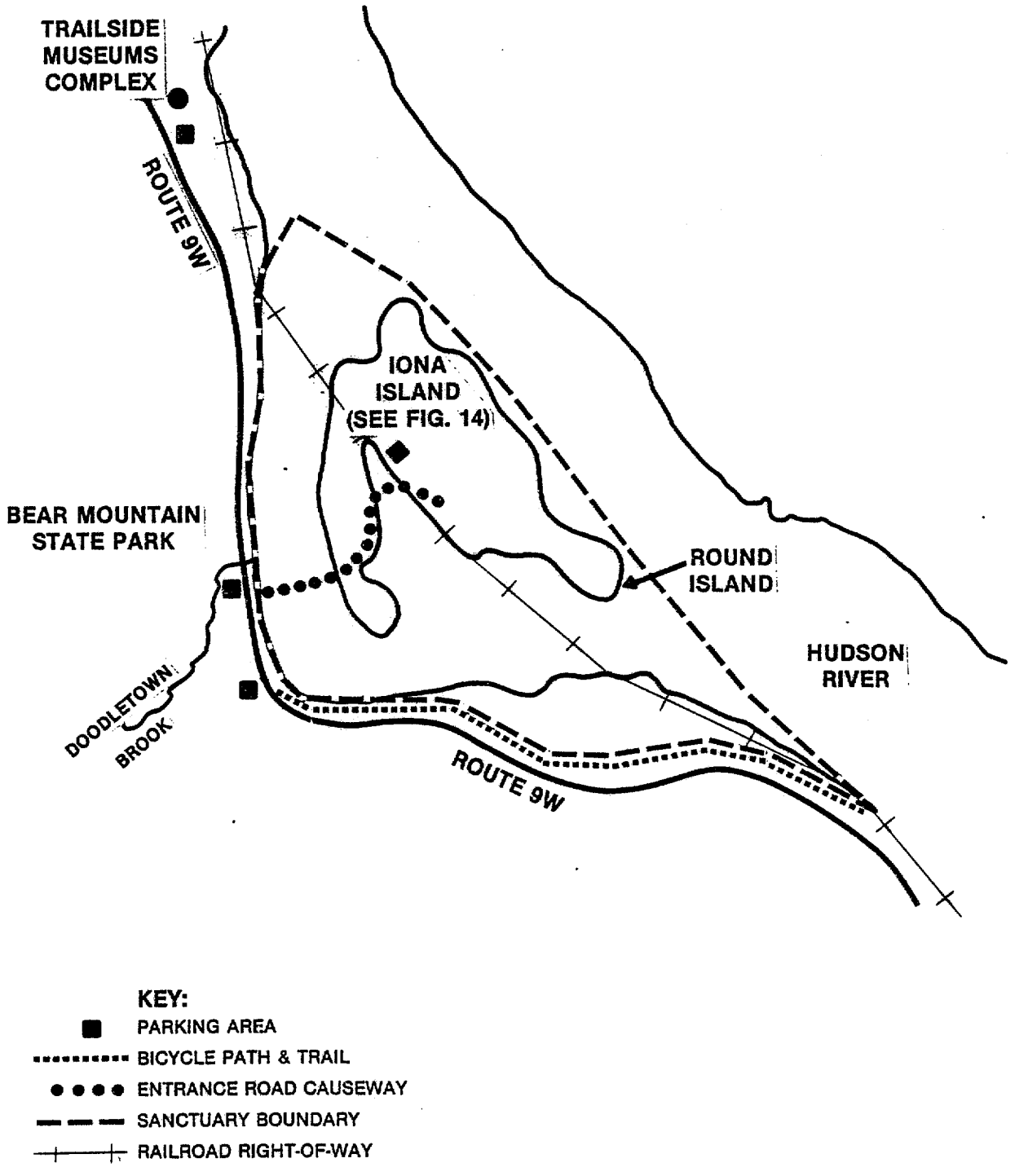
The Trailside Museums complex will be the Sanctuary's main educational facility. The museum complex hosts more than one-half million visitors yearly. Renovation of portions of the Bear Mountain Trailside Museums complex are underway, and both indoor and outdoor exhibits adjacent to the Iona Island Marsh component are being developed as discussed in the education section. In addition, the Trailside Museums' capability for basic natural history research in the local area will be augmented by the purchase of small equipment, specimen storage cabinets, and library materials for use by Trailside staff.

The remaining buildings on Iona Island will continue to be used for the Palisades Interstate Park Commission's (PIPC) storage and maintenance operations. Arrangements will be made for storage of selected field equipment and boats for use in research and monitoring at the Iona Island Marsh. Facilities, trails, and cultural features at the Iona component are noted on Figures 13 & 14.

The central fields of the portion of Iona Island east of the railroad are open to certain large group users by PIPC permit. PIPC intends to develop additional public uses of the eastern parts of the island that are harmonious with the site's missions as a National Natural Landmark and wildlife sanctuary. The gate

FIGURE 13.

IONA ISLAND CULTURAL FEATURES



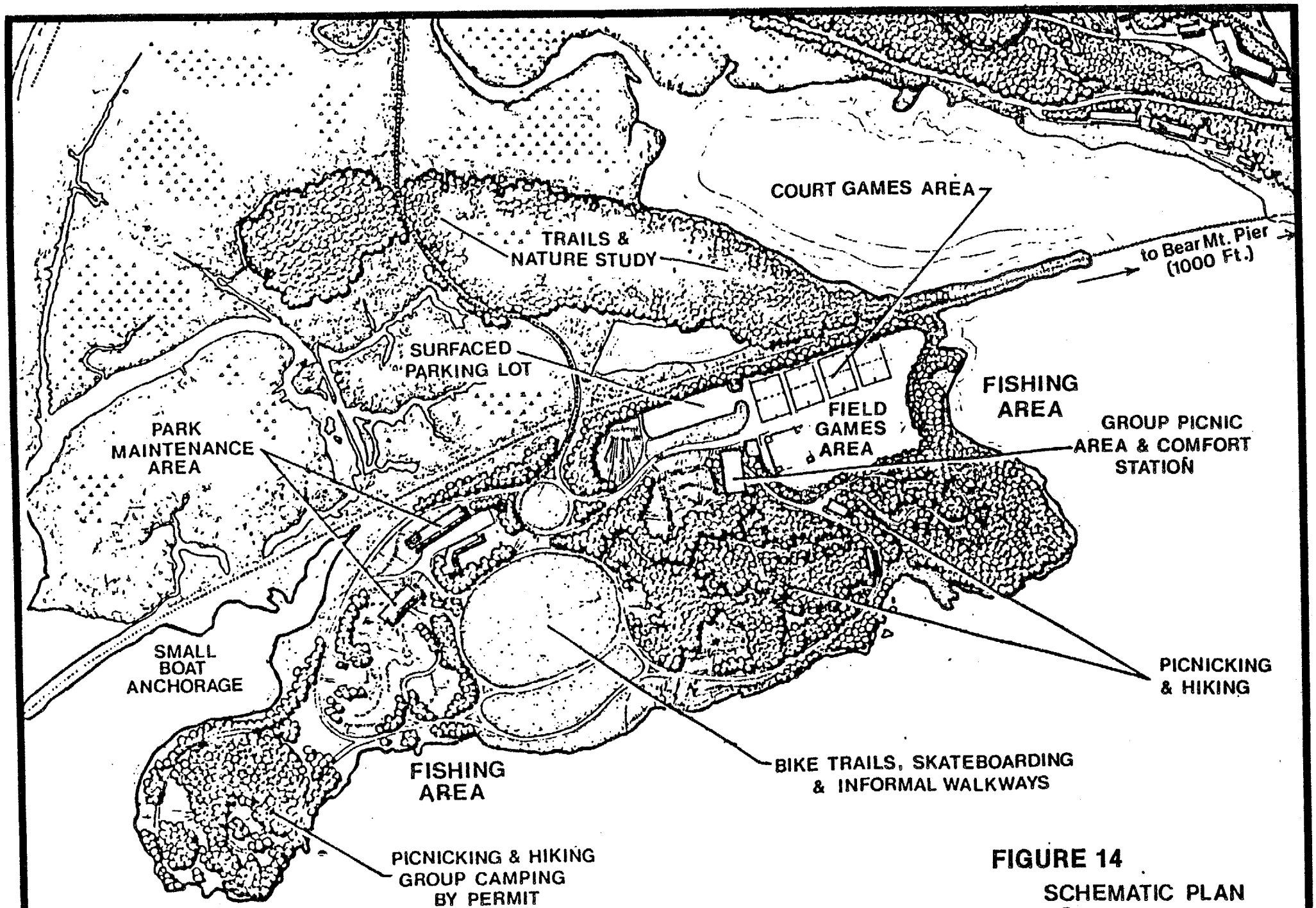


FIGURE 14

SCHEMATIC PLAN

Bear Mt. State Park
Iona Island Area

on the east side of the railroad will remain in place for control of public access.

Piermont

No specific facilities are planned for the Sanctuary at Piermont. Arrangements will be made for storage of field equipment and boat(s) at existing park buildings as space permits. The Village-owned Erie Pier will be available as an access point, under a permit system instituted by the Village. Pedestrians may use the pier without a permit. Permits are required for vehicles; an annual fee of $10 is charged to Village residents, $25 to Town residents, and $50 to all others. No boats may be launched from the pier now, but the Village is planning construction of a concrete boat ramp and possibly a marina on the pier.

Discussion will take place to consider use of facilities at Lamont-Doherty Geological Observatory (near the Piermont Marsh) by scientists doing research in the Estuarine Sanctuary.

Derelict wooden barges on the Sanctuary site, and any old pilings or other structures, will be removed if justifiable for reasons of hazard ecology, following appropriate study and depending on availability of funds.

The closed municipal landfill on the DEC property on the south side of the pier will be monitored periodically for toxic substances, and any nuisance materials on the surface will be

cleaned up. Habitat restoration, including further capping and grading, or removal of material, will be done if ecologically justified, if consistent with Sanctuary goals, and if funds are available.

D. Existing Right-of-Ways

Policy: Existing right-of-ways which are in use such as water lines, gas lines, telephone or electric lines, or sewer lines will be permitted to continue in use under pre-existing agreement.

Any construction, repair, renovation, or maintenance of these utilities and rights-of-way are subject to DEC permits (Protection of Waters, Freshwater Wetlands or Tidal Wetlands Laws) if dredge or fill is involved. Furthermore, the owners of such utilities will keep the lines in good repair and not allow environmental or health hazards to develop.

E. Off-site Concerns for Sanctuary Site Management

Several conditions and activities outside the boundaries of the Sanctuary have the potential to affect various resources, patterns, and processes within its boundaries, and must be considered in the management of the Sanctuary.

Policy: The Sanctuary Steering Committee, Sanctuary Manager, and the local advisory committees will seek to be informed about existing and planned

activities and conditions outside Sanctuary boundaries that will or already do affect resources and conditions within the Sanctuary. The Steering Committee, Manager, and local advisory committees will act to inform and influence management decisions that indirectly affect the Sanctuary, and in doing so, to prevent or mitigate adverse effects of off-site management practices on the Sanctuary.

Water quality

Among the many off-site activities that have the potential to affect Sanctuary conditions, those that affect water quality are the most pervasive. Water is distributed to the Hudson Estuary by direct runoff and a network of rivers and streams that drain large areas of upland watersheds, and water circulation within the estuary is highly complex. The problems of industrial discharges, oil leakage, sewage discharges, nutrient loading, pesticide contamination, metals and metal-like non-metal residuals, and other pollutants are not known to be serious immediate threats. Yet the presence of these contaminants at persistently low levels and occasional acute episodes at medium or high levels may pose long-term threats to the vitality of ecosystems at Sanctuary component sites. Positive resolution of these problems will require environmental monitoring, communication with state permitting systems, and negotiation with the public and private parties involved.

Management of railroad right-of-ways

Management activities on railroad lands and right-of-way crossings adjacent to three of the Sanctuary components have the potential to significantly affect both estuarine ecosystems and Sanctuary users. Cooperation from the railroads on a number of management issues will be sought by the Sanctuary Manager and the Steering Committee through discussions of pedestrian crossings over railroad right-of-way; the use of herbicides and other railroad vegetation management practices; removal of debris from under railroad bridges and in culverts to maintain drainage patterns; disposal of old railroad ties and other debris in the Sanctuary; toxic substances along railroad rights-of-way; and hazards associated with railroads and other visitor control measures.

Dredging and spoil disposal

The Federal navigation channel requires periodic dredging to maintain a safe depth for commercial ships between Kingston and Troy (including the channel adjacent to the Stockport and Tivoli sites), in Haverstraw Bay, and in New York Harbor. The U.S. Army Corps of Engineers have prepared a Draft Environmental Impact Statement on Maintenance and Dredging and a 10-year Management Plan (U.S. Army Engineers, 1980). According to this plan, dredging will be conducted in a manner designed to minimize turbidity and to avoid critical fish spawning periods. Upland

spoil disposal is preferred over traditional disposal in estuarine wetlands and shallows. A separate site-specific environmental assessment and an environmental impact statement will be prepared for dredging and spoil disposal for each annual dredging program. The Corps has identified in a generic manner a list of spoil disposal sites that could be used in the vicinity of Stockport.

Spoil disposal on upland property near the Sanctuary might be considered compatible with New York's Coastal Management Plan assuming that upland property is available for this purpose. In such a case, the Sanctuary Manager and DEC will determine whether or not disturbance from temporary slurry pipelines, noise, eroded sediments, and turbulence resulting from disposal will significantly harm the Sanctuary. If so, evidence will be presented and alternatives offered at the appropriate time in the state permitting process. The behavior of old spoil and volunteer vegetation on spoil at the Sanctuary should guide future management of spoil deposits off-site. Other off-site dredging and spoil disposal proposals will be similarly evaluated by Sanctuary advisors and management.

Emergency plans for spills

The Sanctuary Manager will consult with the Coast Guard and other appropriate agencies or private groups and devise appropriate emergency plans for spills of oil or hazardous

materials from ship, train, or truck at or near the Sanctuary sites if existing plans are found to be inadequate.

Agriculture and forestry

The Sanctuary Manager will consult with the Columbia and Dutchess County Soil and Water Conservation Districts concerning erosion control on the farmlands east of the Stockport and Tivoli Bays components. Voluntary agreements with adjoining landowners concerning erosion control and maintenance of buffer vegetation on the bluffs south of Stockport Creek and east of Tivoli South Bay will be sought if necessary.

Off-site tidal wetlands

The Sanctuary research program addresses the entire estuary with its related terrestrial and aquatic ecosystems, and efforts will be made to track and interpret changes throughout the estuary. Several off-site tidal wetlands that merit investigation and protection are identified in Appendix 12.

F. Surveillance, Enforcement, and Maintenance

Protection and maintenance of the Sanctuary's resources is critical to preserve the value of the Sanctuary for scientific research, education, and other activities. Although several policies throughout this management plan provide direction for Sanctuary users and managers, the arrangements for reporting violations, enforcing Sanctuary policies, and providing Sanctuary maintenance will be addressed here.

Surveillance and enforcement

Policy: Sanctuary staff and enforcement personnel from state and local agencies will periodically visit the component sites to determine whether Sanctuary policies are being violated and to investigate violations that occur. The Sanctuary will also rely on researchers, educators, and other users to report any violations.

Enforcement personnel from several state and local agencies will cooperate with Sanctuary staff to ensure that management policies stated in this plan are obeyed. The Department of Environmental Conservation (DEC) has Conservation Officers who enforce the State Fish and Wildlife Law and other acts and laws administered by DEC. Forest Rangers from DEC enforce the State Lands and Forests Law, but often assist Conservation Officers in their activities. The Palisades Interstate Park Commission (PIPC) has a police staff to patrol its own lands, and the Office of Parks, Recreation, and Historic Preservation (OPRHP) will have a seasonal caretaker to oversee their property at Stockport. At Piermont, Village Officers will aid in enforcing Sanctuary policies and State regulations. The U.S. Fish and Wildlife Service will provide assistance to state agencies in matters related to violation of federal fish and wildlife regulation. In addition, Sanctuary staff members, regional representatives from DEC and OPRHP, researchers, educators, and other Sanctuary users will aid

enforcement by reporting violations. Although continuous surveillance is prevented by time and budget limitations, enforcement services will be adequate.

Several regulatory programs guide decisions that will affect Sanctuary resources. Appendix 8 provides a detailed list of existing laws and jurisdictions, and the most important of these are briefly discussed below.

- o Tidal Wetlands law (Piermont), Freshwater Wetlands law (Stockport, Tivoli, Iona), and Protection of Waters law (all sites) require permits for certain uses of areas below mean high water and a 100-foot strip of adjoining upland (e.g., construction, dredging, filling, placement of rip-rap). These laws are administered and enforced by DEC. Since the Estuarine Sanctuary is a special use of these areas, the objectives of the Sanctuary Program will be considered in DEC review of permit applications.

- o The Power Plant siting review process under Article 8 of the Public Service Law will operate as it has previously, and consideration will be given to Estuarine Sanctuary policies in siting decisions.

- o The Estuarine Sanctuary Program will be given consideration in environmental impact assessments and enforcement proceedings performed under the National Environmental Policy Act and under the New York State Environmental Quality Review Act.

- o Zoning decisions will continue to be made by the local communities. The Towns of Orangetown (Piermont) and Red Hook (Tivoli) have the capability to use existing zoning ordinances to give some protection to lands adjoining the Sanctuary sites. The Sanctuary Steering Committee requests that the towns inform the Committee of significant project proposals.

- o The State Park and Recreation Law includes a provision for OPRHP review of project proposals within 500 feet of a state park boundary. OPRHP owns land at the Stockport, Iona, and Piermont components.

- o The New York Coastal Management Program in the Department of State requires a federal or state agency approving or initiating a project in or near the defined Coastal Zone to undertake actions consistent with a series of Coastal Management policies and existing environmental protection laws. The Sanctuary Manager will pursue adoption of an additional Coastal Management Program policy that specifically requires consistency with this Sanctuary Management Plan.

- o The Department of State awards block grants for waterfront development; these constitute a positive financial incentive for local governments to comply with Coastal Management policies. Among other things, grant money may be used for environmental impact statement preparation.

- o The Department of Environmental Conservation administers the Coastal Erosion Hazard Act which governs use of areas with a recession rate of one foot per year or more, including portions of the old spoil deposits at Stockport (Gay's Point, Unnamed Island and Priming Hook).

- o The Army Corps of Engineers, through the Clean Water Act, Section 404 and the Rivers and Harbors Act, Section 10 regulates hazards to navigation and dredging, filling or dumping activities in wetlands, the river, and larger tributaries.

Maintenance

Policy: All maintenance activities, including debris pickup, removal of dangerous obstacles, facility upkeep, posting, and maintenance of trails and markers will be conducted by the landowning agency, unless done under contract by another state agency (Department of Environmental Conservation or Office of Parks, Recreation, and Historic Preservation). The Sanctuary will also rely heavily on volunteers and Sanctuary users to promote litter control and habitat protection.

It will be desirable to expand the buffer zone around the existing Sanctuary sites in order to provide additional protection.

Protective agreements will be sought at Stockport bluffs and Tivoli South Bay bluffs. Voluntary cooperation, agreements, and negotiations will be the means used to attain any additional buffer zones.

VII. RESEARCH PROGRAM

The Hudson River National Estuarine Sanctuary Research Program has the following goals:

- o To increase knowledge of the complex natural processes and ecological relationships that exist in the Estuary;
- o To provide information about natural and anthropogenic influences on estuarine ecosystems that is relevant to sound management of coastal resources; and
- o To foster creative collaboration between sanctuary research efforts and other Hudson River and estuarine research programs.

The Hudson River National Estuarine Sanctuary is a natural laboratory system that unites a diverse array of sites in each of the four large wetland complexes. The subsystems within each sanctuary component provide a wealth of opportunity for a variety of scientific investigations. The increasingly saline tidal environments lend themselves to comparative research along the estuary's north to south salinity gradient. The Hudson River is also well suited for studying phenomena that are most easily observed in a long, narrow, unbranched estuary, such as certain mixing phenomena.

The Sanctuary research program will emphasize long-term environmental monitoring, ecosystem studies, and applied problems in the management of estuary resources. Research will focus on the estuary and on the interaction of the estuary with

terrestrial and marine systems. Special emphasis will be placed on shorelines, shallows, and tidal wetlands since these are the least studied habitats, both on the Hudson Estuary and on other tidal river. The Sanctuary research program will focus on Sanctuary sites, but will also encompass off-site research.

Past research on the Hudson has emphasized sport and commercial fish species. Researchers have also investigated terrestrial and aquatic flora and fauna, sediments, soils, economic geology, water quality, and chemical contaminants. References to published work on the Sanctuary sites appear in the bibliography (Appendix 13), and a list of current research and monitoring activities is included as Appendix 14. Appendix 15 provides an extended list of specific survey, environmental monitoring, and research priorities.

A. Research Priorities

Research policies and outline of priorities

Policy: Baseline studies, monitoring and research that pertain directly to the long-term management of the Sanctuary and Hudson River estuarine resources will be actively encouraged and will receive highest priority of any research supported by Sanctuary funding.

More information is needed about natural conditions at each component site, human impacts on these natural patterns and

processes, and ways of managing these impacts to ensure each component's long-term viability, diversity, and productivity. Several types of research will yield information integral to the successful long-term management of the Sanctuary and the Hudson River estuary.

- o Baseline studies of each Sanctuary component's biological, chemical, and physical characteristics to provide a more comprehensive data and information base than currently exists for monitoring, research, and management activities.
  - Document the location, extent, and biological resources of the Sanctuary's various habitats.
  - Determine water quality at each site and identify the factors influencing it.
  - Identify the hydrologic and geomorphologic processes that shape each site, including water currents and sediment movements.
  - Determine chemical quality of sediments and wetland soils at several sites on each component.
  - Document the locations and population characteristics of endangered and threatened plant and animal species.
  - Document current levels of common bioaccumulating compounds in selected vertebrates and invertebrates.
  - Determine patterns of human use of each component site.
- o Monitoring of changes in each component site's biological, chemical, and physical conditions.
  - Track changes over time in the location, extent, and biological resources of the Sanctuary's habitats and identify the causes of these changes.

- Track changes in water quality over time (seasonal, daily, storm event related, etc.) and identify causes of these changes.

- Track changes over time in land forms and identify causes of these changes.

- Track quantitative and qualitative changes in chemical nature of sediments and wetland soils; identify causes of these changes.

- Track changes in location and success of endangered and threatened species.

- Track changes in levels of bioaccumulating compounds in animals.

- Track changes in patterns of human use of the Sanctuary components.

o Studies of the effects of human activities on the Sanctuary's water quality, flora, fauna, ecological processes, and physical processes and studies of ways to mitigate negative impacts.

- Evaluate the effects of nutrient loading from point and nonpoint sources on water quality and biota, and evalute the assimilative capacities.

- Evaluate incidence and effects of on- and off-site contamination of water, sediments, and biota from oil spills, industrial processes, pesticide use, and residual or derelict sources of contaminants.

- Evaluate the effects of ship disturbances on Sanctuary shorelines and biota, and determine most vulnerable areas.

- Evaluate the impacts of railroad right-of-way management practices on the Sanctuary's resources.

- Evaluate the impacts of hunting, fishing, trapping, and other recreational uses on the Sanctuary's resources.

Policy: Research about on estuarine ecosystems that is relevant to coastal resource management in New York and other states will be encouraged.

The Hudson River National Estuarine Sanctuary has been set aside to provide valuable information that can be used to better manage the resources found in other estuarine environments. The Sanctuary will help provide information on estuarine ecosystems by serving both as a reference for comparisons with other systems and as a model for estuarine processes found in other areas. Several types of research will yield information with bearing on coastal resource management, including:

o Comparative studies incorporating measurements at other estuarine locations and using the Sanctuary as a reference area.

  - Determine the direct and indirect impacts of wetland alterations on terrestrial and aquatic flora, fauna, and habitats.
  - Assess the direct and indirect impacts of dredging and covering subtidal and intertidal habitats.
  - Assess the direct and indirect impacts of nutrient loading and chemical contamination of estuarine habitats.

o Studies of the biological, physical, and chemical processes that shape and sustain the estuarine system. These investigations will be done to draw conclusions about ecological, hydrological, geomorphological, and chemical processes and relationships in estuaries, human effects on them, and ways that resources and human activities can be managed to minimize negative impacts on estuarine systems.

Policy: Research which has a less direct application to the management of coastal resources and the

Sanctuary than those types of studies described above will be permitted and encouraged as long as it does not conflict with higher priority research.

Policy: Research involving physical, biological, or chemical manipulation of the Sanctuary environment is not encouraged, but will be permitted on a very limited basis under strict review. The project site must be restored by the researcher(s) to its original condition upon completion of the study.

In general, manipulative studies are incompatible with the goals of the Sanctuary. However, if benefits to the Sanctuary or to the Hudson River Estuary can be realized, the studies will be permitted. Proposals for this type of research will be closely evaluated by the Sanctuary Manager and Steering Committee to determine duration of project, the type, extent, and reversibility of planned activities, the impact on long-term stability of the Sanctuary environment, and the benefit to coastal resource management. The landowning agency must grant approval for any such research.

Ongoing clarification of research needs

Discussions will be initiated and maintained with various interested groups to clarify research needs, further develop priorities, and enhance coordination and collaboration among

these interested groups and with Sanctuary research activities. The local advisory committees will play a key role in maintaining many of these contacts, particularly those with groups represented on the local committees. The Hudson River Fisheries Advisory Committee, Hudson River Environmental Society, Hudson River Research Council, Heritage Task Force for the Hudson River Valley, Hudson River Sloop Clearwater, and Scenic Hudson, are some of the important regional groups with a strong research interest.

B. Coordination of Sanctuary Research

The Sanctuary Manager will coordinate all research and environmental monitoring in the Sanctuary, and will ensure a consistent interpretation of Sanctuary goals and research objectives.

Research proposal

A written proposal for research in the Sanctuary must be submitted to and approved by the Sanctuary Manager. The proposal must include the following information:

- o name, address, telephone number, and agency affiliation of principal investigator(s);
- o names of persons to conduct field work;
- o objectives of the proposed study and how they relate to the management of the Sanctuary and other coastal resources;
- o the precise location in the Sanctuary in writing and on a map;

- o explanation of methods, materials, and equipment to be used; and
- o duration of study, including starting and completion dates.

A sample research proposal is included as Appendix 16. Routine wildlife management activities and water quality sampling conducted by state and federal agencies will not require a research proposal. The agency must notify the Sanctuary Manager either by telephone or in writing about upcoming research or monitoring projects on Sanctuary property.

Proposal evaluation and approval

The Sanctuary Manager will evaluate the feasibility of proposed research projects and the degree to which projects meet Sanctuary objectives and policies defined in the Sanctuary management plan. Only research that complies with the management plan will be permitted. The impacts of proposed research on ongoing or other proposed projects at the Sanctuary will be assessed. When a conflict occurs, preference will go to the project more directed to resource management, as long as the proposed research does not displace or disrupt an existing project.

A research review panel will be selected by the Sanctuary Manager to provide evaluation and comment on individual research proposals. The Manager will select three reviewers from public and private agencies and institutions. Selection will be based on field of expertise and on familiarity with the Hudson River

Estuary, estuarine research, and coastal management issues. The Sanctuary Manager will ensure that each proposal receives an interdisciplinary assessment. Copies of a research proposal will be sent to research reviewers with a review sheet. The Sanctuary Manager will use reviewer responses to make a final decision regarding use of the Sanctuary.

The landowning or landmanaging state agency will review and approve research proposals selected by the Sanctuary Manager through the agency's representative on the Sanctuary Steering Committee.

Field work may not begin in the Sanctuary until the principal investigator receives written notification of approval from the Sanctuary Manager. Major changes in the original research objectives, materials, or methods must be submitted in writing to the Sanctuary Manager, who will consult the research reviewers. Variations from the original research proposal must be approved in writing by the Sanctuary Manager.

Research that fails to meet the objectives and policies of the Sanctuary management plan through variation from the approved research proposal or approved amendments may be terminated immediately by the Sanctuary Manager.

Scientific collection permits

Before research involving the collection of out-of-season and/or protected species may begin in the Sanctuary, the research

must obtain all the necessary permits required by New York State agencies and the U.S. Fish and Wildlife Service.

A Scientific Collector's Permit from the Department of Environmental Conservation is required to collect fish or wildlife protected by state laws. The U.S. Fish and Wildlife Service requires a Scientific Collecting Permit for work with endangered species, and for banding, taking, transporting, or possessing migratory birds, their parts, nests, or eggs for scientific research or education purposes. For archeological research or collection, written permission from the New York State Commissioner of Education is needed. A permit from the State Museum's Botany Office is required for research or collection of certain species of plants.

Researcher responsibilities

Researchers bear sole responsibility for maintaining their own field equipment, for removing their own trash, and for removing any equipment, structures, or markers when a project is finished.

After a research project is completed, the researcher must submit to the Sanctuary Manager an abstract summation of the project and one copy of any report, publication, dissertation, or thesis resulting from work in the Sanctuary.

Research recruitment

Researchers will be attracted to work in the Sanctuary or on Sanctuary-related studies through the placement of advertisements and through active dissemination of information by Sanctuary committees and staff about work that has taken place at the Sanctuary and the Sanctuary's value for research. The accessibility of a variety of facilities and support services, an expanding information base about Sanctuary and ancillary sites, the availability of student or volunteer assistants, and opportunities for interaction with other workers engaged in estuarine research will be strong inducements to conduct research in the Sanctuary.

C. Sanctuary Research Facilities and Support Services

The Sanctuary Manager will maintain a directory of facilities and support services available from public and private organizations, potential funding sources, locations of specimen collections, identification specialists, and other relevant facilities and services.

Bard College facilities and services

The central research facility for the Hudson River National Estuarine Sanctuary will be the Bard College Ecology Field Station at Tivoli Bays. The Field Station will house a wet laboratory; facilities for specimen sorting, identification, preservation, and storage; facilities for work with experimental animals on a limited basis; and other laboratory equipment.

The map collection, library, microcomputer, weather station, and an office for the Sanctuary Manager will be located at the Field Station. Office, bunk, and kitchen space for visiting scientists and students will be available on a limited basis. The Field Station will also house canoes and a Boston Whaler jonboat for Sanctuary research.

Other Bard College facilities will be available to visiting scientists and agency personnel to an extent compatible with Bard's academic program. Such facilities will be most available during January and the summer months. They include computer terminals; a library; darkrooms; a machine shop; biology, chemistry and physics laboratories; an atomic absorption spectrometer; nuclear magnetic resonance; a gas chromatograph; the histology-microbiology laboratory; and a rodent facility.

Although Bard's Field Station is located at Tivoli Bays, use of a van and a DEC trailer will allow a "mobile laboratory" approach to field work at the other Sanctuary sites. Canoes and Boston Whaler jonboats will be available at all Sanctuary sites or housed near the sites.

Pursuant to the attached Memorandum of Understanding (Appendix 9), Bard College will participate in review and approval of all research activities involving Bard facilities.

Cooperation with other institutions

Other facilities in the Hudson Valley are potentially available for field base or laboratory use. The Steering Committee and Sanctuary Manager will attempt to facilitate arrangements with other institutions, such as:

American Museum of Natural History

Dutchess Community College Norrie Point Environmental Museum/Laboratory

Hudson River Foundation for Science and Environmental Research

Lamont-Doherty Geological Observatory of Columbia University

Museum of the Hudson Highlands

New York Botanical Garden's Institute of Ecosystem Studies at the Mary Flager Cary Arboretum

New York State Museum

Rensselaer Polytechnic Institute

State University of New York

Vassar College

Student and volunteer assistance

The Sanctuary Manager will seek assistance from graduate fellows, student interns, and volunteers. A stipend (from the Operations Grants budget) will be provided to a graduate student who will assist researchers with environmental monitoring and other research on a part-time basis while pursuing master's or doctoral thesis research on a priority Sanctuary-related project. Unpaid internships will be open to college students (and possibly some older high school students) for work on specific research or

monitoring projects. Volunteers will be drawn from the general public and will help with a variety of projects in the Sanctuary.

Other assistance may be drawn from institutionalized populations (e.g., minimum security prisons). This can be done in the form of supervised work crews. "Earthwatch"-type arrangements, where a group of persons pay to participate in a scientific project such as an archeologic dig or vegetation study, will also be explored.

D. Funding Sanctuary Research

The Sanctuary Programs Division of the National Oceanic and Atmospheric Administration's Office of Ocean and Coastal Resource Management provides limited financial support on a competitive basis for management related research in national estuarine sanctuaries. Research funded partially or wholly with these funds may only be conducted within Sanctuary boundaries.

With the exception of limited contract work, the Hudson River National Estuarine Sanctuary does not award research funding.

The Steering Committee and Sanctuary Manager will keep apprised of other funding sources, and will initiate discussions with the Hudson River Foundation, New York State Sea Grant, and other appropriate foundations concerning areas of mutual interest. Representatives from these groups will be invited to attend Steering Committee meetings.

Local Sanctuary advisory committees will also act to raise private sector funds or to make contacts with private sector funding sources in connection with needed work on coastal management problems.

E. Sanctuary Data Management and Depositories

The Sanctuary Manager will develop a strict protocol for storing data collected in the Sanctuary. This program will include design of a central depository for both paper copy and computer files, as well as a system for maintaining duplicate copies of all data at another location. The program will be designed to facilitate the use and analysis of data, particularly through the use of computers.

The Sanctuary Manager will also develop procedures for recording observations and events, and for receiving and routing information. For example, all agency information on the Sanctuary sites will be centralized and available to the Manager and to scientists working in the Sanctuary -- information such as fish or game stocking dates and numbers, monitoring data, or toxic substance analyses. Efforts will be made to obtain similar types of information for the rest of the Estuary. In addition, a procedure will be developed for obtaining and recording public observations of short-lived phenomena such as unusual species dances, migrations, and natural or unnatural events that damage the environment (such as ice storms or oil spills).

A limited set of samples and specimens will be retained by the Sanctuary for historical purposes. Conventions for accurate labeling and suitable storage will be developed for these samples and specimens.

F. Dissemination of Sanctuary Research Results

The Sanctuary Manager will disseminate information about Sanctuary research to academic institutions, research organizations, and government agencies in a variety of ways, including brochures about Sanctuary programs and research opportunities, group presentations, and newsletters. Press releases about research projects will be prepared for the news media.

The Sanctuary Manager, with assistance from the Steering Committee, will also ensure that the general public is informed about the initiation and progress of research projects in the Sanctuary, and that the results of such research (including relevant past research) are made available to decision-makers and to the public in an accessible form (see Education Program).

VIII. EDUCATIONAL PROGRAM

The educational goals of the Hudson River National Estuarine Sanctuary are:

- o To increase public awareness and understanding of estuarine ecosystems, their importance, human effects on them, and the need for sensible resource management;
- o To disseminate scientific information generated in the Hudson River National Estuarine Sanctuary, as well as elsewhere on the Hudson and in other estuaries, in lay terms that meet the information needs of the general public, educators, and natural resource managers;
- o To increase public awareness of the Sanctuary components and facilities, and to encourage public use that is consonant with the management plan;

The establishment of the Hudson River National Estuarine Sanctuary focuses special attention on the need for long-term protection, wise use, and proper management of estuarine areas. The Sanctuary environments and the dynamics of the Hudson River will be introduced through effective interpretive programs geared to a wide range of people. Visitors will be encouraged to learn more about the Hudson Estuary, to support wise resource management policies, and to participate in the development of future policies related to the estuary and its environs.

Every year several million people visit the shores of the Hudson River for recreation and other activities. It is possible to accomodate many people at locations on or adjacent to the four Sanctuary components for educational purposes without damage to natural resources or conflicts with other uses. In addition, facilities outside the immediate vicinity of the Sanctuary will be used to further extend the Sanctuary's education program.

A. Educational Facilities, Programs, and Materials

Facilities

Policy: Sanctuary education programs will be provided from and supported by several facilities in order to provide access to a wide segment of the public.

The Bear Mountain State Park Trailside Museum is the Sanctuary's main education facility. The Trailside Museum and Zoo complex overlooks the Hudson River and the Iona Marsh component at the southern gateway to the Hudson Highlands, and is visited by over half a million visitors annually.

Native habitat exhibits will be constructed at the Trailside Small Animal Museum to represent many of the terrestrial and aquatic habitats that exist around the Hudson River and to exhibit a variety of plants and animals native to these habitats. Natural tides will be simulated in some of the aquatic exhibits, and tape recordings of sounds associated with the individual ani-

mals and their habitats will accompany the exhibits wherever possible. Color slides associated with each exhibit will further illuminate aspects of the natural habitats. The delicate relationship that exists between the animal life of the region and its varied habitats will be emphasized throughout these exhibits.

Two illustrated exhibits will also be developed for the Geology Point overlook at the Bear Mountain State Park. The Iona Island Estuarine Marsh exhibit will relate the history of this site and discuss the complex nature of this and other marshes, their beneficial qualities, and problems confronting these ecosystems. The second exhibit will illustrate the geologic history of the Hudson River through cross-sections of the Hudson Highlands which show the area's evolution over millions of years.

Several exhibits will be developed for the renovated wing of the Ecology Field Station at Bard College. These exhibits will describe ecosystems at the Tivoli Bays component and the important relationships that exist between the Hudson River and the surrounding area. Space will also be available at the Field Station for special educational activities such as research program openhouses.

The Department of Environmental Conservation's Five Rivers and Stony Kill Farm Environmental Education Centers in Delmar and Fishkill, and the Department's Camp DeBruce will play a role in the Sanctuary's education program. Staff at these facilities

will provide assistance in planning nature trail, exhibits, and other interpretive facilities and in developing educational materials and activities; conduct interpretive walks for the general public each year at Sanctuary sites; and provide assistance with teacher and youth leader training workshops.

Sanctuary education programs

Policy: Sanctuary education programs and activities will actively draw on and be coordinated with existing programs offered by public and private organizations.

The Sanctuary Manager will coordinate the sanctuary education programs with existing educational programs and activities, and will seek assistance in the development of instructional materials, slide shows, and permanent displays from institutions with these programs. Cooperative arrangements will be developed with schools and other groups to incorporate existing information about the Sanctuary and information generated by Sanctuary research with their education programs and materials.

Specialized courses and workshops on the Sanctuary's resources and estuarine ecosystems will be offered to science teachers and other educators. The Sanctuary staff will accept speaking engagements about the Sanctuary with audiences such as conservation groups, school classes, service organizations, and others. Forums, meetings and workshops on subjects related to

the Hudson River Estuary may be sponsored by the Department of Environmental Conservation or other agencies represented on the Steering Committee.

Interpretive nature walks will be offered to public groups, school groups, and special groups on request. Guided field trips starting from public transportation stations will be scheduled. Volunteers and teachers will receive training and materials as preparation for taking groups to the Sanctuary on their own.

Researchers will be encouraged to give site tours for college students and other groups in order to acquaint students with the practical aspects of equipment design, research protocol, and raw data collection. These tours will be coordinated by the Sanctuary Manager with researchers.

Policy: The Sanctuary will actively encourage the dissemination of scientific information from the Sanctuary to resource managers and the public.

Several avenues are open within the scientific community for presenting new information and data. In addition, Sanctuary staff will issue press releases, prepare non-technical newspaper and magazine articles, write letters to the editor, and use other means to attract media coverage of Sanctuary research accomplishments. Research abstracts will also be made available.

The Sanctuary Manager will monitor the progress of research activities, and will ensure that information relevant to manage-

ment of Sanctuary lands is transmitted to landowning and managing agencies and individuals in memo and other forms.

Education materials

Policy: Literature, visual aids, and related materials will be developed, distributed, and routinely updated in order to convey information to the general public and specialized groups about the resources, goals, and accomplishments of the Hudson River National Estuarine Sanctuary.

Several pamphlets, maps, and brochures will be available to Sanctuary visitors who wish to take self-guided tours. Checklists of plant and animal species will be available. Rules and regulations will be clearly outlined to familiarize visitors with the Sanctuary's management policies.

The Sanctuary Manager will work with science teachers and other educators to develop or update materials for science curricula. Instructional materials already being used will be adapted for Sanctuary use. Materials will be geared to different levels of students. Information kits for on-site instructors will include scientific information, rules and regulations, and other pertinent information. Instructors will receive both field workshops and instruction and off-site presentations.

Slide shows and mobile exhibits will be developed and adapted for use in classrooms, seminars, lectures, and other speaking engagements.

Press releases and a Sanctuary newsletter will be issued periodically by the Sanctuary Manager. The newsletter will include notes on Sanctuary activities, current research projects, and Hudson River related activities of other organizations, including field trips, talks, and courses.

B. Education Priorities

Sanctuary educational activities have been designated as short-term or five-year objectives. Short-term activities will be completed within 18 months of approval of the Sanctuary management plan. Within these divisions, two levels of priority are recognized.

Short-term educational activities

Highest priority is assigned to developing the following materials, programs and facilities:

- o Small animal museum and Geology Point exhibits at Bear Mountain State Park;
- o Interpretive exhibits at Ecology Field Station at Bard College;
- o Sanctuary newsletter;
- o Component site brochures and maps;
- o Press releases;
- o Undergraduate internships;
- o Graduate fellowship; and
- o Brochure about the Hudson River shortnose sturgeon population.

High priority assigned to developing the following materials, programs, and facilities:

- o Information kits for instructor's use in preparing class units or field trips to Sanctuary;
- o Interpretive nature trails at the Stockport Flats and Tivoli Bays components;
- o Staff or volunteer field trip leaders and lecturers;
- o Training workshops for instructors and other field trip leaders;
- o Placement of Sanctuary reports and informational material in Hudson Valley libraries; and
- o Slide-tape presentations on the Sanctuary

Five-year educational activities

Highest priority is assigned to developing the following materials and programs:

- o Regular on-site and off-site school and summer camp programs;
- o Educational posters;
- o Short training courses and workshops for teachers and others;
- o Symposia or workshops on Hudson River Estuary;
- o Regular guided field trips to Sanctuary sites beginning at public transportation stations;
- o Slide-tape presentations on specific subjects to accompany existing slide-tape program

Moderate priority is assigned to developing the following materials and programs:

- o Video programs;
- o Brochures on Sanctuary sites and other points of interest for Amtrack riders

IX. OTHER ACTIVITIES

Public use of the Hudson River National Estuarine Sanctuary for activities other than research and education will be guided by the need to protect Sanctuary resources and to ensure that these activities do not interfere with research, monitoring, and education programs, which are the priority uses. Traditional uses such as recreation, hunting, fishing, and trapping will be allowed in appropriate areas, consistent with pre-existing land management policies. Some of the uses will be restricted to certain areas of the Sanctuary to protect fragile environments or to avoid disruption of research or education projects.

Policy: Traditional uses of the Sanctuary components will be allowed to continue as long as they do not disrupt the natural integrity of the Sanctuary or any research or education projects.

Table 6 indicates by component and state agency jurisdiction activities that are prohibited, allowed, allowed only under permit, or pending state agency decision (refer to figures 2 through 5). Information about permits will be available from the Sanctuary Manager and landowning or managing agencies.

Guidelines and use policies for all components

Conservation, research, monitoring, and education are the priority uses for all Sanctuary lands and waters.

TABLE 6

ALLOWABLE SANCTUARY USES OF EACH COMPONENT

BY STATE AGENCY JURISDICTION

SANCTUARY USES						
RESEARCH	P	P	P	P	P	P
COLLECTING SCIENTIFIC SPECIMENS	P	P	P	P	P	P
ARCHEOLOGIC DIGGING	N	N	P	N	P	N
GUIDED FIELD TRIPS	Y	Y	Y	P	Y	P
LARGE GROUP USE (over 25 People)	P	P	P	P	P	P
BIRD WATCHING, OTHER NATURE STUDY	Y	Y	Y	Y	Y	Y
PICKING OR GATHERING PLANTS	P	P	P	P	P	P
COLLECTING OR REMOVING ANIMALS	P	P	P	P	P	P
WOOD CUTTING OR COLLECTION	P	N	P	N	P	N
PICNICKING	Y	Y	Y	N	N	Y
PRIMITIVE CAMPING	P	N	N	N	N	N
WALKING, SKIING, SNOWSHOEING	Y	Y	Y	Y	Y	Y
BICYCLING	N	N	Y	Y	N	N
CANOEING, KAYAKING, ROWBOATING	Y	Y	Y	Y	Y	Y
POWER BOATING	Y	Y	N	N	N	N
OFF-ROAD VEHICLE OPERATION	N	N	N	N	N	N
COMMERCIAL FISHING AND CRABBING	Y	Y	Y	N	Y	N
NON-COMMERCIAL CRABBING	n.a.		n.a	Y	Y	Y
SPORT FISHING	Y	Y	Y	Y	Y	Y
BAITFISHING (SEINE)	Y	Y	Y	Y	Y	N
HUNTING	Y	Y	Y	N	U	N
FUR TRAPPING	Y	Y	Y	N	U	N

N=Not Allowed, Y=Allowed, P=Allowed Under Permit Only, U=Undecided.

Nature study, birdwatching, walking, skiing, snowshoeing, canoeing, kayaking, rowboating, and sport fishing are allowed without permit on all components. Sanctuary users are requested to use trails, and must comply with seasonal or area restrictions which are established to protect fragile habitats or research in progress. At Stockport Flats and Tivoli Bays (and other Sanctuary sites if hunting or trapping are allowed in the future), hunters and trappers are required to turn over carcasses or body parts to the Department of Environmental Conservation (DEC) upon request, for research purposes. These requests will normally not include edible meat of game animals, but may include pelted muskrat or mink carcasses, or waterfowl wings or gizzards.

Plants may not be picked or gathered without a permit, except for cattails used to build temporary hunting blinds. Permits are also required for collection or removal of Sanctuary animals for any purpose. Any group of more than 25 people must obtain a permit identifying time and places of activities before engaging in these activities.

The use of off-road vehicles, including trail bikes and snowmobiles is prohibited on all Sanctuary lands. Regulation of several other activities is described below by component.

Stockport Flats

Several activities are allowed without permit at Stockport Flats, including picnicking, power boating, and conducting guided

field trips. Ice boating is allowed on the ice on open waters. Fishing, hunting, and trapping are allowed at Stockport, subject to federal and state laws and regulations.

Woodcutting and primitive camping are allowed in certain areas under permit on lands owned by the Office of Parks, Recreation, and Historic Preservation; neither activity is allowed on DEC property.

Bicycling and archeologic digging are not allowed on the Stockport Flats component.

Tivoli Bays

Guided field trips may be conducted at the Tivoli component without permit, and picnicking, power boating, and ice boating are all allowed without permit. Fishing, hunting, and trapping are also allowed without permit, subject to federal and state laws and regulations. Bicycling is allowed on Cruger Island and Ward Manor Roads, but not on trails and foot paths.

Archeologic digging may be conducted on Sanctuary property at Tivoli under permit. Woodcutting, wood collection, and camping are all prohibited at Tivoli Bays.

Iona Marsh

Non-commercial crabbing and sport fishing are allowed at Iona, and bicycling is allowed on the bicycle path along the

southwest edge of the component. Guided field trips may be conducted, but only under permit.

Hunting, trapping, baitfishing, commercial fishing and crabbing, archeologic digging, woodcutting, picnicking, camping, powerboating, and ice boating are all prohibited at the Iona Marsh component.

Piermont Marsh

Piermont Marsh may be used for guided field trips, but a permit is required to guide field trips on lands owned by the Palisades Interstate Park Commission (PIPC). Archeologic digging and woodcutting are not allowed on PIPC lands, but are allowed under permit on Department of Environmental Conservation (DEC) lands. Picnicking is allowed on PIPC lands, but is prohibited on DEC lands.

Camping, bicycling, powerboating, and ice boating are all prohibited on the Piermont component.

Non-commercial crabbing and sport fishing are allowed throughout the Piermont component. Commercial fishing, commercial crabbing, and baitfishing are allowed on DEC property, but not on PIPC property. Hunting and trapping are prohibited on PIPC property. A policy for hunting and trapping on the DEC portion of Piermont has not yet been established.

Policy: Activities and levels of use of the Sanctuary lands and waters for all activities will be monitored.

Activities other than research and education will be the first to be restricted if levels of use cause damage to habitats or biota, or interfere with research, monitoring, and education activities.

Appendix 1

VASCULAR PLANTS OF THE HUDSON RIVER NATIONAL ESTUARINE SANCTUARY

Appendix 1

VASCULAR PLANTS OF THE HUDSON RIVER NATIONAL ESTUARINE SANCTUARY

Presence at the Stockport, Tivoli, Iona, and Piermont Sanctuary components is indicated by S.T.I. and P. Revised by Erik Kiviat in September 1984 from the list in the Hudson River National Estuarine Sanctuary Final Environmental Impact Statement list compiled by Nancy Zeising and Kiviat.

Common name	Scientific name	Component
ACERACEAE		
Boxelder	Acer negundo	S T
Red maple	A. rubrum	S T I
Silver maple	A. saccharinum	S T
ALISMATACEAE		
Water-plantain	Alisma sp.	T
Water-plantain	A. subcordatum	I P
Arrowhead	Sagittaria eatonii	S T I
Broadleaf arrowhead	S. latifolia	S T I P
Stiff arrowhead	S. rigida	S T
Arrowhead	S. spatulata (S. calycina, Lophotocarpus spongiosus)	S I
Subulate arrowhead	S. subulata	S T I P
AMARANTHACEAE		
Tidewater-hemp	Amaranthus cannabinus	S T I P
ANACARDINACEAE		
Smoke tree	Cotinus coggygria	T
Poison ivy	Rhus radicans	T I
Staghorn sumac	R. typhina	S
Poison sumac	R. vernix	I
APOCYNACEAE		
Black swallowwort	Cynanchum nigrum	S
AQUIFOLIACEAE		
Winterberry	Ilex verticillata	T I

Common name	Scientific name	Component
ARACEAE		
Sweet flag	Acorus calamus	S T
Jack-in-the-pulpit	Arisaema triphyllum	T
Goldenclub	Orontium aquaticum	S T
Arrow arum	Peltandra virginica	S T I P
Skunk cabbage	Symplocarpus foetidus	S T I
ASCLEPIADACEAE		
Swamp milkweed	Asclepias incarnata	T I
BALSAMINACEAE		
Jewelweed	Impatiens biflora	S T I P
BERBERIDACEAE		
Japanese barberry	Berberis thunbergii	T
BETULACEAE		
Speckled alder	Alnus rugosa	I
Smooth alder	A. serrulata	S T I
Yellow birch	Betula lutea	T
Gray birch	B. populifolia	T
American hornbeam	Carpinus caroliniana	T
American hazel	Corylus americana	T
Hop hornbeam	Ostrya virginiana	T
BIGNONIACEAE		
Catalpa	Catalpa sp.	T
BORAGINACEAE		
Forget-me-knot	Myosotis sp.	S T I
CAESALPINIACEAE		
Wild senna	Cassia hebecarpa	S
CALLITRICHACEAE		
Water starwort	Callitriche sp.	P
Water starwort	C. verna	T

Common name	Scientific name	Component
CAPRIFOLIACEAE		
Bell's honeysuckle	Lonicera x. bella	S T
Elderberry	Sambucus canadensis	S T I
Arrowwood	Viburnum dentatum	S T I
Nannyberry	V. lentago	T
Highbush cranberry	V. opulus	T
Black haw	V. prunifolium	I
CARYOPHYLLACEAE		
Water chickweed	Stellaria aquatica	T
CELASTRACEAE		
Bittersweet	Celastrus scandens	T
CERATOPHYLLACEAE		
Coontail	Ceratophyllum demersum	S T I
CLETHRACEAE		
Sweet pepperbush	Clethra alnifolia	I
CHENOPODIACEAE		
Spearscale	Atriplex patula	P
COMMELINACEAE		
Dayflower	Commelina communis	S T
COMPOSITAE		
Giant ragweed	Ambrosia trifida	T
Aster	Aster sp.	I
Aster	A. puniceus	T
Aster	A. subulatus	P
Bur-marigold	Bidens sp.	P
Beggar-ticks	Bidens bidentoides	S T I
Bur-marigold	B. cernua	S T
Eaton's bur-marigold	B. eatoni	T
Beggar-ticks	B. frondosa	T
Estuary beggar-ticks	B. hyperborea	T

Common name	Scientific name	Component
Beggar-ticks	B. laevis	T
Ox-eye daisy	Chrysanthemum leucanthemum	T
Fireweed	Erechtites hieracifolia	I P
Fleabane	Erigeron philadelphicus	T
Joe Pye-weed	Eupatorium maculatum	T
Boneset	E. perfoliatum	S T
Sneezeweed	Helenium autumnale	S T I
Marsh elder	Iva frutescens	P
Climbing hempweed	Mikania scandens	T I P
Marsh fleabane	Pluchea purpurascens (P. odorata)	I P
Greenhead coneflower	Rudbeckia laciniata	T
Groundsel	Senecio aureus	T
Goldenrod	Solidago sp.	S I
Goldenrod	S. altissima	T
Goldenrod	S. graminifolia	T
Goldenrod	S. sempervirens	P
Dandelion	Taraxacum officinale	T
Cocklebur	Xanthium strumarium	S
CONVOLVULACEAE		
Bindweed	Convolvulvus sepium	T
Dodder	Cuscuta sp.	S
Dodder	C. cephalanthi	I
Dodder	C. gronovii	T
CORNACEAE		
Silky dogwood	Cornus amomum	S T I
Gray dogwood	C. racemosa	T
Red-osier dogwood	C. stolonifera	T
CRASSULACEAE		
Ditch stonecrop	Penthorum sedoides	T
CRUCIFERAE		
Garlic-mustard	Alliaria officinalis	T
Wintercress	Barbarea vulgaris	T
Bittercress	Cardamine pensylvanica	T
Cuckoo flower	C. pratensis	T
Dame's rocket	Hesperis matronalis	S T
Marshcress	Rorippa islandica	T P

Common name	Scientific name	Component
CUCURBITACEAE		
Balsam-apple	Echinocystis lobata	S
Bur-cucumber	Sicyos angulatus	S
CUPRESSACEAE		
Arborvitae	Thuja occidentalis	S T
CYPERACEAE		
Sedge	Carex grayii	T
Sedge	C. hormathodes	P
Sedge	C. stipata	T I
Tussock sedge	C. stricta	T I
Galingale	Cyperus rivularis	T I
Galingale	C. flavescens	P
Galingale	C. strigosus	T
Three-way sedge	Dulichium arundinaceum	T
Spikerush	Eleocharis acicularis	S
Spikerush	E. ovata	S T
Spikerush	E. diandra	S T I
Spikerush	E. palustris	S T P
Spikerush	E. parvula	P
Bulrush	Scirpus acutus	S
Threesquare	S. americanus (S. pungens)	S T I P
Bulrush	S. atrovirens	T
Cylindrical bulrush	S. cylindricus	I P
Wool-grass	S. cyperinus	I
River bulrush	S. fluviatilis	S T P
Bulrush	S. maritimus	P
Threesquare	S. olneyi (S. americanus)	I P
Saltmarsh bulrush	S. robustus	I P
Bluntscale bulrush	S. smithii	S T I
Bulrush	S. validus (S. tabernaemontanii)	S T I P
DIOSCOREACEAE		
Wild yam	Dioscorea villosa	T
ELATINACEAE		
Waterwort	Elatine americana	S T

Common name	Scientific name	Component
EQUISETACEAE		
Equisetum sp.	Equisetum sp.	S
Field horsetail	E. arvense	T
Horsetail	E. fluviatile	T
Marsh horsetail	E. palustre	T
ERICACEAE		
Highbush blueberry	Vaccinium corymbosum	T
ERIOCAULACEAE		
Pipewort	Eriocaulon parkeri	T
FABACEAE		
False-indigo	Amorpha fruticosa	T I
Hog-peanut	Amphicarpa bracteata	T I
Groundnut	Apios americana	T I
Wild pea	Lathyrus palustris	T
Wild bean	Strophostyles helvola	I
FAGACEAE		
Swamp white oak	Quercus bicolor	T
GENTIANACEAE		
Closed gentian	Gentiana andrewsii	T
Floating heart	Nymphoides cordata	T
GERANIACEAE		
Wild geranium	Geranium maculatum	T
GRAMINEAE		
Bentgrass	Agrostis sp.	I
Bentgrass	A. hyemalis	T
Redtop	A. stolonifera (A. alba)	P
Wood-reed	Cinna sp.	I
Wood-reed	C. arundinacea	T

Common name	Scientific name	Component
Grass	Diplachne maritima	P
Saltgrass	Distichlis spicata	P
Barnyard grass	Echinochloa crusgalli	T
Water-millet	E. walteri	T I P
Wild-rye	Elymus virginicus	T I
Rice cutgrass	Leersia oryzoides	T I
White grass	L. virginica	S T
Panic grass	Panicum sp.	S I
Panic grass	Panicum capillare	S
Panic grass	P. dichotomiflorum	S T
Panic grass	P. virgatum	P
Reed canary grass	Phalaris arundinacea	S T
Common reed	Phragmites communis (P. australis)	S T I P
Saltwater cordgrass	Spartina alterniflora	P
Tall cordgrass	S. cynosuroides	I P
Saltmeadow cordgrass	S. patens	P
Freshwater cordgrass	S. pectinata	S T P
Wild-rice	Zizania aquatica	S T I P
HALORAGACEAE		
Watermilfoil	Myriophyllum sp.	S I
Watermilfoil	M. humile	T
Eurasian watermilfoil	M. spicatum	S T I P
HYDROCARYACEAE		
Water-chestnut	Trapa natans	S T I
HYDROCHARITACEAE		
Waterweed	Anacharis canadensis (Elodea c.)	S T I
Waterweed	A. nuttallii (Elodea n.)	S T I P
Water-celery	Vallisneria americana	S T I P
HYPERICACEAE		
Marsh St. John's-wort	Triadenum virginicum	I
IRIDACEAE		
Yellow iris	Iris pseudacorus	S T I
Blue flag	I. versicolor	S T I
Blue-eyed-grass	Sisyrhynchium sp.	I

Common name	Scientific name	Component
ISOETACEAE		
Guillwort	*Isoetes riparia*	T
JUNCACEAE		
Rush	*Juncus brachycephalus*	T
Black-grass	*J. gerardi*	P
Path rush	*J. tenuis*	T
LABIATAE		
Stoneroot	*Collinsonia canadensis*	T
Ground-ivy	*Glecoma hederacea*	T
Bugleweed	*Lycopus americanus*	T
Bugleweed	*L. europaeus*	T
Mint	*Mentha sp.*	S I
Field mint	*Mentha arvensis*	T
Skullcap	*Scutellaria galericulata*	I
Skullcap	*S. lateriflora*	T
Hedge-nettle	*Stachys palustris*	T
Wood sage	*Teucrium canadense*	P
LAURACEAE		
Spicebush	*Lindera benzoin*	S T
Sweetgum	*Liquidambar styraciflua*	P
LEMNACEAE		
Common duckweed	*Lemna minor*	S T I P
Great duckweed	*Spirodela polyrhiza*	S T I
Watermeal	*Wolffia columbiana*	T
LENTIBULARIACEAE		
Bladderwort	*Utricularia vulgaris*	S I
LILIACEAE		
Wild onion	*Allium sp.*	I
Adder's-tongue	*Erythronium americanum*	S
Day-lily	*Hemerocallis fulva*	T
Canada lilly	*Lilium canadense*	T
Greenbrier	*Smilax herbacea*	T
Greenbrier	*S. hispida*	T

Common name	Scientific name	Component
LOBELIACEAE		
Cardinal flower	Lobelia cardinalis	S T I
Great blue lobelia	L. siphilitica	T
LYTHRACEAE		
Purple loosestrife	Lythrum salicarcia	S T I P
MALVACEAE		
Swamp rose mallow	Hibiscus palustris (H. moscheutos)	T I P
MORACEAE		
Hops	Humulus lupulus	T
NAJADACEAE		
Naiad	Najas flexilis	S T I
Naiad	N. guadalupensis	S P
Naiad	N. minor	S T
Muenscher's naiad	N. muenscheri	S T I
Curlyleaf pondweed	Potamogeton crispus	T I P
Pondweed	P. epihydrus	S T
Leafy pondweed	P. foliosus	S T I
Long-leaved pondweed	P. nodosus	S T
Sago pondweed	P. pectinatus	S I P
Pondweed	P. perfoliatus	S T I P
Pondweed	P. pusillus	S
Pondweed	P. richardsonii	S T I
Flat-stemmed pondweed	P. zosteriformis	S T
Horned pondweed	Zannichellia palustris	S T I P
NYMPHAEACEAE		
Spatterdock	Nuphar advena (N. luteum)	S T I
White water-lily	Nymphaea sp.	T
OLEACEAE		
Ash	Fraxinus sp.	I
Black ash	F. nigra	S T
Red ash	F. pennsylvanica	S T

Common name	Scientific name	Component
ONAGRACEAE		
Willow herby	Epilobium sp.	I
Willow herby	E. adenocaulon	T
Willow herb	E. glandulosum	P
Water-purslane	Ludwigia palustris	S T P
Evening-primrose	Oenothera sp.	S T
ORCHIDACEAE		
Helleborine	Epipactis helleborine	T
OSMUNDACEAE		
Cinnamon fern	Osmunda cinnamomea	T I
Interrupted fern	O. claytoniana	I
Royal fern	O. regalis	T I
PINACEAE		
White pine	Pinus strobus	T
PLANTAGINACEAE		
Heartleaf plantain	Plantago cordata	S T
PLATANACEAE		
Sycamore	Platanus occidentalis	S
POLYGONACEAE		
Tearthumb	Polygonum arifolium	T I P
Smartweed	P. caespitosum	T
Japanese knotweed	P. cuspidatum	S
Seabeach knotweed	P. glaucum	P
Water-pepper	P. hydropiper	T
Swamp smartweed	P. hydropiperoides	I
Dotted smartweed	P. punctatum	S T I P
Tearthumb	P. sagittatum	S T I
Jumpseed	P. virginianum	T
Dock	Rumex mexicanus	I
Water dock	R. verticillatus	T

Common name	Scientific name	Component
POLYPODIACEAE		
Ostrich fern	Matteuccia struthiopteris	S
Sensitive fern	Onoclea sensibilis	S T I
Marsh fern	Thelypteris palustris	T I P
PONTEDERIACEAE		
Mud-plantain	Heteranthera reniformis	S T P
Pickerelweed	Pontederia cordata	S T I
Water star-grass	Zosterella dubia	S T I
PORTULACACEAE		
Spring beauty	Claytonia virginica	T
PRIMULACEAE		
Fringed losestrife	Lysimachia ciliata	S T
Moneywort	L. nummularia	T
Water pimpernel	Samolus parviflorus	I P
RANUNCULACEAE		
Marsh-marigold	Caltha palustris	S T
Virgin's bower	Clematis virginiana	S T
Crowfoot	Ranunculus abortivus	T
Cursed crowfoot	R. sceleratus	T P
Buttercup	R. septentrionalis	S T
Tall meadow-rue	Thalictrum polygamum	S T
RHAMNACEAE		
Buckthorn	Rhamnus catharticus	T
ROSACEAE		
Chokeberry	Aronia sp.	
Ninebark	Physocarpus opulifolius	T I
Black cherry	Prunus serotina	T
Multiflora rose	Rosa multiflora	T
Swamp-rose	R. palustris	T I
Meadowsweet	Spiraea latifolia	T I
Hardhack	S. tomentosa	I

Common name	Scientific name	Component
RUBIACEAE		
Buttonbush	Cephalanthus occidentalis	T I
Bedstraw	Galium asprellum	T
Bedstraw	G. palustre	T
Bedstraw	G. trifidum	T
SALICACEAE		
Cottonwood	Populus deltoides	S T I P
Quaking aspen	P. tremuloides	T
Willow	Salix sp.	S
Crackwillow	S. gragilis	T I
Blackwillow	S. nigra	I
Basket willow	S. purpurea	I
Heart-leaved willow	S. rigida	T
SCROPHULARIACEAE		
Turtlehead	Chelone glabra	T I
Mudwort	Limosella subulata	S T
False-pimpernel	Lindernia dubia	S T P
Nuttall's micranthemum	Micranthemum micranthemoides	T
Monkeyflower	Mimulus ringens	T
SOLANACEAE		
Climbing nightshade	Solanum dulcamara	T
SPARGANIACEAE		
Burreed	Sparganium americanum	T
Big burreed	S. eurycarpum	S T
STAPHYLEACEAE		
Bladdernut	Staphylea trifolia	T
TILIACEAE		
Basswood	Tilia americana	S T
TYPHACEAE		
Narrowleaf cattail	Typha angustifolia	S T I P
Broadleaf cattail	T. latifolia	S T I P
Hybrid cattail	T. x. glauca	S T I P

Common name	Scientific name	Component
ULMACEAE		
Elm	Ulmus sp.	T
American elm	U. americana	S I
UMBELLIFERAE		
Angelica	Angelica atropurpurea	T
Bulb-bearing water-hemlock	Cicuta bulbifera	T I
Water-hemlock	C. maculata	T
Honewort	Cryptotaenia canadensis	T
Lilaeopsis	Lilaeopsis chinensis	P
Mock bishop weed	Ptilimnium capillaceum	P
Water-parsnip	Sium suave	S T I P
URTICACEAE		
False nettle	Boehmeria cylindrica	T I
Wood nettle	Laportea canadensis	S T
Clearweed	Pilea sp.	S
Clearwood	P. fontana	I
Clearweed	P. pumila	T
Nettles	Urtica dioica	S
VIOLACEAE		
Blue violet	Viola sp.	T I
VITACEAE		
Virginia creeper	Parthenocissus quinquefolia	S T
Grape	Vitis sp.	S T

Sources of data for plant list (brackets indicate locations of voucher specimens if any): Buckley and Ristich (1976). [Manhattan College or College of Mount St. Vincent]; Foley and Taber (1951); Kiviat (1978) [Bard College Field Station]; Erik Kiviat (1971-84, unpublished data) [Bard College Field Station]; Lehr (1967a, b) [New York Botanical Garden]; McVaugh (1958) [New York State Museum]; John C. Orth (unpublished data at Bear Mountain State Park Trailside Museums); Schuyler (1975) [Philadelphia Academy of Natural Sciencies]; Schuyler 1984 (unpublished data); Torrey (1931). Scientific names in most cases are from Gleason, Henry A. and Arthur Cronquist, 1963, Manual of vascular plants of Northeastern United States and Adjacent Canada, Van Nostrand Reinhold Co., New York.

Appendix 2

AMPHIBIANS REPORTED IN OR NEAR

THE HUDSON RIVER NATIONAL ESTUARINE SANCTUARY

APPENDIX 2

AMPHIBIANS REPORTED IN OR NEAR THE HUDSON RIVER NATIONAL ESTUARINE SANCTUARY

Verified reports for the Stockport, Tivoli, Iona, and Piermont Sanctuary components are indicated by upper case S,T,I,P; lower case s,t,i,p indicate unverified reports considered reliable, or verified reports outside the Sanctuary boundary. A species listed with no site annotation is known from the Hudson River corridor but has not been reported from the Sanctuary. Names follow: Collins, Joseph T. et al. 1982. Standard Common and Current Scientific Names for North American Amphibians and Reptiles. 2nd ed. Herpetological Circular 12, Society for the Study of Amphibians and Reptiles. Compiled by Erik Kiviat, 1984.

Common Name	Scientific Name	Components S	T	I	P
Mudpuppy	*Necturus maculosus* (a)		t		
Marbled salamander	*Ambystoma opacum*				
Jefferson salamander	*Ambystoma jeffersonianum*		t		
Blue-spotted salamander	*Ambystoma laterale*				
Spotted salamander	*Ambystoma maculatum*		T	I	
Eastern newt (red-spotted newt, red eft)	*Notophthalmus viridescens*		T	i	p
Dusky salamander	*Desmognathus fuscus*		T	i	
Redback salamander (leadback salamander)	*Plethodon cinereus*		T	I	P
Slimy salamander	*Plethodon glutinosus*		t	I	P
Four-toed salamander	*Hemidactylium scutatum*				
Red salamander	*Pseudotriton ruber*				p
Two-lined salamander	*Eurycea bislineata*		T		p
American toad	*Bufo americanus*	S	T	I	
Fowler's toad	*Bufo woodhousii*				
Spring peeper	*Hyla crucifer*	S	T	I	P
Gray treefrog	*Hyla versicolor*		T	I	
Bullfrog	*Rana catesbeiana*	S	T	I	P
Green frog	*Rana clamitans*	S	T	I	p
Wood frog	*Rana sylvatica*		T	I	p
Northern leopard frog (northern meadow frog)	*Rana pipiens* (b)	S	t		
Pickerel frog	*Rana palustris*		T	I	

Data from: Burt (1931) (I, P), Jack Focht (I), Erik Kiviat (all sites), William T. Maple (S, P), and Orth (in Clarke and Rapuano 1976) (I).

a Canal introduction to Hudson River; probably extirpated.
b Specimens from Stockport and Barrytown are at the American Museum of Natural History, and a paper is in preparation by Michael Klemens et al.

Appendix 3

REPTILES REPORTED IN OR NEAR

THE HUDSON RIVER NATIONAL ESTUARINE SANCTUARY

APPENDIX 3

REPTILES REPORTED IN OR NEAR THE HUDSON RIVER NATIONAL ESTUARINE SANCTUARY

Verified reports for the Stockport, Tivoli, Iona and Piermont Sanctuary components are indicated by upper case S,T,I,P; lower case s,t,i,p indicate unverified reports considered reliable, or verified reports outside the Sanctuary boundary. A species listed with no site annotation is known from the Hudson River corridor but has not been reported from the sanctuary. Names follow: Collins, Joseph T. et al 1982. Standard Common and Current Scientific Names for North American Amphibians and Reptiles. 2nd ed. Herpetological Circular 12, Society for the Study of Amphibians and Reptiles. Compiled by Erik Kiviat, 1984.

Common Name	Scientific Name	Components S	T	I	P
Snapping turtle	Chelydra serpentina	S	T	I	P
Stinkpot (musk turtle)	Sternotherus odoratus				
Spotted turtle	Clemmys guttata	S	T		
Bog turtle (Muhlenberg's turtle),	Clemmys muhlenbergii				
Wood turtle	Clemmys insculpta	S	T		
Eastern box turtle	Terrapene carolina		T	I	
Diamondback terrapin	Malaclemys terrapin			I	P
Map turtle	Graptemys geographica	S	T		
Painted turtle	Chrysemys picta				
Blanding's turtle	Emydoidea blandingii				
Spiny softshell turtle	Trionyx spiniferus				
Eastern fence lizard	Sceloporus undulatus			i	
Five-lined skink	Eumeces fasciatus			I	
Northern water snake	Nerodia sipedon	S	T	I	p
Brown snake	Storeria dekayi		T		
Redbelly snake	Storeria occipitomaculata				
Eastern ribbon snake	Thamnophis sauritus		t		
Common garter snake	Thamnophis sirtalis	S	T	I	
Eastern hognose snake	Heterodon platyrhinos			I	
Ringneck snake	Diadophis punctatus		t		
Worm snake	Carphophis amoenus				
Black racer	Coluber constrictor		T	i	p
Smooth green snake	Opheodrys vernalis				
Black rat snake (pilot blacksnake),	Elaphe obsoleta			i	
Milk snake	Lampropeltis triangulum		T		
Cooperhead	Agkistrodon contortrix				
Timber rattlesnake	Crotalus horridus				

Data from: Boyle (1969) (P), Burt (1931), Jack Focht (I), Erik Kiviat (all sites), William T. Maple (S, P), Orth (in Clarke and Rapuano 1976) (I), Platt (1978) (I), John Serrao (I).

a Canal introduction to Hudson River, probably extirpated.

Appendix 4

FISHES REPORTED FROM THE HUDSON RIVER NATIONAL ESTUARINE SANCTUARY

APPENDIX 4

FISHES REPORTED FROM THE HUDSON RIVER NATIONAL ESTUARINE SANCTUARY

Letters in the Ecological Classification column refer to the relationship of the fish to the estuary following McHugh (10): A=Freshwater fishes that enter brackish water, B=Truly estuarine species, C=Anadromous/catadromous species, D=Seasonal adult marine species, E=Estuarine nursery species, and F=Adventitious marine species. Numbers listed under the Sanctuary components S, T, I, P indicate presence of the species at Stockport, Tivoli, Iona, and Piermont, and the source of the data; only one source is listed although several sources may have reported that species. Compiled by Robert Schmidt in 1982 and updated by Erik Kiviat in October, 1984.

Common name	Scientific name	Ecological Classification	Components S	T	I	P
PETROMYZONTIDAE						
American brook lamprey	Lampetra appendix	A		1		
Sea lamprey	Petromyzon marinus	C		1		
ACIPENSERIDAE						
Shortnose sturgeon	Acipenser brevirostrum	B	11	11	11	11
Atlantic sturgeon	A. oxyrhynchus	C				12
ANGUILLIDAE						
American eel	Anguilla rostrata	C	8	1	2	5
CLUPEIDAE						
Blueback herring	Alosa aestivalis	C		1	2	4
Alewife	A. pseudoharengus	C	9	1	8	
American shad	A. sapidissima	C	9	2	8	7
Atlantic Menhaden	Brevoortia tyrannus	E			12	7
Gizzard shad	Dorosoma cepedianum	A			12	
ENGRAULIDAE						
Bay anchovy	Anchoa mitchilli	B				7
SALMONIDAE						
Rainbow trout	Salmo gairdneri	A		1		
Brown trout	S. trutta	A	9	1		
Brook trout	Salvelinus fontinalis	A		1		
OSMERIDAE						
Rainbow smelt	Osmerus mordax	C	9	1		

Common name	Scientific name	Ecological Classification	Components S	T	I	P
UMBRIDAE						
Central mudminnow	Umbra limi	A		1		
Eastern mudminnow	U. pygmaea	A				5
ESOCIDAE						
Redfin pickerel	Esox americanus	A	3	1	2	6
Northern pike	E. lucius	A	9			
Chain pickerel	E. niger	A		1		
CYPRINIDAE						
Goldfish	Carassius auratus	A	4	1	2	
Carp	Cyprinus carpio	A	8	1	2	
Cutlips minnow	Exoglossum maxillingua	A		1		
Eastern silvery minnow	Hybognathus regius	A	3	1		
Golden shiner	Notemigonus crysoleucas	A	3	1	2	7
Satinfin shiner	Notropis analostanus	A		1		
Bridle shiner	N. bifrenatus	A	3	1		
Common shiner	N. cornutus	A	3	1		
Spottail shiner	N. hudsonius	A	8	1	8	7
Spotfin shiner	N. spilopterus	A	3			
Blacknose dace	Rhinichthys atratulus	A		1		5
Creek chub	Semotilus atromaculatus	A		1		
Fallfish	S. corporalis	A	3	1		
CATOSTOMIDAE						
White sucker	Catostomus commersoni	A	4	1	2	5
Creek chubsucker	Erimyzon oblongus	A				6
Northern hogsucker	Hypentelium nigricans	A	3	1		
ICTALURIDAE						
White catfish	Ictalurus catus	A	4	1		12
Yellow bullhead	I. natalis	A				2
Brown bullhead	I. nebulosus	A	4	1	2	
GADIDAE						
Atlantic tomcod	Microgadus tomcod	B			2	7
BELONIDAE						
Atlantic needlefish	Strongylura marina	D				12

APPENDIX 4 (continued)

Common name	Scientific name	Ecological Classification	Components S	T	I	P
FUNDULIDAE						
Banded killifish	Fundulus diaphanus	A	8	8	1	7
Mummichog	F. heteroclitus	B	8	1	8	8
ATHERINIDAE						
Inland silverside	Menidia beryllina	E				7
Atlantic silverside	M. menidia	E				7
GASTEROSTEIDAE						
Fourspine stickleback	Apeltes quadracus	B	8	1	8	7
Threespine stickleback	Gasterosteus aculeatus	B			2	
SYNGNATHIDAE						
Northern pipefish	Syngnathus fuscus	D				7
PERCICHTHYIDAE						
Black seabass	Centropristis striata	F				12
White perch	Morone americana	B	9	1	8	8
Striped bass	M. saxatilis	C	4	1	8	7
CENTRARCHIDAE						
Rock bass	Ambloplites rupestris	A		1		
Bluespotted sunfish	enneacanthus gloriosus	A			2	
Redbreast sunfish	Lepomis auritus	A	3	1	8	8
Pumpkinseed	L. gibbosus	A	3	1	2	6
Warmouth	L. gulosus	A		1		
Bluegill	L. macrochirus	A	9	1		7
Smallmouth bass	Micropterus dolomieui	A	9	1		
Largemouth bass	M. salmoides	A	4	1	2	7
Black crappie	Pomoxis nigromaculatus	A		1		
PERCIDAE						
Tessellated darter	Etheostoma olmstedi	A	3	1	2	5
Yellow perch	Perca flavescens	A	3	1	8	
POMATOMIDAE						
Bluefish	Pomatomus saltatrix	E			8	7

Common name	Scientific name	Ecological Classification	Components S T I P
LABRIDAE			
Tautog	Tautoga onitis	F	12
CARANGIDAE			
Crevalle jack	Carane hippos	D	12 12
COTTIDAE			
Longhorn sculpin	Myoxcephalus octodecemspinosus	A	12
SCIAENIDAE			
Weakfish	Cynoscion regalis	E	7
SOLEIDAE			
Hogchoker	Trinectes maculatus	B	12

1. Kiviat, E. In press. Natural history of the fish fauna of Tivoli Bays. Hudson River Fisheries Symposium, Hudson River Environmental Society. (Includes a few species found in nontidal waters close to the proposed site.

2. Orth, J. D. ca. 1965. Vertebrates of Iona Island and vicinity. Bear Mountain State Park Trailside Museums. 17 p.

3. Greeley, J. R. 1937. Fishes of the area with annotated list, pp. 45-85. In. Anonymous. A biological survey of the lower Hudson watershed. In. Anonymous. A biological survey of the lower Hudson watershed. Supplement to 26th Annual Report, New York Conservation Department, Part II.

4. New York State Department of Environmental Conservation, 1971 Stream Survey.

5. New York State Department of Environmental Conservation, Sparkill Creek Stream Surveys.

6. Bailey, R. M. 1936. Stream survey records. New York State Department of Environmental Conservation.

7. Smith, C. L. Stream survey records, American Museum of Natural History.

8. Hudsonia Limited. Miscellaneous collections, 1981-84.

9. Observations by Everett Nack (Claverack, New York), Salvatore Cozzolino (Department of Environmental Conservation), or Louis Gerrain (DEC).

10. McHugh, J. L. 1967. Estuarine Nekton, pp. 581-620. In. G. H. Lauff (Ed.) Estuaries. AAAS Publ. No. 83, Washington, D.C.

11. Letter from Ruth Rehfus (National Marine Fisheries Service) to Richard B. Mieremet, dated June 4, 1982.

12. Tom Lake, personal communication, or Steve Stanne, personal communication, miscellaneous seine or trawl observations in or near Piermont Marsh many of these species likely to enter the Sanctuary.

13. Texas Instruments, Inc., beach seine survey, beach 99 (Cruger Island).

Appendix 5

BIRDS REPORTED IN OR NEAR THE HUDSON RIVER NATIONAL ESTUARINE SANCTUARY

APPENDIX 5

BIRDS REPORTED IN OR NEAR THE HUDSON RIVER NATIONAL ESTUARINE SANCTUARY

Upper case S, T, I, P, indicate verified reports for the Stockport, Tivoli, Iona, and Piermont Sanctuary components; lower case s indicates verified reports near the Stockport component. Common and scientific names are current with the American Ornithologists' union usage per supplement to Auk 99(3), 1982. Compiled by Erik Kiviat, revised in 1984.

Common Name	Scientific Name	Components S	T	I	P
Red-throated loon	Gavia stellata	s	T	I	P
Common loon	G. immer	S	T	I	P
Pied-billed grebe	Podilymbus podiceps	S	T	I	P
Horned grebe	Podiceps auritus	S	T	I	P
Red-necked grebe	P. grisegena	S	T	I	
Northern gannet	Sula bassanus		T		
Great cormorant	Phalacrocorax carbo				P
Double-crested cormorant	P. auritus	S	T	I	P
American bittern	Botaurus lentiginosus	S	T	I	P
Least bittern	Ixobrychus exilis	S	T	I	P
Great blue heron	Ardea herodias	S	T	I	P
Great egret	Casmerodius albus	S	T	I	P
Snowy egret	Egretta thula	S	T	I	P
Tricolored heron	E. tricolor				P
Little blue heron	Florida caerulea	s	T	I	P
Cattle egret	Bubulcus ibis	s			
Green-backed heron	Butorides striatus	S	T	I	P
Black-crowned night-heron	Nycticorax nycticorax	S	T	I	P
Yellow-crowned night-heron	Nyctanassa violacea				P
Glossy ibis	Plegadis falcinellus		T		P
Fulvous whistling duck	Dendrocygna bicolor		T		
Tundra swan	Cygnus columbianus	S	T		
Mute swan	Cygnus olor	S		I	P
Greater white-fronted goose	Anser albifrons				P
Snow goose	Chen caerulescens	S	T	I	P
Brant	B. bernicla	S	T	I	P
Canada goose	Branta canadensis	S	T	I	P
Wood duck	Aix sponsa	S	T	I	
Green-winged teal	Anas crecca crecca	S			
American green-winged teal	A. crecca carolinensis	S	T	I	P
American black duck	A. rubripes	S	T	I	P
Mallard	A. platyrhynchos	S	T	I	P
Northern pintail	A. acuta	S	T	I	P
Blue-winged teal	A. discors	S	T	I	P
Northern shoveler	A. clypeata	S	T		
Gadwall	A. strepera	S	T	I	P

Common Name	Scientific Name	Components S	T	I	P
Eurasian wigeon	A. penelope		T		
American wigeon	A. americana	S	T	I	P
Canvasback	A. valisineria	S	T	I	P
Redhead	Aythya americana	S	T	I	
Ring-necked duck	A. collaris	S	T	I	P
Greater scaup	A. marila	S	T	I	P
Lesser scaup	A. affinis	S	T	I	P
Oldsquaw	Clangula hyemalis	S	T	I	P
Black scoter	Melanitta nigra	S	T	I	
Surf scoter	M. perspicillata	s	T	I	P
White-winged scoter	M. deglandi	s	T	I	P
Common goldeneye	Bucephala clangula	S	T	I	P
Bufflehead	B. albeola	S	T	I	P
Hooded merganser	Lophodytes cucullatus	S	T	I	P
Common merganser	Mergus merganser	S	T	I	P
Red-breasted merganser	M. serrator	s	T	I	P
Ruddy duck	Oxyura jamaicensis		T	I	P
Turkey vulture	Cathartes aura	S	T	I	P
Osprey	Pandion haliaetus	S	T	I	P
Bald eagle	Haliaeetus leucocephalus	S	T	I	P
Northern Harrier	Circus cyaneus	S	T	I	P
Sharp-shinned hawk	Accipiter striatus	S	T	I	P
Cooper's hawk	A. cooperii	S	T	I	P
Northern goshawk	A. gentilis	S	T	I	P
Red-shouldered hawk	Buteo lineatus	S	T	I	P
Broad-winged hawk	B. platypterus	s	T	I	P
Red-tailed hawk	B. jamaicensis	S	T	I	P
Rough-legged hawk	B. lagopus	s	T	I	P
Golden eagle	Aquila chrysaetos		T	I	P
American kestrel	Falco sparverius	S	T	I	P
Merlin	F. columbarius		T	I	P
Peregrine falcon	F. peregrinus		T	I	P
Gyrfalcon	F. rusticolus		T		
Gray partridge	Perdix perdix		T		
Ring-necked pheasant	Phasianus colchicus	S	T	I	P
Ruffed grouse	Bonasa umbellus	S	T	I	
Wild turkey	Meleagris gallopavo	S			
Clapper rail	Rallus longirostris				P
King rail	R. elegans	s	T	I	P
Virginia rail	R. limicola	S	T	I	P
Sora	Porzana carolina	S	T	I	P
Common moorhen	Gallinula chloropus	s	T	I	P
American coot	Fulica americana	S	T	I	P
Sandhill crane	Grus canadensis		T		
Black-bellied plover	Pluvialis squatarola		T		P

Common Name	Scientific Name	Components S	T	I	P
Lesser golden plover	P. dominica		T		
Semipalmated plover	Charadrius semipalmatus	S	T		P
Killdeer	C. vociferus	S	T	I	P
Greater yellowlegs	Tringa melanoleuca	S	T	I	P
Lesser yellowlegs	T. flavipes	S	T	I	P
Solitary sandpiper	Tringa solitaria	s	T		P
Willet	Catoptrophorus semipalmatus				P
Spotted sandpiper	Actitis macularia	S	T	I	P
Upland sandpiper	Bartramia longicauda			I	P
Ruddy turnstone	Arenaria interpres		T		P
Red knot	Calidris canutus				P
Sanderling	C. alba		T		P
Semipalmated sandpiper	C. pusillus		T		P
Western sandpiper	C. mauri				P
Least sandpiper	C. minutilla	s	T		P
White-rumped sandpiper	C. fuscicollis				P
Pectoral sandpiper	C. melanotos	S	T		P
Dunlin	C. alpina	S	T		P
Short-billed dowitcher	Limnodromus griseus		T		P
Long-billed dowitcher	L. scolopaceus				P
Common snipe	Capella gallinago	S	T	I	P
American woodcock	Philohela minor	S	T	I	P
Red-necked phalarope	Lobipes lobatus			I	P
Laughing gull	Larus atricilla		T	I	P
Bonaparte's gull	L. philadelphia	S	T	I	P
Ring-billed gull	L. delawarensis	S	T	I	P
Herring gull	L. argentatus	S	T	I	P
Iceland gull	L. glaucoides	s		I	
Glaucous gull	L. hyperboreus	s		I	P
Great black-backed gull	L. marinus	S	T	I	P
Black-legged kittiwake	Rissa tridactyla		T		
Caspian tern	Sterna caspia		T		P
Royal tern	S. maximus	S			P
Sandwich tern	S. sandvicensis				P
Roseate tern	S. dougallii				P
Common tern	S. hirundo	s	T	I	P
Forster's tern	S. forsteri				P
Least tern	S. albifrons				P
Sooty tern	S. fuscata	S		I	P
Black tern	Chlidonias niger	S	T	I	P
Rock dove	Columbia livia	S	T	I	P

Common Name	Scientific Name	Components S	T	I	P
Mourning dove	Zenaida macroura	S	T	I	P
Monk parakeet	Myiopsitta monachus				P
Black-billed cuckoo	Coccyzas erythrophthalmus	S	T	I	P
Yellow-billed cuckoo	C. americanus	s	T	I	P
Common barn owl	Tyto alba	s			
Eastern screech owl	Otus asio	s	T	I	P
Great horned owl	Bubo virginianus	S	T	I	
Snowy owl	Nyctea scandiaca				P
Barred owl	Strix varia		T	I	
Long-eared owl	Asio otus		T		P
Short-eared owl	A. flammeus	s			P
Northern saw-whet owl	Aegolius acadicus	s	T		
Common nighthawk	Chordeiles minor	S	T	I	P
Whip-poor-will	Caprimulgus vociferus	s	T	I	P
Chimney swift	Chaetura pelagica	S	T	I	P
Ruby-throated hummingbird	Archilochus colubris	S	T	I	P
Belted kingfisher	Megaceryle alcyon	S	T	I	P
Red-headed woodpecker	Melanerpes erythrocephalus		T		
Red-bellied woodpecker	M. carolinus	s	T		P
Yellow-bellied sapsucker	Sphyrapicus varius	S	T	I	P
Downy woodpecker	Picoides pubescens	S	T	I	P
Hairy woodpecker	P. villosus	S	T	I	P
Black-backed three-toed woodpecker	P. arcticus		T		
Northern flicker	Colaptes auratus	S	T	I	P
Pileated woodpecker	Dryocopus pileatus	S	T	I	P
Olive-sided flycatcher	Contopus borealis		T	I	
Eastern wood pewee	C. virens	S	T	I	P
Yellow-bellied flycatcher	Empidonax flaviventris		T	I	
Acadian flycatcher	E. virescens		T		
Alder flycatcher	E. alnorum				
Willow flycatcher	E. traillii	S	T	I	P
Least flycatcher	E. minimus	S	T	I	P
Eastern phoebe	Sayornis phoebe	S	T	I	P
Great crested flycatcher	Myiarchus crinitus	S	T	I	P
Western kingbird	Tyrannus verticalis		T		
Eastern kingbird	T. tyrannus	S	T	I	P
Horned lark	Eremophila alpestris	s	T	I	P
Purple martin	Progne subis	s	T	I	P
Tree swallow	Iridoprocne bicolor	S	T	I	P
Northern rough-winged swallow	Stelgidopteryx ruficollis	s	T	I	P

Common Name	Scientific Name	Components S	T	I	P
Bank swallow	Riparia riparia	S	T	I	
Cliff swallow	Petrochelidon pyrrhonota	s	T	I	P
Barn swallow	Hirundo rustica	S	T	I	P
Blue jay	Cyanocitta cristata	S	T	I	P
American crow	Corvus brachynhynchos	S	T	I	P
Fish crow	C. ossifragus	S	T	I	P
Common raven	C. corax		T	I	
Black-capped chickadee	Parus atricapillus	S	T	I	P
Boreal chickadee	P. hudsonicus	S	T		P
Tufted titmouse	P. bicolor	S	T	I	P
Red-breasted nuthatch	Sitta canadensis	s	T	I	P
White-breased nuthatch	S. carolinensis	S	T	I	P
Brown creeper	Certhia familiaris	S	T	I	P
Carolina wren	Throyothorus ludovicianus	S	T		P
House wren	Troglodytes aedon	S	T	I	P
Winter wren	T. troglodytes	S	T	I	P
Sedge marsh wren	Cistothorus platensis				P
Marsh wren	C. palustris	S	T	I	P
Golden-crowned kinglet	Regulus satrapa	S	T	I	P
Ruby-crowned kinglet	R. calendula	S	T	I	P
Blue-gray gnatcatcher	Polioptila caerulea	S	T	I	P
Northern wheatear	Oenanthe oenanthe		T		
Eastern bluebird	Sialia sialis	S	T	I	P
Veery	Catharus fuscescens	S	T	I	P
Gray-cheeked thrush	C. minima		T	I	
Swainson's thrush	C. ustulata	s	T	I	P
Hermit thrush	C. guttata	s	T	I	P
Wood thrush	C. mustelina	S	T	I	P
American robin	Turdus migratorius	S	T	I	P
Gray catbird	Dumetella carolinensis	S	T	I	P
Northern mockingbird	Mimus polyglottos	S	T	I	P
Brown thrasher	Toxostoma rufum	S	T	I	P
Water pipit	Anthus spinoletta	s	T	I	P
Cedar waxwing	Bombycilla cedrorum	S	T	I	P
Northern shrike	Lanius excubitor		T		P
Loggerhead shrike	L. ludovicianus		T		P
European starling	Sturnus vulgaris	S	T	I	P
White-eyed vireo	Vireo griseus		T	I	
Solitary vireo	V. solitarius	s	T	I	P
Yellow-throated vireo	V. flavifrons	S	T	I	P
Warbling vireo	V. gilvus	S	T		P

Common Name	Scientific Name	Components S	T	I	P
Philadelphia vireo	V. philadelphicus		T		P
Red-eyed vireo	V. Olivaceus	S	T	I	P
Blue-winged warbler	Vermivora pinus	S	T	I	P
Golden-winged warbler	V. chrysoptera		T	I	
Tennessee warbler	V. peregrina	S	T	I	P
Orange-crowned warbler	V. celata		T		P
Nashville warbler	V. ruficapilla		T	I	P
Northern parula	Parula americana		T	I	P
Yellow warbler	Dedroica petechia	S	T	I	P
Chestnut-sized warbler	D. pensylvanica	S	T	I	P
Magnolia warbler	D. magnolia	s	T	I	P
Cape May warbler	D. tigrina	S	T	I	
Black-throated blue warbler	D. caerulescens	s	T	I	P
Yellow-rumped warbler	D. coronata	S	T	I	P
Black-throated green warbler	D. virens	S	T	I	P
Blackburnian warbler	D. fusca	s	T	I	P
Yellow-throated warbler	D. dominica		T		
Pine warbler	D. pinus	s	T	I	
Prairie warbler	D. discolor	S	T	I	P
Palm warbler	D. palmarum				
Bay-breasted warbler	D. castanea	s	T	I	P
Blackpoll warbler	D. striata	S	T	I	P
Cerulean warbler	D. cerulea	s	T	I	P
Black-and-white warbler	Mniotilta varia	S	T	I	P
American redstart	Setophaga ruticilla	S	T	I	P
Prothonotary warbler	Protonotaria citrea	S	T		P
Worm-eating warbler	Helmitheros vermivorus		T	I	P
Ovenbird	Seiurus aurocapillus	S	T	I	P
Northern waterthrush	S. noveboracensis	s	T	I	P
Louisiana waterthrush	S. motacilla	s	T	I	P
Kentucky warbler	Opovovnis formosus		T		P
Connecticut warbler	O. agilis		T		
Mourning warbler	O. philadelphia		T		
Common yellowthroat	Geothlypis trichas	S	T	I	P
Hooded warbler	Wilsonia citrina		T	I	P
Wilson's warbler	W. pusilla	S	T	I	P
Canada warbler	W. canadensis	S	T	I	P
Yellow-breasted chat	Icteria virens		T	I	P
Summer tanager	Piranga rubra		T		
Scarlet tanager	P. olivacea	S	T	I	P
Northern cardinal	Cardinalis cardinalis	S	T	I	P

Common Name	Scientific Name	Components			
		S	T	I	P
Rose-breasted grosbeak	Pheucticus ludovicianus	S	T	I	P
Blue grosbeak	Guiraca caerulea		T		
Indigo bunting	Passerina cyanea	S	T	I	P
Rufous-sided towhee	Pipilo erythrophthalmus	S	T	I	P
American tree sparrow	Spizella arborea	S	T	I	P
Chipping sparrow	S. passerina	S	T	I	P
Field sparrow	S. pusilla	S	T	I	P
Vesper sparrow	Pooecetes gramineus		T	I	P
Lark sparrow	Chondestes grammacus				P
Savannah sparrow	Passerculus sandwichensis	S	T	I	P
Grasshopper sparrow	Ammodramus savannarum		T		P
Henslow's sparrow	A. henslowii		T		
Sharp-tailed sparrow	Ammospiza caudacuta		T		P
Seaside sparrow	A. maritima				P
Fox sparrow	passerella iliaca	s	T	I	P
Song sparrow	Melospiza melodia	S	T	I	P
Lincoln's sparrow	M. lincolnii	s	T	I	P
Swamp sparrow	M. georgiana	S	T	I	P
White-throated sparrow	Zonotrichia albicollis	S	T	I	P
White-crowned sparrow	Z. leucophrys	S	T	I	P
Dark-eyed junco	Junco hyemalis	S	T	I	P
Lapland longspur	Calcarius lapponicus		T		
Chestnut-collard longspur	C. ornatus		T		
Snow bunting	Plectrophenax nivalis	S	T	I	P
Bobolink	Dolichonyx oryzivorus	S	T	I	P
Red-winged blackbird	Agelaius phoeniceus	S	T	I	P
Eastern meadowlark	Sturnella magna	S	T	I	P
Yellow-headed blackbird	Xanthocephalus xanthocephalus		T		
Rusty blackbird	Euphagus carolina	S	T	I	P
Common grackle	Quiscalus quiscula	S	T	I	P
Brown-headed cowbird	Molothrus aler	S	T	I	P
Orchard oriole	Icterus spurius	S	T		P
Northern oriole	I. galbula	S	T	I	P
Pine grosbeak	Pinicola enucleator		T	I	P
Purple finch	Carpodacus purpureus	S	T	I	P
House finch	C. mexicanus	S	T		P
Red crossbill	Loxia curvirostra		T		
White-winged crossbill	L. leucoptera		T	I	
Common redpoll	Acanthis flammea	S	T	I	P
Hoary redpoll	A. hornemanni		T		
Pine siskin	Carduelis pinus	S	T	I	P
American goldfinch	C. tristis	S	T	I	P

Common Name	Scientific Name	Components S T I P
Evening grosbeak	Hesperiphona vespertina	S T I P
House sparrow	Passer demesticus	S T I P

a) Sources of data:

Stockport: Lawrence Biegel, Arlene Brown, Tom Brown, William Cook, Kate Durham, Elizabeth Grace, Richard Guthrie, Nancy Kern and Erik Kiviat. S (upper case) indicates sight record of the site; s (lower case) indicates species likely to occur based on records from nearby areas.

Tivoli: from Kiviat (1978) (includes a few species recorded from areas near, but not within, Sanctuary boundaries); and Richard Gunthrie

Iona: from Orth (1965).

Piermont: Robert Deed, includes species of land birds observed within about 50 yards of the landward edge of the marsh (landward boundary of the Sanctuary site); all sight records. Sedge marsh wren datum from Joseph Hickey field notes.

Appendix 6

MAMMALS REPORTED IN OR NEAR THE HUDSON RIVER NATIONAL ESTUARINE SANCTUARY

APPENDIX 6

MAMMALS REPORTED IN OR NEAR THE HUDSON RIVER NATIONAL ESTUARINE SANCTUARY

Verified reports for the Stockport, Tivoli, Iona, and Piermont Sanctuary components are indicated by upper case S, T, I, P; lower case s, t, i, indicate unverified reports considered reliable, or verified reports outside the Sanctuary boundary. A species listed with no site annotation is known from the Hudson River corridor but has not been reported from the Sanctuary. Names follow: Jones, J. Knox, Jr., Dilford C. Carter and Hugh H. Genoways. 1979. Revised Checklist of North American Mammals North of Mexico, 1979. Occasional Papers, the Museum of Texas Technical University 62, 17 p. Compiled by Erik Kiviat, 1984.

Common Name	Scientific Name	Components S	T	I	P
Virginia opossum	Didelphis virginiana		T	i	
Masked shrew	Sorex cinereus				
Smokey shrew	Sorex fumeus				
Short-tailed shrew	Blarina brevicauda		T	I	
Hairy-tailed mole	Parascalops breweri	s			
Eastern mole	Scalopus aquaticus				
Star-nosed mole	Condylura cristata		T		
Little brown bat	Myotis lucifugus		T		
Keen's bat	Myotis keenii		T		
Indiana bat	Myotis sodalis				
Eastern pipistrelle	Pipistrellus subflavus				
Big brown bat	Eptesicus fuscus		t		
Red bat	Lasiurus borealis		t		
Hoary bat	Lasiurus cinereus				
Eastern cottontail	Sylvilagus floridanus	S	T	i	P
Eastern chipmunk	Tamias striatus		T	I	P
Woodchuck	Marmota monax	S	T	i	
Gray squirrel	Sciurus carolinensis	S	T	I	p
Red squirrel	Tamiasciurus hudsonicus	s	T	I	
Southern flying squirrel	Glaucomys volans		T	I	
Beaver	Castor canadensis (a)		T	I	P
Deer mouse	Peromyscus maniculatus				
White-footed mouse	Peromyscus leucopus (b)	S	T	I	
Eastern woodrat	Neotoma floridana			i	p
Southern red-backed vole	Clethrionomys gapperi				
Meadow vole	Microtus pennsylvanicus		T	I	
Woodland vole (pine vole)	Microtus pinetorum				
Muskrat	Ondatra zibethicus	S	T	I	P
Southern bog lemming	Synaptomys cooperi				

Common Name	Scientific Name	Components S	T	I	P
Norway rat	Rattus norvegicus		T	i	
House mouse	Mus musculus		t		
Meadow jumping mouse	Zapus hudsonius		T		
Woodland jumping mouse	Napaeozapus insignis				
Porcupine	Erethizon dorsatum		t		
Common dolphin	Delphinus delphis (c)		t		
Harbor porpoise	Phocoena phocoena (d)				
Coyote	Canis latrans				
Red fox	Vulpes vulpes	S	T	I	
Gray fox	Urocyon cinereoargenteus		T		
Black bear	Ursus americanus		t		P
Raccoon	Procyon lotor	S	T	I	P
Fisher	Martes pennanti			i	
Ermine (short-tailed weasel)	Mustela erminea		t		
Long-tailed weasel	Mustela frenata		T		
Mink	Mustela vison		T	I	
Striped skunk	Mephitis mephitis		T	I	
River otter	Lutra canadensis (g)		T	I	
Habor seal	Phoca vitulina (h)				
Bobcat	Felis rufus		t		
White-tailed deer	Odocoileus virginianus	S	T	I	P

Data from: Jack Focht (I), Michael Hardy (P), Erik Kiviat (all sites), William T. Maple (S, P), John Orth (in Clarke and Rapuano 1976) (I), Jasz Rodziewicz (T, I), Robert Speiser (I).

a Very rarely seen in Hudson River and not resident.
b Deer mouse rare in Hudson Valley; (Peromyscus found in sanctuary assumed to be white-footed mouse).
c Reports of this species in the Hudson River are limited to the 1930s and may have involved a single school.
d No Hudson River reports from the current century; probably extirpated.
e Rare individuals; not resident along Hudson River.
f Single old report.
g Very rare in Hudson River.
h Verified occasionally elsewhere in Hudson River; 1984 reports of a seal in the Cold Spring to Stony Point reach assumed to be this species.

Appendix 7

MEMORANDUM OF UNDERSTANDING AMONG FIVE NEW YORK STATE AGENCIES

APPENDIX 7

MEMORANDUM OF UNDERSTANDING

This Memorandum serves as an expression of intent among five parties-in-interest hereinafter called the Signatories: the New York State Department of Environmental Conservation (Lead Agency), the New York State Office of General Services, the Palisades Interstate Park Commission, the New York State Office of Parks, Recreation and Historic Preservation, and the New York State Department of State.

Witnesseth:

WHEREAS, New York State has received a grant from the United States Secretary of Commerce for acquisition, development and operation of certain portions of the Hudson River Estuary (see Appendix A) as the Hudson River National Estuarine Sanctuary (the Sanctuary), and

WHEREAS, the purpose of such grant is to create new opportunities for coordinated Hudson River research and public education (the Program), and

WHEREAS, such Program has wide public support, and

WHEREAS, the Signatories have already evidenced support for such Program through the formation in 1981 of a Hudson River Estuarine Sanctuary Steering Committee which has met regularly to coordinate the efforts of the Signatories in establishing the Sanctuary,

NOW THEREFORE, in consideration of the mutual benefits to be derived from implementing this Program, the Signatories agree to the following:

1. The lands described in Appendix A are hereby designated as the Hudson River Estuarine Sanctuary.

2. There shall be a Management Plan for the Sanctuary, which Management Plan shall provide a framework for conducting research and educational programs. The Management Plan shall be developed by the Estuarine Sanctuary staff and reviewed by the Steering Committee. Such Management Plan shall set forth compatible and non-compatible uses for each site in the Sanctuary. The Management Plan shall not take effect except upon unanimous approval of the Signatories. The Management Plan shall be reviewed annually and shall be revised as needed, but no revisions shall take place except upon unanimous approval of the Signatories.

3. No land ownership and management prerogatives in the Sanctuary shall be changed except as specified in the Management Plan.

4. The purpose of the Program is the protection of such lands for use as a natural field laboratory in which to gather data and make studies of the natural and human processes occurring within the Hudson River estuary.

5. The Signatories shall adhere to the Management Plan in their land ownership and management activities within the Sanctuary.

6. Multiple uses of such lands are encouraged to the extent such uses are compatible with the Program and its purpose as expressed in the Management Plan. These areas are being managed to facilitate ecological research and education. Uses and/or levels of use, which are not compatible with the use of the Sanctuary as a natural field laboratory, shall be prohibited or limited to the greatest extent feasible, by the agency having jurisdiction.

7. Management Structure

a. There shall be a Sanctuary Steering Committee, comprised of one member from each of the Signatories, which shall review the recommendations of Sanctuary Advisory Committees and shall submit them to the agencies having jurisdiction over lands in the Sanctuary. The Steering Committee shall review the Management Plan annually and shall advise the Lead Agency regarding its implementation. The chairman of each Sanctuary Advisory Committee and a representative of the National Oceanic and Atmospheric Administration shall serve as non-voting, ex-officio representatives to the Steering Committee.

b. There shall be three Sanctuary Advisory Committees appointed by the Lead Agency, in consultation with the Steering Committee, which shall meet regularly to discuss the progress of the Sanctuary and to make recommendations to the Steering Committee.

c. The Lead Agency shall implement the Program by hiring and directing Estuarine Sanctuary staff, supervise and coordinate implementation of the provisions of the Management Plan, and by receiving and acting upon the recommendations of the Steering Committee.

d. The Estuarine Sanctuary staff, hired by and reporting to the Lead Agency, is immediately responsible for Program coordination with the agencies having jurisdiction over respective Sanctuary sites.

8. No projects shall be carried out on Sanctuary lands without the approval of the agency having jurisdiction over such lands. Such agency shall maintain all facilities built on its lands in furtherance of a project, and shall cooperate with Sanctuary staff in carrying out the Program.

9. The Lead Agency and the Department of State shall confer regularly to ensure coordination between the Estuarine Sanctuary Program and the Coastal Management Program.

10. This Memorandum shall not be construed so as to preclude additional transfers of property among the Signatories, or to preclude additions of appropriate lands to the Estuarine Sanctuary.

11. This Memorandum shall continue in effect in perpetuity; additional Signatories may join by unanimous approval of existing Signatories, and the Memorandum may be amended or terminated by majority vote of the Signatories at any time. Nothing in this Memorandum shall, however, preclude the unilateral withdrawal of any of the Signatories. In such latter eventuality is understood that the lands of such withdrawing Signatory would be dedesignated from the Sanctuary, and it is understood that the federal Office of Management and Budget will take appropriate action with respect to grant funds as may be indicated by its regulations.

Signed,

Department of Environmental Conservation

By _____

Date 8/4/82 Title First Deputy Comm

Office of General Services

By _____

Date 8/5/82 Title Deputy Commissioner

Palisades Interstate Park Commission

By _____

Date _____ Title _____

Office of Parks, Recreation and Historic Preservation

By _____

Date 8/2/82 Title Deputy Commissioner

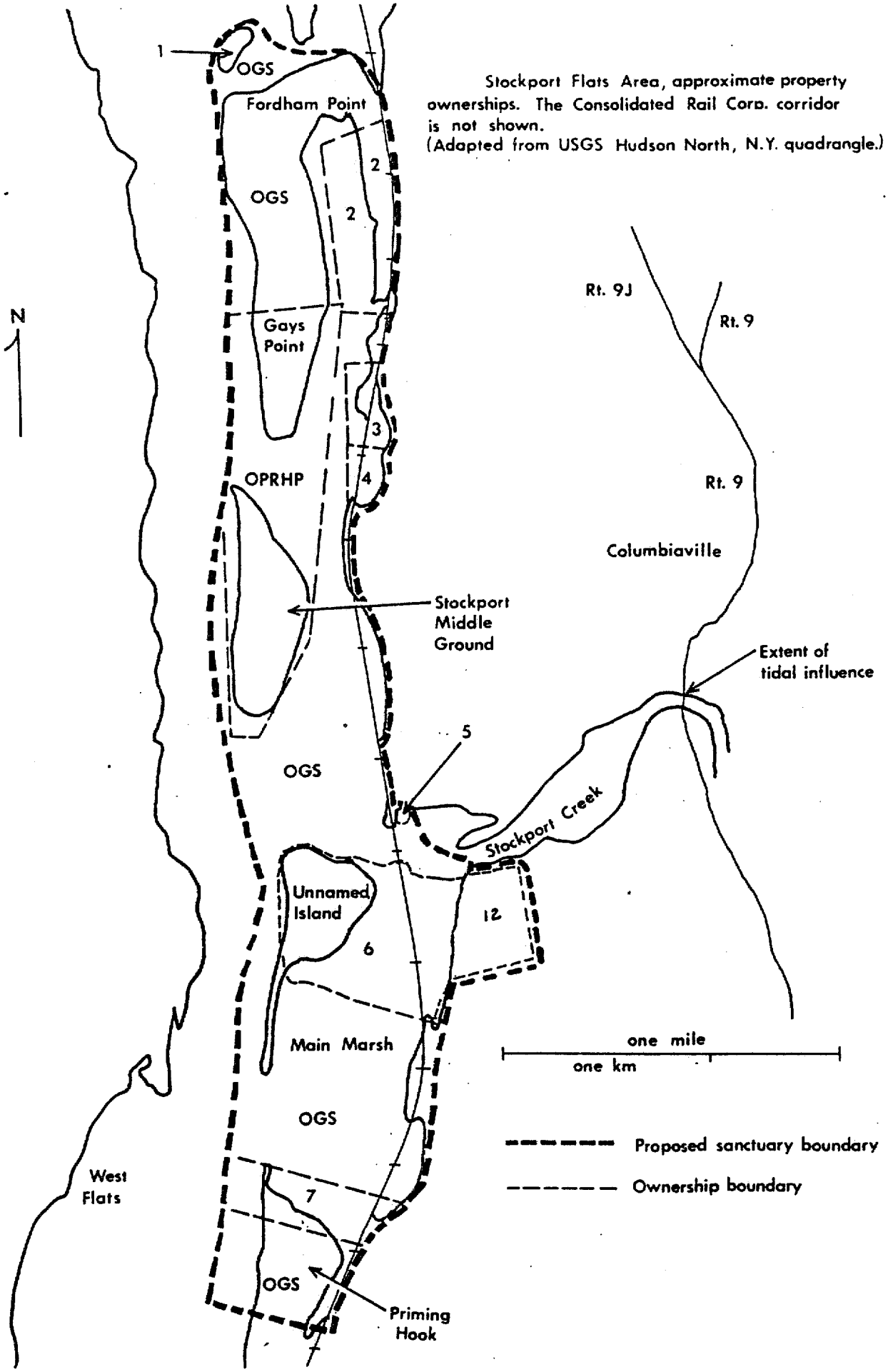
Department of State

By _____

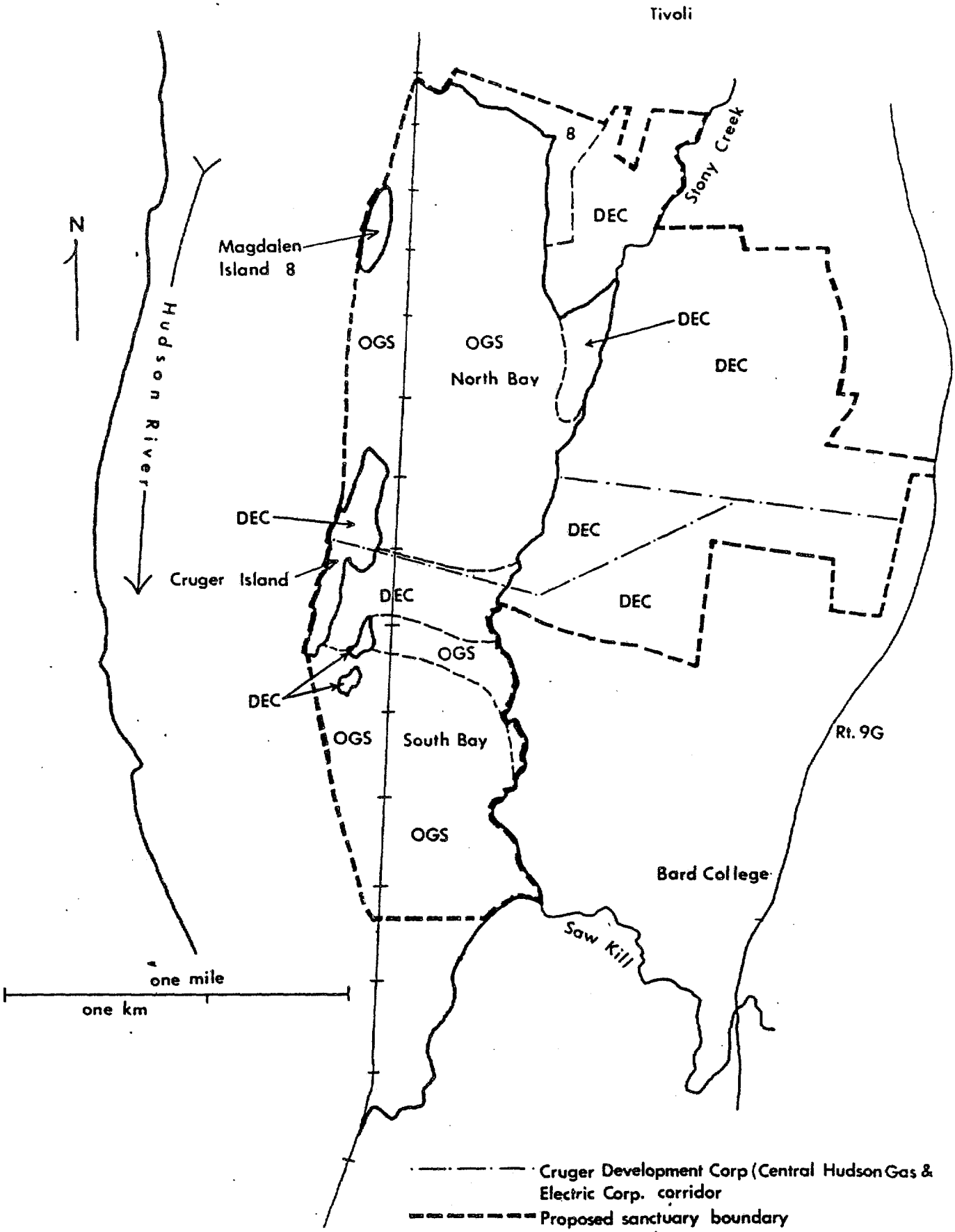
Date 8-2-82 Title _____

APPENDIX A

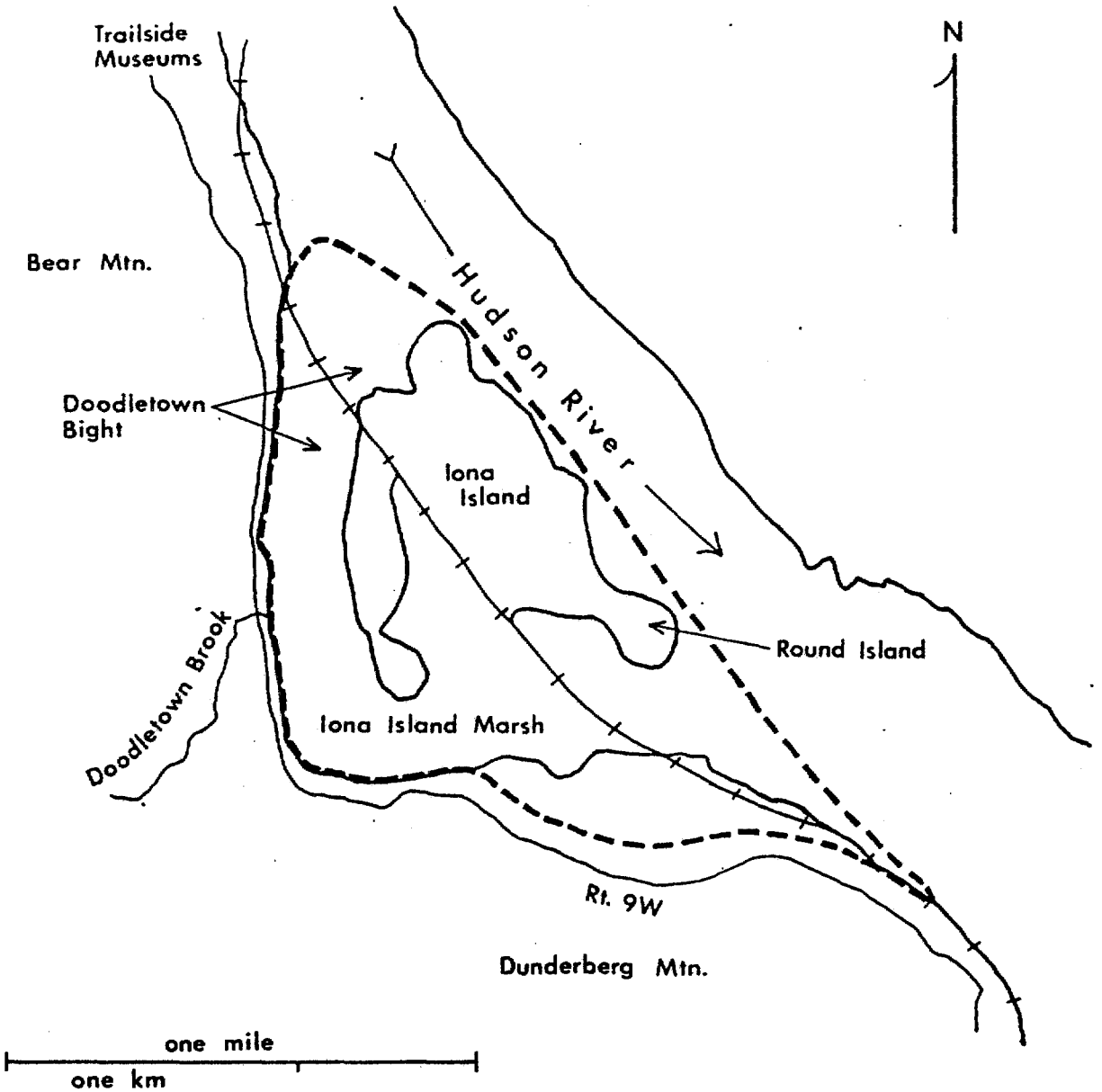
to the Memorandum of Understanding



Stockport Flats Area, approximate property ownerships. The Consolidated Rail Corp. corridor is not shown.
(Adapted from USGS Hudson North, N.Y. quadrangle.)

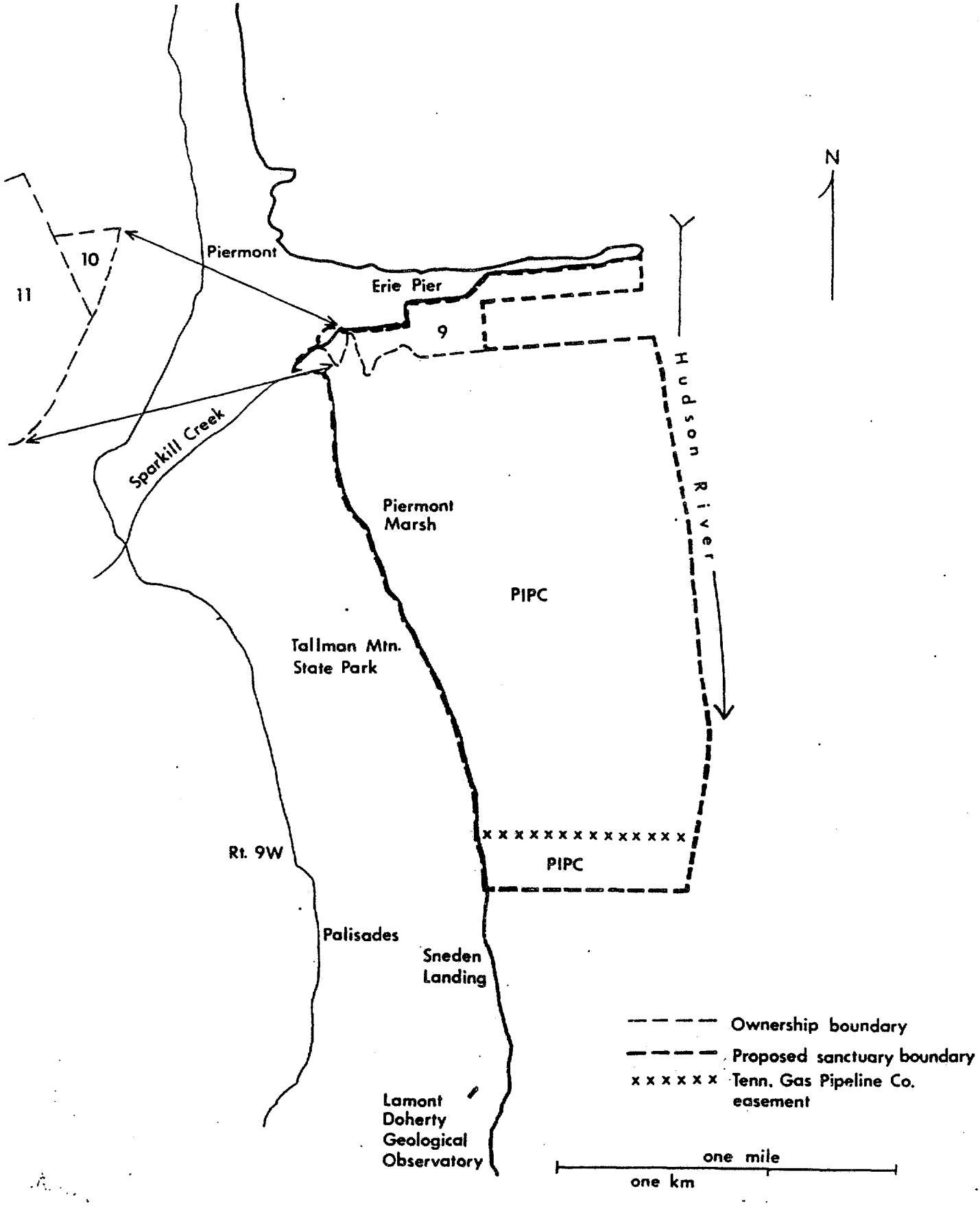


Tivoli Bays Area.
(Adapted from USGS Saugerties, N.Y. quadrangle.)



Proposed sanctuary boundary

Iona Island Marsh Area
(Adapted from USGS Peekskill, N.Y. quadrangle.)
Ownership all PIPC



Piermont Marsh Area.
(Adapted from USGS Nyack, N.Y.– N.J. quadrangle.)

Appendix 8

EXISTING JURISDICTIONS IN THE HUDSON RIVER NATIONAL ESTUARINE SANCTUARY

APPENDIX 8

EXISTING JURISDICTIONS IN THE HUDSON RIVER NATIONAL ESTUARINE SANCTUARY

AGENCY	JURISDICTION	LEGISLATION (if any)
Federal:		
Army Corps of Engineers	dredging, filling, dumping, hazards to navigation, wetlands in river and larger tributaries	Sec. 404 of Clean Water Act, Rivers & Harbors Act, Section 10, as amended
Dept. of Commerce: Office of Coastal Zone Management	oversight of National Estuarine Sanctuary Program	Coastal Zone Management Act, as amended
National Marine Fisheries Service	marine fishery resources, endangered species, marine mammals	Fishing Conservation and Management Act of 1976, Fish and Wildlife Coordination Act of 1934, Endangered Species Act of 1972, Commercial Fisheries Research and Development Act of 1964, Anadromous Fish Conservation Act of 1965, all as amended
Sea Grant Program	research, education, and conservation in the coastal zone	Public Law 94461
Dept. of the Interior: Fish & Wildlife Service	migratory birds, endangered species, marine mammals, interstate commerce of organisms	Migratory Bird Treaty Act, Endangered Species Conservation Act, Lacey Act, Marine Mammal Protection Act, all as amended
National Park Service	Natl. Register of Historic Places, Natl. Natural Landmarks, Natl. Trust for Historic Preservation	Historic Preservation Act, as amended
Dept. of Transportation: Coast Guard	maintenance of navigable waters, shipping, small craft, aids to navigation search and rescue	14 USC 2, Primary Responsibilities of the Coast Guard

AGENCY	JURISDICTION	LEGISLATION (if any)
Federal (cont.):		
Environmental Protection Agency	air and water quality guidelines, solid waste and toxic materials guidelines, spills noise pollution, PCB reclamation demonstration, environmental review of projects	Clean Air Act, Clean Water Act, TOSCA, RCRA, FIFRA, Superfund, NEPA, all as amended
Nuclear Regulatory Commission	oversight over operation Indian Point power plants	Energy Reorganization Act
Consolidated Rail Corporation	right-of-way improvement and maintenance	
State:		
Department of Environmental Conservation	lead agency in Hudson River Estuarine Sanctuary Program, landowner at Tivoli Bays & Piermont, fish & game, protected animals, collecting and marking licenses, freshwater and tidal wetlands, water and air quality solid water & toxic substances pesticides, mining, scenic areas, project review. The Heritage Task Force for the Hudson River Valley, Inc.	Environmental Conservation Law and regulations promulgated thereunder (as amended) including the Fish & Wildlife Law, Water Resources Law, Freshwater Wetlands Act, Tidal Wetlands Act, Resource Conservation and Recovery Act, and Wild, Scenic, and Recreational River System, State Environmental Quality Act
Department of Commerce	tourism developement	Tourist Promotion Act
Department of Health	food quality (e.g., fish)	Public Health Law
Department of State	cooperating agency in Hudson River Estuarine Sanctuary Program, coastal management	Waterfront Revitalization & Coastal Resources Act

AGENCY	JURISDICTION	LEGISLATION
State (cont.):		
Department of Transportation	navigation channel, spoil disposal, roads, bridges	Transportation Law
Office of General Services	cooperating agency in Hudson River Estuarine Sanctuary Program, landowner at Stockport and Tivoli	Public Lands Law, Art. 6
Office of Parks, Recreation and Historic Preservation	cooperating agency in Hudson River Estuarine Sanctuary Program, landowner at Stockport, park land management, historic preservation, promotion and regulation of pleasure boating	Parks, Recreation, and Historic Preservation Law, as amended
Palisades Interstate Parks Commission	cooperating ageny in Hudson River Estuarine Sanctuary Program, landowner at Piermont & Iona, management of the interstate park	Parks, Recreation and and Historic Preservation Law, as amended
State Energy Office	energy policy	Energy Law, as amended
Public Service	energy facility siting and regulations	Public Service Law
County:		
Departments of Health	facility safety and sanitation, water supply, landfills, pest control	General Municipal Law, NYCR&R, as amended laws of various counties
Environmental Management Councils	advice to legislatures, natural resource inventories, public information	General Municipal Law (as above)
Highway Departments	county roads	(as above)

AGENCY	JURISDICTION	LEGISLATION
County (cont.):		
Planning Departments	review of Federal spending (A-95), planning recommendations and coordination of planning activities	(as above)
Town:		
Planning, Zoning, and Conservation Boards & Commissions	planning, zoning, advice to town boards on environmental issues, natural resource inventories, conformance to existing laws	(as above) also town ordinances including zoning ordinances*
Highway Departments	maintenance of town roads and town landfills	
Village:		
Piermont	owner of pier, portion of marsh within its jurisdiction	See under Town
Tivoli	small portion of Tivoli Bay within its jurisdiction	See under Town

*Zoning classifications for the four Proposed Estuarine Sanctuary areas:

Piermont - Village of Piermont - - - Use by special permit from Village
Town of Orangetown - - - Residential, 2 acre minimum

Iona - wholly within the Palisades Interstate Park

Tivoli - Town of Red Hook - - - Agricultural (uplands), Land Conservation (wetlands and Cruger Island)
Village of Tivoli

Stockport - no zoning ordinances

Appendix 9

MEMORANDUM OF UNDERSTANDING BETWEEN

BARD COLLEGE AND

THE NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

MEMORANDUM OF UNDERSTANDING

This Memorandum of Understanding between Bard College and the New York State Department of Environmental Conservation outlines the establishment of a cooperative effort to develop and enhance the existing research capability of Bard College at the Ecology Field Station, entered into as of the 19th day of July, 1983.

Witnesseth:

WHEREAS, New York State through the Department of Environmental Conservation has received a grant for the acquisition, development, and operation of sanctuaries in the Hudson River as part of the National Estuarine Sanctuary System, and

WHEREAS, a major goal of this program is to facilitate research that will result in improved knowledge of the human and natural processes occurring within the estuary, and

WHEREAS, Bard College is a well established and involved institution with research interests in and physical facilities on the Hudson Estuary in close proximity to the estuary at Tivoli, and

WHEREAS, the Estuarine Sanctuary Program would be facilitated greatly by establishment of a science center and $115,000 has been budgeted to achieve research capability, and

WHEREAS, a cooperative effort between Bard College and the Department of Environmental Conservation in supporting research capability would be cost effective,

NOW, THEREFORE, in consideration of the mutual benefits to be gained by this cooperative effort, Bard College and the Department of Environmental Conservation agree as follows:

1. The New York State Department of Environmental Conservation and Bard College will confer on the modifications to be made to the existing Ecology Field Station and will mutually agree to the final construction plans.

2. The Department agrees to make available up to $115,000 to complete the agreed to capital modifications the Field Station, contingent upon receipt of monies in this amount from the Federal government.

3. All modifications to the Field Station are to be carried out by Bard College personnel during the Acquisition Grant Period (September 30, 1982, to September 30, 1983). If Bard College cannot meet this deadline, they will notify the Department by August 1, 1983. The Department will request an extension for the Acquisition Grant from the Grants and Loans Operations Branch of the Office of Coastal Zone Management.

4. Bard College will continue to be responsible for maintenance of the Field Station after construction is completed.

5. Research equipment purchased for the Hudson River Estuarine Sanctuary Program using funds provided through a Federal grant shall be subject to the provisions of Office of Management and Budget Circular A-102 concerning the use and disposition of property funded by the Federal Government, which document is incorporated by reference into this Memorandum of Understanding. Research equipment donated through the Estuarine Sanctuaries Program by private parties will be under the ownership and control of the Department. Use of facilities and equipment at the Field Station will be shared by both parties as well as by approved outside scientists in furthering estuarine-related research.

6. In the unlikely event the Sanctuary is terminated through an action initiated by the Federal government for reasons attributable to the Department, the Department, but not Bard College would be responsible to reimburse the Federal government according to OMB Circular A-102 for the value of the unexpired life of the property (improvements and equipment). However, it should be noted that the National Oceanic and Atmospheric Administration has the capacity to permit the recipient (Bard College) to keep the improvements, if the National Oceanic and Atmospheric Administration so decides.

7. In the unlikely event that Bard College chooses to withdraw from this MEMORANDUM OF UNDERSTANDING for good cause and cease to offer the availability of the Field Station research facilities for Estuarine Sanctuary research purposes, then Bard College will reimburse the value of the unexpired life of the property (improvements) depreciated according to OMB Circular A-102 to the Department; and it is further understood that the Department remains ultimately responsible for reimbursing the Federal government, if the National Oceanic and Atmospheric Administration should request such reimbursement, for the value of the unexpired life of the property (improvements).

8. In the unlikely event that the Department for good cause chooses to withdraw from this MEMORANDUM OF UNDERSTANDING, the Department is responsible for reimbursement to the Federal government according to OMB Circular A-102 for the value of the unexpired life of the property (improvements), if the National Oceanic and Atmospheric Administration should request such reimbursement. If the Department terminates this MEMORANDUM OF UNDERSTANDING because Bard College does not make the research facility available for Estuarine Sanctuary research work and/or fails to meet other conditions of the MEMORANDUM OF UNDERSTANDING, then Bard College will reimburse the Department for the value of the unexpired life of the property (improvements). However, if the Department terminates this MEMORANDUM OF UNDERSTANDING for reasons other than those cited above, Bard College will not be liable to make reimbursement to the Department for the value of the life of the unexpired property (improvements).

9. There will be an Ecology Field Station--Sanctuary Management Committee responsible for recommending approval of outside scientists who wish to perform Sanctuary research at the Field Station. The committee will be made up of one representative each from the Department, Bard College, and the Advisory Committee of the Sanctuary on which the research will be conducted, and non-voting, ex-office representatives from the Estuarine Sanctuaries Steering Committee, the Federal Office of Coastal Zone Management, and Bard College administration.

10. This memorandum shall remain in effect so long as the Sanctuary remains in operation as a designated Sanctuary under the Federal program, and may be amended with the approval of both parties. Either Bard College or the Department may terminate this agreement with 60 days written notice.

11. For a period of three years after the termination of this MEMORANDUM OF UNDERSTANDING, the State, the Federal Government, the Comptroller General of the United States, or any duly authorized representatives shall have access, at such reasonable times and for such reasonable periods as may be mutually agreed upon, to any of the recipient's books, documents, papers and records directly to the subject matter of this MEMORANDUM OF UNDERSTANDING for the purpose of making audits, examinations, excerpts or transcripts.

12. During the term of this MEMORANDUM OF UNDERSTANDING, Bard College agrees to increase insurance on the Field Station against damage or loss by the amount expended pursuant to paragraph 2 above, and further agrees that all insurance monies received as a result of damage or loss of the Field Station be applied to the restoration of the Field Station. Bard College is not responsible for maintenance or insurance of the Department's equipment housed at the Ecology Field Station.

IN WITNESS WHEREOF, the parties have caused this MEMORANDUM OF UNDERSTANDING to be signed the day and year first above written.

BARD COLLEGE

BY _____ EXEC.

NEW YORK STATE DEPARTMENT OF
ENVIRONMENTAL CONSERVATION

BY _____

COLLEGE ACKNOWLEDGMENT

STATE OF NEW YORK)
) ss:
COUNTY OF DUTCHESS)

On the 13th day of April, 1983, before me personally came Dimitri B. Papadimitriou, to me known, who, being by me duly sworn, did depose and say that he resides in the County of New York; that he is the Executive Vice President of BARD COLLEGE, the institution described in and which executed the foregoing instrument; that he knows the seal of said institution; that the seal affixed to said instrument is such corporate seal; that it was so affixed by order of the Board of Trustees of said institution and that he signed his name thereto by like order.

Susan Howard
Notary Public
SUSAN HOWARD
Notary Public, State of New York
Qualified in Dutchess County
Commission Expires March 30, 1984
4709656

Appendix 10

CONSISTENCY WITH THE OTHER STATE AND FEDERAL MANAGEMENT PROGRAMS

Appendix 10

CONSISTENCY WITH OTHER STATE AND FEDERAL MANAGEMENT PROGRAMS

Programs and activities of the Hudson River National Estuarine Sanctuary are consistent with the goals of other government programs on the Hudson River and particularly at the Sanctuary sites, and insofar as is reasonable, consistent with private sector initiatives in estuarine research and education on the Hudson. The jurisdictions of various government agencies are listed in Appendix 8.

New York State Coastal Management Program:

The role of the New York State Coastal Management Program in maintaining environmental quality at and near the Sanctuary sites is discussed in the Administration section of this plan.

National Natural Landmarks Program:

Iona Island is a designated National Natural Landmark under the National Park Service National Natural Landmarks Program (NNLP). Tivoli Bays has been nominated and is under consideration for Landmark status. This program selects sites that best represent defined types of biological and geological features and the Landmarks are considered to have special educational and scientific value. NNLP management guidelines stipulate that the site be protected and maintained in a natural condition.

Mid-Hudson Historic Shorelands State Scenic Area:

The Mid-Hudson Historic Shorelands State Scenic Area stretches from Hyde Park to Germantown on the east bank only of the Hudson River (Figure 15), and includes the Tivoli Bays Estuarine Sanctuary site in its entirety. The Scenic Area was the first of its kind to be designated by the Commissioner of The Department of Environmental Conservation (DEC). The management plan prepared by the Hudson River Shorelands Task Force under contract to the Heritage Task Force for the Hudson River Valley emphasizes guidelines for public works activities, and voluntary cooperation by private landowners. The Plan's emphasis on historic and aesthetic preservation is compatible with the goals of the National Estuarine Sanctuary program and vice versa.

Federal "18-Mile" Historic District

The Mid-Hudson Historic Shorelands State Scenic Area approximately covers the "18-mile" federal Historic District and includes the Tivoli Bays Estuarine Sanctuary site. All

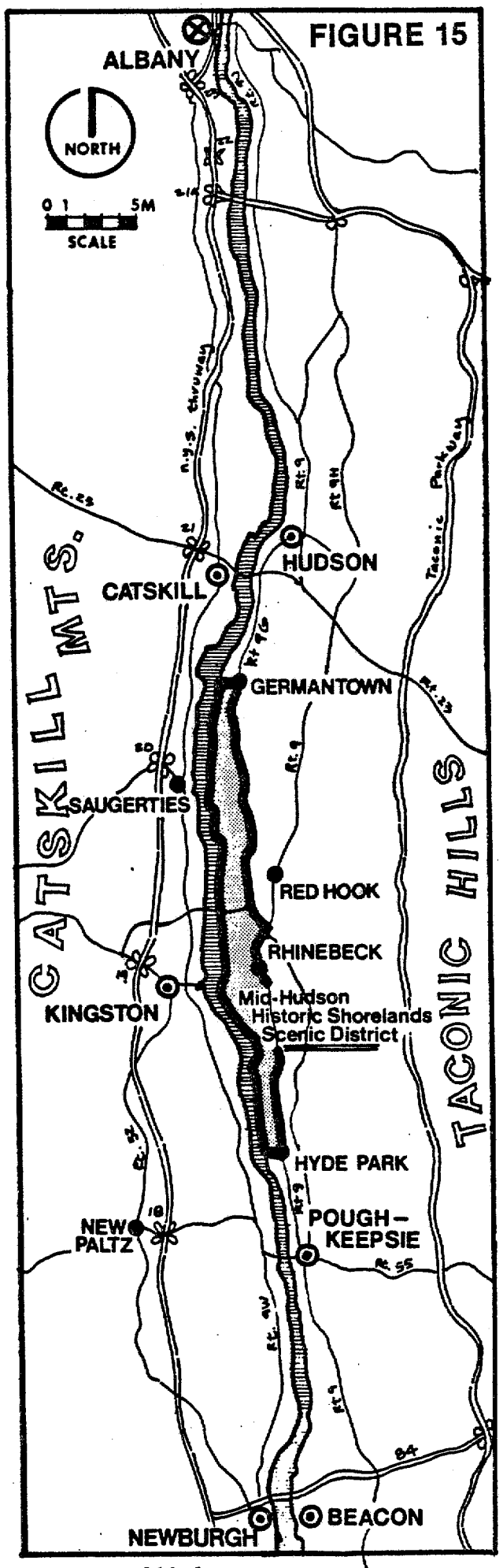


FIGURE 15
ALBANY
NORTH
0 1 5M
SCALE
CATSKILL MTS.
TACONIC HILLS
n.y.s. thruway
Taconic Parkway
Rt. 23
Rt. 9
Rt 9H
Rt 9G
CATSKILL
HUDSON
GERMANTOWN
SAUGERTIES
RED HOOK
RHINEBECK
KINGSTON
Mid-Hudson
Historic Shorelands
Scenic District
HYDE PARK
POUGH-
KEEPSIE
NEW
PALTZ
Rt 55
Rt 84
NEWBURGH
BEACON

structures in the Historic District are automatically on the Federal and State Registers of Historic Places, whether they have been specifically studied or not. This provision affects the derelict buildings on the Ward Manor property (eastern portion of Sanctuary site) and the contrived "ruins" on South Cruger Island. Permission is required from the appropriate State and Federal historic preservation agencies before modifying any of these structures. It is intended, in DEC's management plan for Tivoli, that the South Cruger Island ruins be left as is, and that all of the buildings and ruins on the upland areas be razed excepting only the ca. 1930 masonry and wood barn - the barn will be saved only if a financially self-maintaining use can be found for it. Although the barn appears to be structurally sound, the roof of the main section is in serious disrepair and all of the windows and doors are damaged; furthermore, all of the utilities and furnishings were stripped from the building before the property was acquired by DEC. The building appears to be somewhat unusual architecturally, but it is not clear to what extent it is historically valuable.

Experimental Ecological Reserve Program:

The Tivoli Bays - Bard College Field Station Experimental Ecological Reserve (EER) program is a private initiative of the Institute of Ecology at Butler University, partly funded by the National Science Foundation and national in scope. Several sites, in public or semi-public ownership represent specific types of ecosystems that are in a relatively natural condition and are considered suitable for long-term ecological research. The Tivoli Bays component (state-owned portions) was designated an EER in 1981. The designation does not bring any direct funding, nor does it impose scientific management requirements. The prestige of the program should help in attracting research scientists and grant money, much as does the National Estuarine Sanctuary program. The Tivoli Bays EER is conterminous with the Estuarine Sanctuary site and with the state ownership.

Although some EERs (e.g., Hubbard Brook Experimental Forest in New Hampshire) are well known for large-scale manipulative ecological experiments, such experiments are neither desirable at Tivoli nor consistent with Estuarine Sanctuary guidelines. DEC will not issue permits for any manipulative procedures that would damage the site for future scientific use, adversely affect rare or endangered species or communities, or seriously affect the aesthetic or recreational values of the site. However, DEC will entertain proposals for small-scale manipulations if these procedures are designed to yield valuable scientific knowledge and if serious damage would not be likely to result. Experiments that involve small-scale transplantation of marsh plants between different sites within the Tivoli Bays area or fertilization of small plots for example, might be acceptable.

Areas outside the Estuarine Sanctuary (with the permission of the owners and the appropriate government permits) could be used for other types of manipulative experiments to assess the effects or values of various management practices or simulate the impacts of various natural or artificial stresses to tidal wetlands. The effects could then be compared with results from control or reference sites on Estuarine Sanctuary sites. Procedures of this type might be useful to evaluate appropriate management techniques for the Estuarine Sanctuary sites.

Apart from manipulative experiments, EERs are also sites for long-term monitoring and measurement of biotic and abiotic components of ecosystems, and for comparisons of patterns and processes in relatively undisturbed natural areas and those more highly modified by human activities. This mission is shared by the National Estuarine Sanctuary Program.

Tivoli Bays Unique Area:

The New York State Department of Environmental Conservation prepared a draft management plan for the Tivoli Bays Unique Area. This land is managed to protect the freshwater tidal wetlands, perpetuate fish and wildlife resources, and provide the public with opportunities for research, education, and recreation. Multiple use management has traditionally accommodated hunting, fishing, trapping, research, bird watching and hiking at this site. More opportunity for research and education will be provided through the construction of trails and provision of better access.

State Park Regulations

The Office of Parks, Recreation, and Historic Preservation publishes statewide rules and regulations for all activities on state lands, including those which are regulated, prohibited, or allowed only under permit. Provisions of this management plan are compatible with these rules and regulations.

Hudson River Islands State Park, Gays Point - Stockport Middleground Management Plan:

The Office of Parks, Recreation, and Historic Preservation manages the Hudson River Islands State Park to protect natural resources and provide opportunities for low intensity public recreation, including fishing and hiking. Plans to improve public access and provide primitive facilities are compatible with sanctuary management.

Appendix 11

MANAGEMENT NEEDS OF SELECTED INDIVIDUAL SPECIES

Appendix 5

MANAGEMENT NEEDS OF SELECTED INDIVIDUAL SPECIES

Rare and Endangered Plants:

Nuttall's micranthemum (Micranthenuum micranthemoides). This species has not been seen in many years, but is believed to survive at Tivoli Bays. This species was last known from either the tidal wetland of the mouth of Stony Creek or between the northern part of Cruger Island and the railroad ("North Sinus"). Both of these areas should be stringently protected from disturbance (other rare plant species also occur in these types of environments). Because Nuttall's micranthemum is unquestionably the most endangered organism known from the Sanctuary, special priority should be given to arranging searches by competent botanists, particularly in September when it is most easily spotted.

Heartleaf plantain (Plantago cordata). This species occurs as a large population at Stockport and a small but stable population at Tivoli. This species requires shade from trees, reasonable freedom from mechanical disturbance, and good water quality. Bank erosion could eventually be a problem at Stockport, particularly on the west shore of Unnamed Island. Boat landing and any use other than research should be prohibited.

Endangered, Threatened, or Special Concern Animal Species:

Shortnose sturgeon (Acipenser brevirostrum). No specific management practices are required now. Water quality should be maintained. Information is needed on the extent to which shortnose sturgeon enter the Sanctuary sites (shallows and wetland creeks) and why.

Jefferson salamander (Ambystoma jeffersonianum), spotted salamander (A. maculatum), marbled salamander (A. opacum), and wood frog (Rana sylvatica) are species that depend on intermittent woodland pools for reproduction and larval development, and occur or could occur at the Sanctuary sites. There is concern in New York that species breeding in acidic woodland pools could be affected by acidic precipitation. All intermittent or shallow permanent pools in forest or open habitats will be protected from pollution, filling, dumping or draining, or other stresses, on the Sanctuary sites.

The northern leopard frog (Rana pipiens) has been found at the Stockport site and near the Tivoli site. The species is rare in the Hudson Valley and deserves study.

Spotted turtle (Clemmys guttata). State "Special Concern." This species is rare at Stockport and Tivoli. No specific management required.

The bog turtle (Clemmys muhlenbergi), State Endangered, and the mud turtle (Kinosternon subrubrum), State Threatened, could be found at the Sanctuary sites. The general provisions of this plan protect any potential habitat. If found, special provisions for protection of these species will be instituted.

Hognose snake (Heterodon platyrhinos), black racer (Coluber constrictor), ribbon snake (Thamnophis sauritus) and smooth green snake (Opheodrys vernalis) are all species that appear to have declined in numbers in the Hudson Valley in the last decade or two, and are found or could be found at the Sanctaury sites. Further study is required to see if specific management is needed.

Common loon (Gavia immer), double-crested cormorant (Phalacrocorax auritus), common tern (Sterna hirundo), black tern (Chlidonias niger), common raven (Corvus corax). All these species are migrants or visitants with no known threat in the Sanctuary sites. No specific management required.

Least bittern (Ixobrychus exilis). State "Special Concern." In the Hudson River estuary, requires extensive stands of cattail for nesting. Health of cattail stands should be protected.

Cooper's hawk (Accipiter cooperii) and red-shouldered hawk (Buteo lineatus). Not known to nest on the Sanctuary sites now, but potential nesting habitat is present. If either species nests in the future, appropriate management actions can be taken, possibly including closed areas around the nest sites during breeding season.

Golden eagle (Aquila chrysaetos). Very rare visitant now. It has been suggested that the fields of Iona Island might provide wintering habitat. If golden eagles ever use the Sanctuary regularly, appropriate measures can be taken to reduce habitat disturbance.

Bald eagle (Haliaeetus leucocephalus). Occasional visitor at any time of the year at any site, most often seen at times of partial ice cover. In the last few years, bald eagles have more-or-less regularly roosted on Iona Island in winter. Iona Island is closed to the public December-February to reduce potential disturbance.

Marsh hawk (Circus cyaneus). Migrant, no known nesting at Sanctuary sites. If nesting occurs, appropriate measures can be taken.

Osprey (Pandion haliaetus). Regular and persistent visitor in spring, irregular or occasional in summer and fall. Unverified reports of nesting. Further study is required to tell if erection of artificial nest platforms is justified, or if any existing or proposed Sanctuary activities might disturb osprey, especially during the spring.

Peregrine falcon (Falco peregrinus). Extremely rare visitor in recent years. Study of potential use of the Sanctuary sites is needed.

It may be appropriate to erect nesting structures for the eastern bluebird (Sialia sialis) in areas where such structures would not be esthetically intrusive, but only with predator-proof boxes.

Grasshopper sparrow (Ammodramus savannarum), Henslow's sparrow (A. henslowii), and vesper sparrow (Pooecetes gramineus). State "Special Concern." potential nesting habitat may exist at Stockport, Tivoli, and Iona, in field and oldfield type habitats. Study is required to see if these secretive birds are present, or if these secretive birds are present, or if manipulation of dry field habitats (e.g., some type of mowing or burning) could attract them to nest.

Other Species:

A small population of the Baltimore butterfly (Baltimore checkerspot) (Euphydrayas phaeton) in the tidal swamp at the Cruger Island Neck (Tivoli) depends upon its larval food plant turtlehead (Chelone glabra) for survival. Turtleheads grow on the shoulders of the Cruger Island Road causeway, in the tidal swamp at this site, along the upland margins of North Bay, and probably in the mouth of Stony Creek. Care should be taken not to disturb the turtlehead during any road maintenance at the Neck. Turtlehead and the Baltimore could also occur at Stockport.

The American brook lamprey (Lampetra lamottei), a nonparasitic species, has been found in the mouth of the Saw Kill, Tivoli South Bay. Further study is needed, and this area should be protected from disturbance (fishing is not harmful). Central mudminnow (Umbra limi) occurs in two ponds on Cruger Island (Tivoli) just above high tide level, and possibly elsewhere in the Sanctuary. These ponds should be maintained in a natural condition, and not cleared of snags or dredged. The outlet (spillway) of the North Pond is formed by an old road which should be maintained at its present level during trail maintenance operations. (Spotted salamanders also breed in these ponds.) The eastern mudminnow (U. pygmaea) occurs in Sparkill Creek; further study is needed to see if management is required. Both mudminnows are rare in the Hudson Valley although common elsewhere in their ranges. Northern hogsucker (Hupentelium nigricans) has been found in the mouth of the Saw Kill and in the mouth of Stockport Creek it needs further study to determine the significance of the Hudson River estuary population. Records of yellow bullhead (Ictalurus natalis), three-spined stickleback (Gasterosteus aculeatus) and blue-spotted sunfish (Enneacanthus gloriosus) from Iona Island Marsh require verification; these may be regionally rare species.

The cerulean warbler is a species of special interest to bird-watchers; it breeds at Tivoli in some years and can be found at the other sanctuary sites. Patches of forest with large hardwoods near water or wetland appear to be the requirement for this species.

Evidence of nesting by great blue heron and black-crowned night heron should be watched for. If these species nest, disturbance buffer zones may be indicated.

Other marsh-nesting birds (American bittern, king rail, Virginia rail, sora, common gallinule, long-billed marsh wren, short-billed marsh wren) require particular plant communities, usually graminoids, for breeding on the Hudson. Maintenance of healthy cattail stands and other graminoid communities is needed to preserve habitat for these birds.

Muskrat populations have been low in the Sanctuary in the last few years. Further study is recommended to identify any special problems affecting muskrats in the Hudson estuary apart from normal population fluctuations.

Study is needed to determine whether PCB affects the survival of mink and river otter in the Hudson River estuary.

Extensive, nearly monospecific stands of narrowleaf cattail (Typha angustifolia), wild rice (Zizania aquatica), and water-celery (Vallisneria americana) are valuable communities characteristic of high quality freshwater tidal marshes in the Virginian biogeographic region. These stands need study to determine what factors control their structure. Meanwhile, mechanical disturbance (e.g., over-trampling, construction, fill, channelization) in these community types should be avoided to reduce the risk of invasion by introduced species of vascular plants.

Certain species of introduced vascular plants may require management to prevent their becoming overabundant and replacing native vegetation in special habitat types. Among the species that are of most concern are purple loosestrife (Lythrum salicaria), water-chestnut (Trapa natans), multiflora rose (Rosa multiflora), turasian water-milfoil (Myriophyllum spicatum), Bell's honeysuckle (Lonicera bella), Japanese honeysuckle (L. japonica), and yellow iris (Iris pseudacorus). The best protection is to prevent all unnecessary mechanical disturbance to natural soil and vegetation. Water-chestnut (Trapa natans) is too abundant in Tivoli South Bay for control at the present time. However, in North Bay and possibly at Stockport it could be easily controlled by hand-pulling in early July before seeds mature. This can be done at North Bay working at low tide by canoe.

Appendix 12

SELECTED OFF-SITE TIDAL WETLANDS

Appendix 12

SELECTED OFF-SITE TIDAL WETLANDS

Selected off-site tidal wetlands, USGS sheets, believed ownership, and possible guides. The "possible guides" are persons familiar with the wetlands, not necessarily scientists, and who may not have been contacted in this capacity. Refer to Figure 16 for locations.

1. Schodack complex

   USGS Delmar, Ravena; Jim Dunn

2. Papscanee Creek Complex

   USGS Delmar, East Greenbush; largely private?; Paul F. Connor, Robert McLean

3. Mill Creek Swamp

   USGS Ravena; private?

4. West Flats

   USGS Hudson North; private?; Robert McLean, Everett Nack

5. Hudson Bays (North Bay, South Bay)

   USGS Hudson North, Hudson South; Doug Carlson, Erik Kiviat, Joe Murell, Everett Nack

6. Rogers Island Complex

   USGS Hudson South; largely public; Everett Nack

7. Catskill - Ramshorn - Livingston Complex

   USGS Hudson South; private (incl. National Audubon Society); Everett Nack, Jim Rod

8. Inbocht Bay - Duck Cove

   USGS Cementon; largely private?; Everett Nack

9. Saugerties marshes

   USGS Saugerties; largely public?

10. Kingston Point - Sleightsburg marshes

    USGS Kingston east; largely public?; Paul Huth, Al Brayton

11. Vanderburgh Cove

    USGS Kingston East, Hyde Park; largely public; Bill Jacobs, Erik Kiviat

    small wetlands between Vanderburgh Cove and Tivoli Bays, east shore only

    USGS Kingston East, Hyde Park; largely private; Erik Kiviat

12. Fishkill Creek

    USGS West Point; private?

13. Moodna Marsh - Cornwall Bay

    USGS Cornwall; private & public; Paul Jeheber, Beth Yanuck-Platt

14. Constitution Island Marsh

    West Point; private & public; Edward H. Buckley, Walter S. Newman, Samuel Ristich, Jim Rod, Robert H. Boyle, Michael Selender

15. Con Hook Marsh

    USGS Peekskill; private; Edward H. Buckley, Walter S. Newman, Samuel Ristich

16. Manitou Marsh

    USGS Peekskill; private?; John Cronin, Edward H. Buckley, Samuel Ristich

17. Peekskill Bay complex

    USGS Peekskill; public (& private?); Edward H. Buckley

18. Grassy Point - Haverstraw - Minisceongo complex

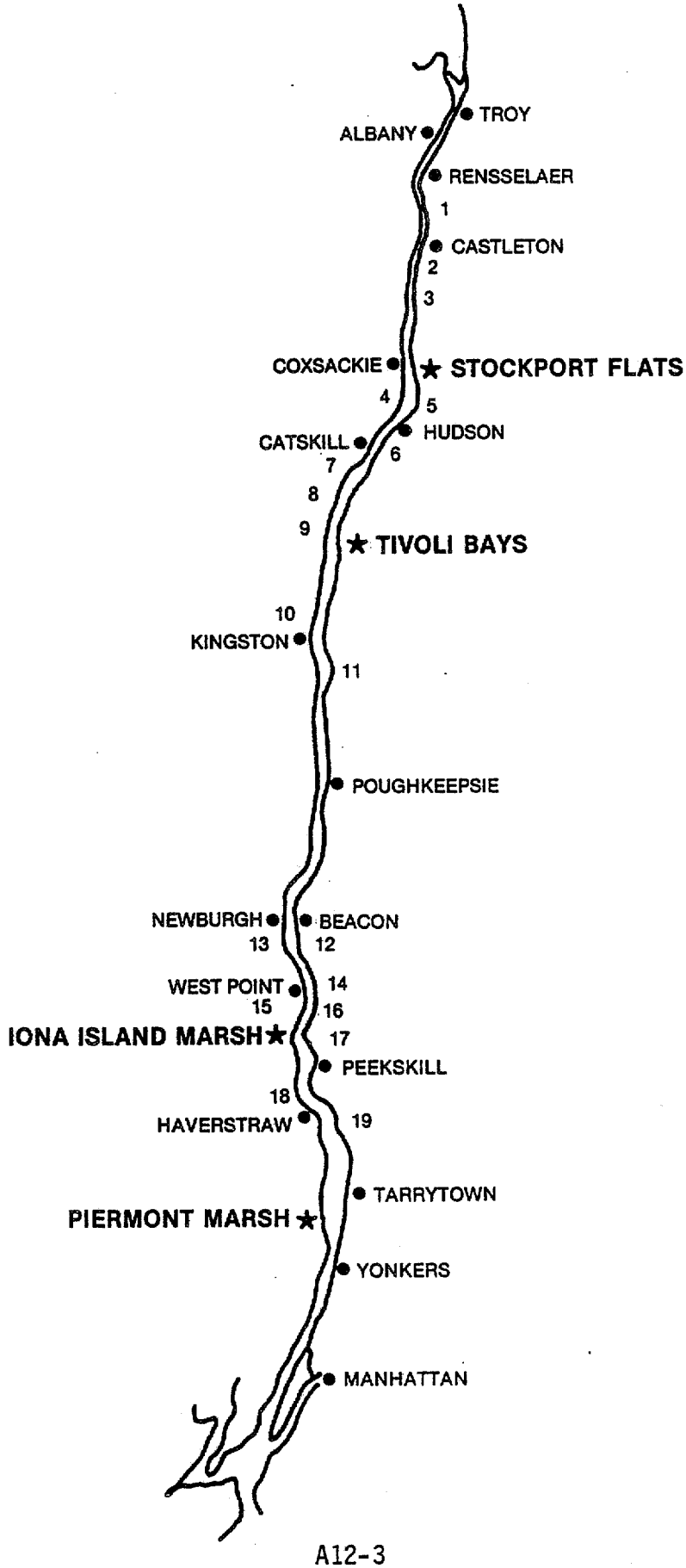
    USGS Haverstraw; private; Edward H. Buckley, Jack Focht, Tom Corette, Zipporah Fleischer, Alan Gussow, Samuel Ristich

19. Croton Point - Croton River complex

    USGS Haverstraw, Ossining; mostly public; Robert H. Boyle, Edward H. Buckley, Samuel Ristich, Michael Selender, John Muenzinger

FIGURE 16

LOCATIONS OF SELECTED OFF-SITE TIDAL WETLANDS NEAR HUDSON RIVER NATIONAL ESTUARINE SANCTUARY SITES AND SELECTED MUNICIPALITIES.



Appendix 13

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Appendix 13

BIBLIOGRAPHY AND LITERATURE CITED

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Appendix 14

CURRENT RESEARCH AND MONITORING ACTIVITIES ON THE HUDSON RIVER ESTUARY

Appendix 14

CURRENT RESEARCH AND MONITORING ACTIVITIES ON THE HUDSON RIVER ESTUARY.

PHYSICAL:

Tide stage - measured by U.S. Geological Survey (USGS) at a few Hudson River estuaries, although none are at Sanctuary sites.

Freshwater discharge - measured by USGS at Green Island (Troy).

Water Quality - sampled by New York State Department of Environmental Conservation (DEC) at several Hudson River stations, including one at Bear Mountain.

Weather - measured by cooperating weather stations located close to estuary at several locations including Albany, Kingston and West Point. There are no official stations on sites; Bard College has an unofficial weather station at the Field Station.

Air quality - sampled by DEC or New York State Department of Health (DOH) at a few selected locations near the Hudson River.

Seismic activity - monitored at Lamont-Doherty Geological Observatory where research is conducted on activity of Ramapo Fault.

Geology - mapped at NYS Museum by R. Dineen and others.

Soils - mapped by U.S. Soil Conservation Service, counties are at various stages of completion (see Secor et al.).

Marsh geology - data from sediment borings including microfossil analyses. Much work done at Iona and Piermont, and also at other wetlands including Tivoli, by Walter S. Newman (Newman et al. 1969 and unpublished data.

Survey and analysis of sediments in Tivoli Bays - Wesley Krawiec (planned).

Sedimentation history of marshes - Walter S. Newman (particularly Iona Island, Piermont; also Tivoli and others).

ENDANGERED SPECIES:

Distribution and abundance of rare or endangered species of animals and plants - monitored (only the rarest species) by DEC (animals) and the NYS Museum (vascular plants).

FLORA:

Vegetation mapping: conducted on several lower-estuary marshes including Piermont and Iona for several years in 1970s by E. H. Buckley (in preparation for publication).

Semiquantitative study of vegetation patterns in Tivoli Bays and several smaller marshes on the Dutchess County shore - Kiviat (1978) and unpublished data.

Flora of Iona Island Marsh - Jack Focht (in progress).

Vegetation and breeding birds of a small fresh-tidal swamp near Tivoli Bays (Mudder Kill) - Erik Kiviat (report in preparation).

Natural history and ecology of purple loosestrife - mostly Tivoli, including vegetational role, relation to muskrats, and associated insect communities (E. Kiviat, Nancy Zeising).

Annual surveys of the extent of water-chestnut infestations - DEC.

FISH:

Fish occurrence records - maintained by C. Lavett Smith (American Museum of Natural History) and C. Allen Beebe (Dutchess County Community College Norrie Point Lab).

Fisheries surveys and stock assessments - conducted by DEC and by the electrical utilities on a limited basis.

Commercial fishing - monitored by DEC.

REPTILES AND AMPHIBIANS:

Reptile and amphibian occurrence records - maintained by Erik Kiviat (Hudsonia).

Snapping turtle population in Tivoli North Bay - tagged turtles studied 1972-75 are still monitored by E. Kiviat.

BIRDS:

Bird occurrence records - maintained by Alan Devoe Bird Club (Stockport and Columbia Co. shores), Ralph T. Waterman Bird Club (Tivoli and Dutchess Co. shores), Rockland Audubon Society (Iona and Piermont, Rockland Co. shores), and other programs.

"May Census" bird counts - Dutchess County-wide, annual mid-May one-day survey; Tivoli Bays covered by E. Kiviat et al. (Ralph T. Waterman Bird Club). Published summaries not broken down by areas but unpublished data available.

Mid-winter aerial waterfowl surveys - flown annually in January by DEC statewide, including a route along the Hudson River.

Christmas bird counts - coordinated by National Audubon Society at a few localities along the Hudson River (count totals are not broken down into estuarine and non-estuarine habitats).

New York State Breeding Bird Atlas - a 5-year project (begun in 1980) to map the distribution of breeding bird species in 5-km square blocks over entire state. Coverage includes Piermont, Iona, and Tivoli.

Breeding birds and vegetation of the railroad right-of-way at Tivoli North Bay and Vanderburgh Cove (Dutchess Co.) - surveyed yearly on two 2-km strips (starting in 1978) by Jim Stapleton and Erik Kiviat of Hudsonia.

Behavioral ecology of long-billed marsh wren - observations made at Tivoli North Bay by Donal Kroodsma (unpublished data).

MAMMALS:

Muskrat lodge counts - made from 1980 oblique color airphotos, E. Kiviat (unpublished data).

Statewide aerial muskrat lodge counts - flown each winter by DEC, including a section of the upper estuary from Stockport to Albany.

OTHER FAUNA:

Xerces Society Annual Butterfly Count - began 1982 at Tivoli Bays by Spider Barbour and Erik Kiviat of Hudsonia.

Survey of mollusks at Tivoli Bays and Stockport areas - Erik Kiviat, R. E. Schmidt, Douglas G. Smith (in progress). Specimens at Bard College Field Station and Museum of Comparative Zoology.

CONTAMINANTS:

Levels of PCBs, selected metals, and a few other contaminants in fish - monitored annually be DEC on large samples of a few species.

Toxic substances in muskrats - under the study at Tivoli and other localities by DEC (Shawn Keeler, Ward Stone, Ron Sloan).

Toxic substances in fish and sediments - a few samples have been analyzed from Tivoli (DEC, Shawn Keeler).

Toxic substances in sediments, vascular plants, small animals - samples from four sites within the Estuarine Sanctuary being analyzed (DEC, Hudsonia).

Toxic substances - movement and distribution in Estuary, various studies by H. J. Simpson, and others at Lamont-Doherty Geological Observatory, including samples from Piermont Marsh.

Metals in vascular marsh plants - preliminary measurements by Michael Selender (unpublished data), including samples from Iona and Piermont.

Metals partitioning in subtidal and intertidal vascular plants - grant proposed by Cornell University.

Appendix 15

SURVEY, ENVIRONMENTAL MONITORING, AND RESEARCH PRIORITIES OF THE HUDSON RIVER NATIONAL ESTUARINE SANCTUARY

APPENDIX 15

SURVEY, ENVIRONMENTAL MONITORING, AND RESEARCH PRIORITIES OF THE HUDSON RIVER NATIONAL ESTUARINE SANCTUARY RESEARCH PROGRAM

HIGHEST PRIORITY

Surveys:

- Algae, including those species associated with mud and plant surfaces.
- Flora of tidal swamps.
- Microbiota of estuarine habitats.
- Insect fauna of intertidal marshes.
- Macrobenthic invertebrates.
- Amphibian and reptile fauna, especially at Stockport and Piermont.

Environmental Monitoring:

- Water quality, with monthly sampling of tributary mouth, river channel, shallows, and marsh creek for coliform bacteria, dissolved oxygen, BOD, nitrogen and phosphorus species, pH, alkalinity, salinity, conductivity, and dissolved and suspended solids at all sites.
- Weather patterns at Bard College Field Station and at the Trailside Museum, in cooperation with the U.S. Weather Bureau.
- Tide, using continuous recording gauge at Tivoli Bays.
- Vascular vegetation, using oblique color airphotos taken every five years, ground truthing as needed.
- Waterfowl use of wetland habitats at all sites.
- Muskrat lodges in intertidal marshes at all sites, using late fall and winter aerial photos with ground truthing.
- Sanctuary user numbers and activities.

Research:

- Role of tidal wetlands and shallows in spawning, nursery, and feeding activities of fishes.
- Ecology and management of federally endangered flora and fauna.
- Sources and cycling or toxic substances in tidal wetlands; effects on flora and fauna.
- Muskrat population biology.
- Microbiology and chemistry of surface scums.

HIGH PRIORITY

Surveys:

- Patterns, community composition, and quantitative surveys of vascular vegetation in Stockport and Tivoli estuarine habitats.
- Vascular vegetation of the upland-estuarine edge habitats at all components.
- Invertebrate fauna of all estuarine habitats.
- Amphibians and reptiles, particularly at Stockport and Piermont.
- Quantitative sampling of birds.
- Mammals, particularly at Stockport and Piermont in estuarine and upland habitats.

Environmental Monitoring:

- Toxic substances in selected plant and animal species at all components for PCBs, organochloride pesticides, herbicides, 13 elements of health concern, petroleum, heavy metals, and metal-like elements.
- Macrobenthic invertebrates at permanent stations in marshes, shallows, and stream mouths at all components.
- Seasonal sampling of fish at permanent stations in marsh creeks, shallows, tributary stream mouths at all components.
- Breeding bird communities in various estuarine habitats at all components, and on Tivoli railroad causeway.

Research:

- Nutrient budgets of wetlands and patterns of nutrient exchange between wetlands and associated ecosystems.
- Role of terrestrial and aquatic plant detritus in nutrition of estuarine organisms; role of individual species in detritus food chains.
- Species composition and biomass production in Hudson River compared to other estuaries.
- Ecology of major estuarine plants, including primary wildlife food plants (cattail, wild rice, water-celery), introduced plants (purple loosestrife, water-chestnut, Eurasian watermilfoil, yellow iris), and other major plants (spatterdock, common reed, cordgrasses, swamp rose mallow).
- Mitigation of channel maintenance and dredge spoil disposal; development of vegetation and wildlife populations on dredge spoil.

High Priority Research: (cont'd.)

- Management of shoreline erosion.
- Role of wetland environments as sinks for nutrients and waste substances.
- Patterns of estuarine circulation and transport of sediment and toxic substances.
- Techniques for wetland creation.
- Role of tidal wetlands and shallows in resting, feeding, breeding, and wintering activities; role of Hudson River compared to other flyways.
- Role of benthic and planktonic invertebrates as fish and wildlife food and in sediment processes and nutrient cycling.
- Comparitive studies of habitats and processes in the Sanctuary to comparable sites in more human perturbed systems.
- Role of killifishes in estuarine food webs and the effects of baitfishing on killifishes.
- Snapping turtle ecology, behavior, and use as an indicator species for toxic substances.
- Role of microbial communities in ecosystem processes.
- Blue crab life history and ecology.
- Feasibility of reestablishing shellfisheries in estuary.
- Impacts of sanctuary visitors on wildlife, vegetation, and soil.
- Lead shot leaching, circulation, and accumulation patterns.
- Manipulative studies (outside sanctuary) on effects of wetland, shoreline, pest, wildlife, and railroad management practices on estuarine habitats.
- Geological character and history of wetland sediments; vegetation history of wetlands.

Appendix 16

SAMPLE RESEARCH PROPOSAL FORM

APPENDIX 16

SAMPLE RESEARCH PROPOSAL

Telephone No. _____ Date _____

NAME OF PRINCIPAL INVESTIGATOR _____

AGENCY AFFILIATION _____

NAMES OF PERSONS CONDUCTING FIELD WORK:

_____ _____

_____ _____

_____ _____

_____ _____

FUNDING AGENCY _____

ADDRESS _____

Describe the objectives of the proposed study and how they relate to the management of the Sanctuary and other coastal resources (use additional pages if necessary):

Explain methods, materials, and equipment to be used:

Will any equipment be left on site for the duration of the investigation?
( ) YES ( ) NO Please explain:

Has an on-site visit been conducted? ( ) YES ( ) NO

Will the investigation require the removal of plants or animals? ( ) YES ( ) NO

Have all the necessary collection permits been obtained?
( ) YES ( ) NO (see notice below)

DURATION OF THE STUDY:

Starting Date _____

Completion Date _____

Using Sanctuary maps available from Sanctuary Manager, please indicate (x) the areas within the Sanctuary to be used for the investigation. Give dimensions of study plot in a sketch if necessary.

NOTICE: COLLECTION PERMITS MAY BE REQUIRED FOR PLANTS AND ANIMALS; SEE SANCTUARY MANAGER

_____ _____
PRINCIPAL INVESTIGATOR DATE

_____ _____
SANCTUARY MANAGER DATE

_____ APPROVED _____ DENIED

_____ APPROVED WITH SPECIAL CONDITIONS (Attached)