3. FRANKLIN DELANO ROOSEVELT PARK MASTER PLAN

Fairmount Park System

Natural Lands Restoration

Master Plan

FDR Park, originally named League Island Park, was designed by the Olmsted Brothers who were nationally known for their innovative park designs, and was the home of the Sesquicentennial.

3.A. TASKS ASSOCIATED WITH RESTORATION ACTIVITIES

3.A.1. Introduction

The project to prepare a natural lands restoration master plan for Franklin Delano Roosevelt (FDR) Park began in October 1997. Numerous site visits were conducted in FDR Park with the Fairmount Park Commission (FPC) District #2 Manager and staff, community members, staff of the Natural Lands Restoration and Environmental Education Program (NLREEP), and ANSP staff. Informal meetings at the Park's district office were held to solicit information and opinions, and ANSP participated in the NLREEP Technical Advisory Committee (TAC) meetings in March and October 1998. These meetings were used to solicit ideas and develop contacts with other environmental scientists and land managers. A meeting was also held with ANSP, NLREEP and FPC engineering staff to discuss completed and planned projects in, or affecting, the natural lands in FDR Park. A variety of informal contacts, such as discussions during field visits provided additional input.

ANSP, NLREEP and the Philadelphia Water Department (PWD) set up a program of quarterly meetings to discuss various issues of joint interest. These meetings are valuable in obtaining information useful in planning restoration and in developing concepts for cooperative programs. As a result of these meetings, PWD staff reviewed the list of priority restoration sites proposed for FDR Park.

3.A.2. Community Meetings

As part of the planning process, NLREEP held two community meetings and conducted a community mapping initiative to solicit citizen attitudes and information on park use and conditions. ANSP participated in these activities and used information from them in planning restoration activities.

The first meeting on the restoration of the natural lands of FDR Park, held on 28 October 1999, introduced the public to NLREEP and the project. The goals of NLREEP were identified, and the ANSP was introduced as the consulting team hired to assess the natural areas of the park and recommend areas to be restored. At this initial meeting, the existing conditions of the park were summarized, based on ANSP's year-long study of natural conditions. Slides of the fauna and flora of the park were shown, and natural areas of high quality were identified. Current environmental problems in the park were identified and explained, and the types of restoration activities which were being considered to address these issues were discussed. The initial list of proposed restoration activities and a draft map of restoration sites were distributed. The sites were categorized into habitat types and their function in the environment was explained to the public. After the ANSP presentation, ANSP team members met with residents to gain information about how they use the park, to obtain feedback on proposed restoration activities and to solicit suggestions for additional sites or activities. These comments from the participants were noted and used in the final site nomination process.

The final meeting with the community on FDR Park, held on 13 January 2000, focused on the recommended high priority restoration sites. The sites proposed for restoration were summarized with pictures depicting areas to receive restoration. The team also commented on what the sites might look like after the restoration work was completed. Slides of comparable restorations in other places were shown. ANSP took the final comments from the public and made necessary adjustments to the restoration site nomination list. At this point the list was finalized and delivered to NLREEP.

3.A.3. Community Mapping

In an effort to further involve community members in the restoration planning process and to augment the technical information about the park system's natural environments prepared by the

ANSP, NLREEP undertook a “community mapping” initiative in FDR Park. The idea of community mapping was to actively engage residents of the neighborhoods adjacent to FDR Park in helping FPC staff and the ANSP team members better understand how the park is used, both currently and historically. The purposes of the community mapping initiative were:

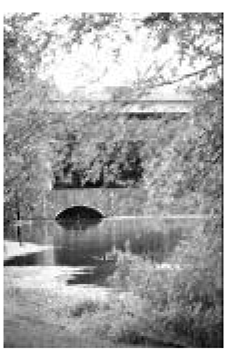
- To increase the effectiveness of restoration activities within the park.
- To increase the FPC staff awareness of the community’s use of the park.
- To increase the community’s understanding of the park’s natural areas.
- To better inform decision-making about which restoration activities should occur and where.

The community mapping initiative occurred in the fall of 1999 and involved interested neighbors, led by FPC staff, in walks through sections of FDR Park. Participants noted human impacts on the park by mapping key indicators of use, such as trash, graffiti and invasive vegetation. During the mapping initiative, community members also noted other positive and negative uses of FDR Park. Specific results of the community mapping initiatives were provided to the ANSP to aid in the selection of potential restoration sites and activities. A general overview of the way the park is used, as determined by the mapping exercises, was shared with community members at the public meetings about natural lands restoration activities in FDR Park.

3.B. FDR ASSESSMENT AND RESTORATION PLANNING

3.B.1. Executive Summary

Franklin Delano Roosevelt (FDR) Park comprises 348 acres, which includes a 146-acre golf course, about 125 acres in buildings and managed landscapes, and approximately 77 acres of natural lands including the ponds and lagoons. The park, designed by Olmsted Brothers, the firm of Frederick Law and John C. Olmsted, is a green oasis among the industry and neighborhoods of south Philadelphia. The park design has been modified to incorporate buildings (many from the Sesquicentennial Exposition in 1926) and recreational fields. Park land was also used for the construction of stadia and Interstate 95. The park provides a mix of active and passive recreation centered on the ponds and lagoons (see Base Map, Section 3.F). The waterbodies, the patches of woods, meadows and wetlands, and the horticultural plantings provide habitat for a variety of plants and animals. FDR Park is located on the Coastal Plain, a hydrographic province which includes extreme southeastern Pennsylvania and southern New Jersey. The Coastal Plain supports different plants and animals than the adjacent Piedmont of Pennsylvania. Because of extreme development of the Coastal Plain in Pennsylvania, many of these distinctive plants and animals are rare in the state.



Culvert to tide gate.

FDR Park

The ponds and lagoons are remnants of the tidal marsh and channel system which originally occupied the area between the Schuylkill and Delaware rivers. Diking, draining and filling of these marshes probably started with the first settlement of the area by the Swedes in the early 17th century, culminating in the installation of a tide gate which restricts most tidal flow between the park waters and Delaware River. The tide gate is designed to permit drainage from the park while preventing inflow; however, because of incomplete sealing, some tidal exchange does occur.

Soundings of water depth and sediment accumulation (above the concrete liners) were made in the main park ponds. The maximum water depth recorded in Edgewood Lake was about 4 ft. Soft sediments were relatively thin near shore, but were up to 6.5 ft deep farther from shore. The deepest sediments were found in the northwestern part of the lake. Pattison Lagoon was very shallow, with a maximum depth of about 1.5 ft. In contrast, South Meadow Lake had relatively little sediment (maximum depth less than a foot). Water depths of up to 4 ft were recorded. The surface sediments were apparently anoxic and supported few benthic invertebrates. Soft sediment in the ponds consists of organic (leaves, etc.) and inorganic (e.g., sand and clay) material washed in from the park and from the storm sewer outlet to Pattison Lagoon, and organic material produced in the ponds (e.g., decaying portions of algae and higher plants). Sediment samples showed high concentrations of nutrients. Metal concentrations were moderately high, consistent with urban sources (storm sewers, etc.).

Algal samples indicate extreme eutrophication (overproduction due to high nutrients; see Glossary) of Edgewood Lake and Pattison Lagoon, as evidenced by high densities of nitrogen-fixing and other blue-green algae. This can lead to reductions in dissolved oxygen and lower quality food for aquatic organisms.

Two species of state-listed endangered plants (*Heteranthera multiflora* and *Echinochloa walteri*) grow along the edges of Hollander Creek and Edgewood Lake. In the Delaware Basin, these plants typically grow in intertidal areas, suggesting the importance of the limited tidal exchange in FDR Park. While the ponds and lagoons support a variety of aquatic plants, the flora is diminished from that which once grew in the mix of tidal marshes, channels, tidal shores, and nontidal marshes which historically occurred in the area.

Excluding the ponds, most of the 45 acres of natural land in FDR Park is located in the southern part of the golf course and north of I-95; these comprise woods, wetlands, old fields and shrub areas. The forest community is a mixture of exotic horticultural and native species. The area along Hollander Creek has the highest quality woods, while areas to the west are dominated by exotic species and affected by dumping of logs and trash.

The park proper is almost entirely landscaped with large specimen trees (both native and exotic species), and natural vegetation is present mainly in and around the ponds. North Meadow Lake is a cattail marsh which appears to be functioning as good habitat for waterbirds.

Because of the large amount of mowed and built land in the park, it does not support high densities of resident wildlife. However, it is extremely valuable for the relatively rare species that occur. For example, some of the breeding birds present in FDR Park are rare or absent from other parts of the Fairmount Park system. The red-bellied turtle, a state-listed threatened species, also occurs in ponds in the park. The ponds also support a variety of fish, including a number of recreationally important species.

Using the information derived from the inventory, other data, and input from the community and FPC staff, potential restoration activities at various sites were considered. Restoration options were evaluated with respect to expected ecological benefits, other benefits, likelihood of success, constraining factors and costs. These criteria were used to prioritize activities and develop groups of restoration sites. Two public meetings were held at different stages of the project to inform the community of assessment results, discuss potential restoration activities and sites, and to present the recommended restoration activities. Ideas and feedback were sought during each meeting. In addition, members of the community provided information on the park and assessed conditions during the community mapping component.

Because of the other activities at the park, the small area of natural lands, and the degree of modification of the pre-existing landscape, the main goal of natural lands restoration in FDR Park is enhancement of existing resources. Target groups which can be enhanced by restoration activities include:

- Aquatic animals, e.g., fishes and macroinvertebrates. Restoration of the pond-creek system to a full tidal regime is not feasible given the structures within the park. However, several activities would enhance the ecological value of the ponds and lagoons. Because of the link between this pond-creek system of the park and the Delaware Estuary, these enhancements would be of regional importance.
- Intertidal plants. Maintenance and possibly enhancement of the state-designated rare plants in the park are important objectives.
- Native vegetation. Expansion of the few small patches of native vegetation and replacement of the exotic-dominated patches with native plants would be beneficial, particularly because of the paucity of natural lands in the Coastal Plain of the city. This vegetation will provide habitat for a variety of animals, as well.
- Birds. The park already serves as an important breeding, migratory and wintering area for land and water birds. These functions can be enhanced by increasing natural lands, enhancing woods, and by wetland enhancement.

The recommended projects encompass virtually all the existing natural lands of FDR Park. Some expansion of natural lands is recommended, so the restoration is expected to greatly enhance the quantity and quality of natural habitats in the park.

Pattison Avenue Lagoon.

FDR Park

Two large projects were identified: dredging parts of Edgewood Lake and Pattison Lagoon, and removing the swimming pool and restoring the southern part of South Meadow Lake. It is recommended that these projects be coordinated with other groups, because of their size, anticipated cost and complexity.

While restoring tidal flow to the park is infeasible, changes in the tide gate to allow more tidal exchange could benefit the flora and fauna of the park. Since the tide gate is located outside the park (in the Philadelphia Naval Yard), any change in structure or operation would require coordination with other agencies.

Other recommended restoration activities focus on the ponds in FDR Park proper. These include invasive control (especially in North Meadow Lake), trash removal, and riparian management. These activities would enhance aquatic vegetation (including several plant species which are rare in the state) and increase the amount of wooded riparian zones, while maintaining vistas and lake access. Increasing the amount of tree and shrub vegetation in other parts of the park (particularly along the east edge) is also recommended.

The southwestern part of the park provides a major opportunity for natural land restoration. While this area has some wetland patches and supports a variety of native species, much of the area is dominated by exotic species. Dumping of trash and logs also reduces its natural value. Recommended activities in this area include control of exotic and invasive plants, trash removal, and replanting of native species. Part of the area could be an appropriate site for creation of a wetland. Because of the potential expense of that project, it is likely that wetland creation would depend on obtaining additional funding.

Several projects would enhance natural value of the golf course proper. These include creating riparian buffers along Shedbrook Creek where these would not interfere with golf course operation, and enhancement of wetland areas within the course. Part of the golf course is currently maintained as old fields and small patches of woods. These areas support wildlife and it is recommended that these areas be maintained.

Reintroduction of aquatic plants formerly occurring in the area can be done as part of restoration and replanting. There are also some opportunities for reintroduction of fish or amphibians in the park, especially if new wetlands are created. These faunal introductions could be implemented after evaluation of the success of habitat enhancement.

Overall, FDR Park has potential for many restoration projects which range from simple tasks such as infrequent mowing and planting, which can improve the diversity of native vegetation, to more complicated projects such as lake dredging or wetland creation. The presence of several species which are rare in the state (including state-listed species) highlight the natural value of the park. The location of the park on the Coastal Plain and the limited natural lands in this part of the city make enhancement of the park an important part of natural lands restoration in the city.

3.B.2. **Introduction**

FDR Park is part of FPC Operations of Landscape Management Division's District 2 of the Fairmount Park system, which is also responsible for street trees in Center City and the southern section of the city. The park comprises 348 acres, including a 146-acre golf course, about 125 acres in buildings and managed landscapes, and approximately 77 acres of natural lands including the ponds and lagoons. As seen from the air (Fig. 3.B.1) the park is a green oasis among the industry and neighborhoods of south Philadelphia. What appears to be a pastoral setting, with sports fields juxtaposed with natural groupings of trees, is in fact a highly designed landscape. The ponds, lagoons and streams form the major visual focus and are remnants of an intricate estuary system which has been systematically filled over the past 200 years.

The neck between the Schuylkill and Delaware rivers was a much different place before European settlement. Early maps (Penn and Holme Map of 1682, located in the archives of the American Swedish Historical Museum) show the area as marsh with numerous tributaries draining what appears as a large tidal marsh which ran up the mouth of the Schuylkill River to Kingsessing (Bartram Gardens). Several large channels formed the mouth of the Schuylkill, a name which means "hidden river" because of their inconspicuous nature. Several islands were formed by these channels and the main Delaware River, including Hog Island to the west of the Schuylkill River (part of which is now occupied by the Philadelphia International Airport) and League Island to the east of the Schuylkill (now the site of the Philadelphia Naval Yard). Greenwich Island lay east of the Schuylkill River and north of League Island, i.e., encompassing part of the current site of FDR Park and the area east of the park (Figures 3.B.2 to 3.B.10).

The upper Delaware Estuary (Philadelphia to Trenton) has a tidal range of approximately 2 m (about 6 ft). Tidal freshwater marshes were extensive along the mouths of the many streams which fed the Delaware from about Chester to Trenton. Although much reduced in extent, the Delaware still contains some of the largest areas of freshwater tidal marsh in the country. Remaining marshes (e.g., around the Christina River in Delaware, Neshaminy Creek in Bucks County, Pennsylvania, and Woodbury and Crosswicks creeks in New Jersey) and historical accounts (e.g., ANSP herbarium records, Barton 1818) give an idea of the likely aspect of the tidal marsh around south Philadelphia.

Larger channels would have contained water throughout the tidal cycle, with a 6-ft range in depth. The surface of the marsh would be flooded at high tide and drained at low tide. The marsh would have been dissected by a maze of smaller channels, which would have been dry or reduced to pools and trickles at low tide, and flooded at high tide. Since these marshes would have been fresh water, they would have had different vegetation than the tidal salt marshes of the lower Delaware Bay. The subtidal channels (areas permanently under water) probably supported a variety of

Figure 3.B.1. As seen from the air, FDR Park is nestled between industry, sports complexes and neighborhoods in the densely populated part of south Philadelphia.

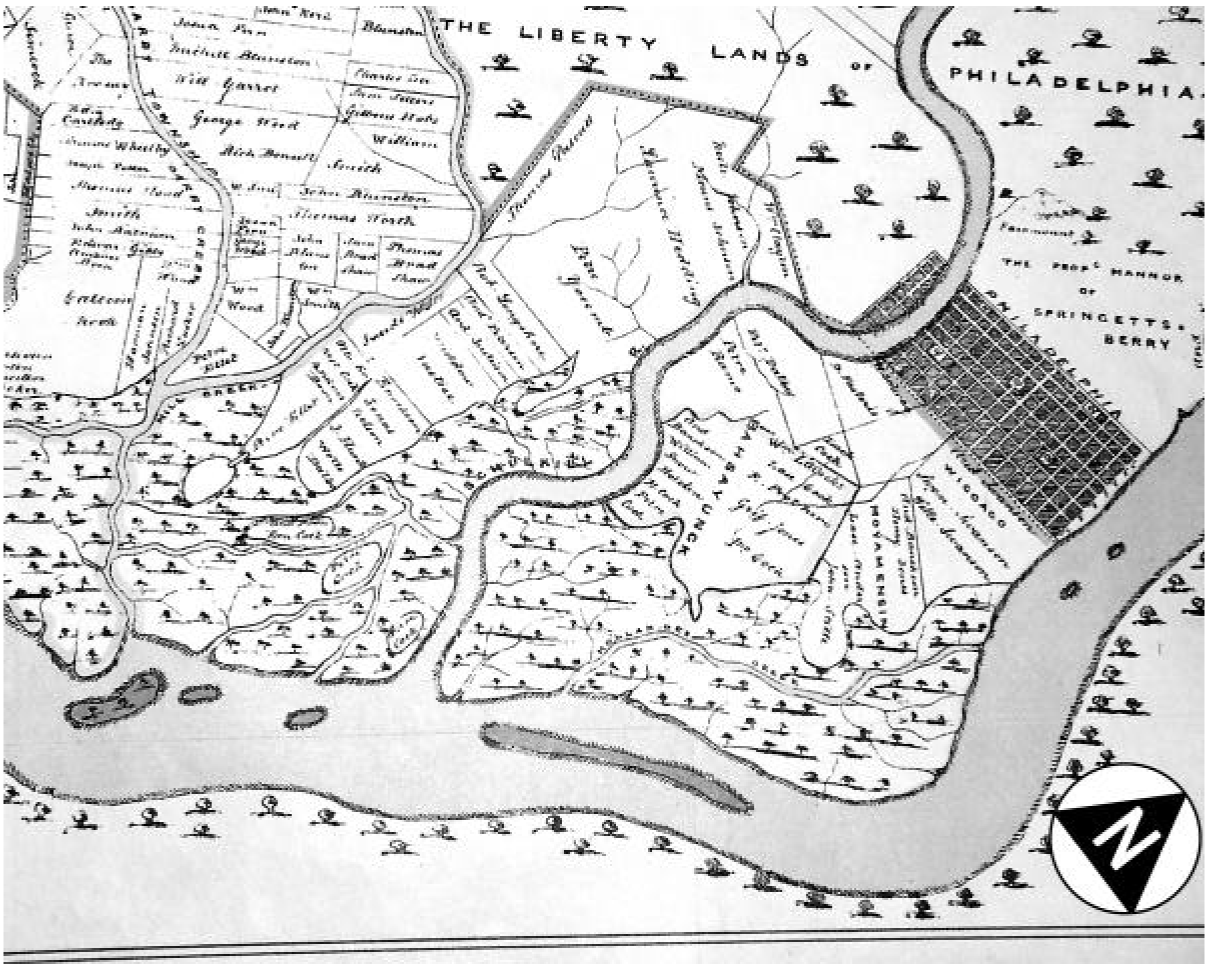


Figure 3.B.2. A map of the improved parts of the province of Pennsylvania in 1681 by Thomas Holme showing the large tidal marsh at the neck of the Schuylkill River.

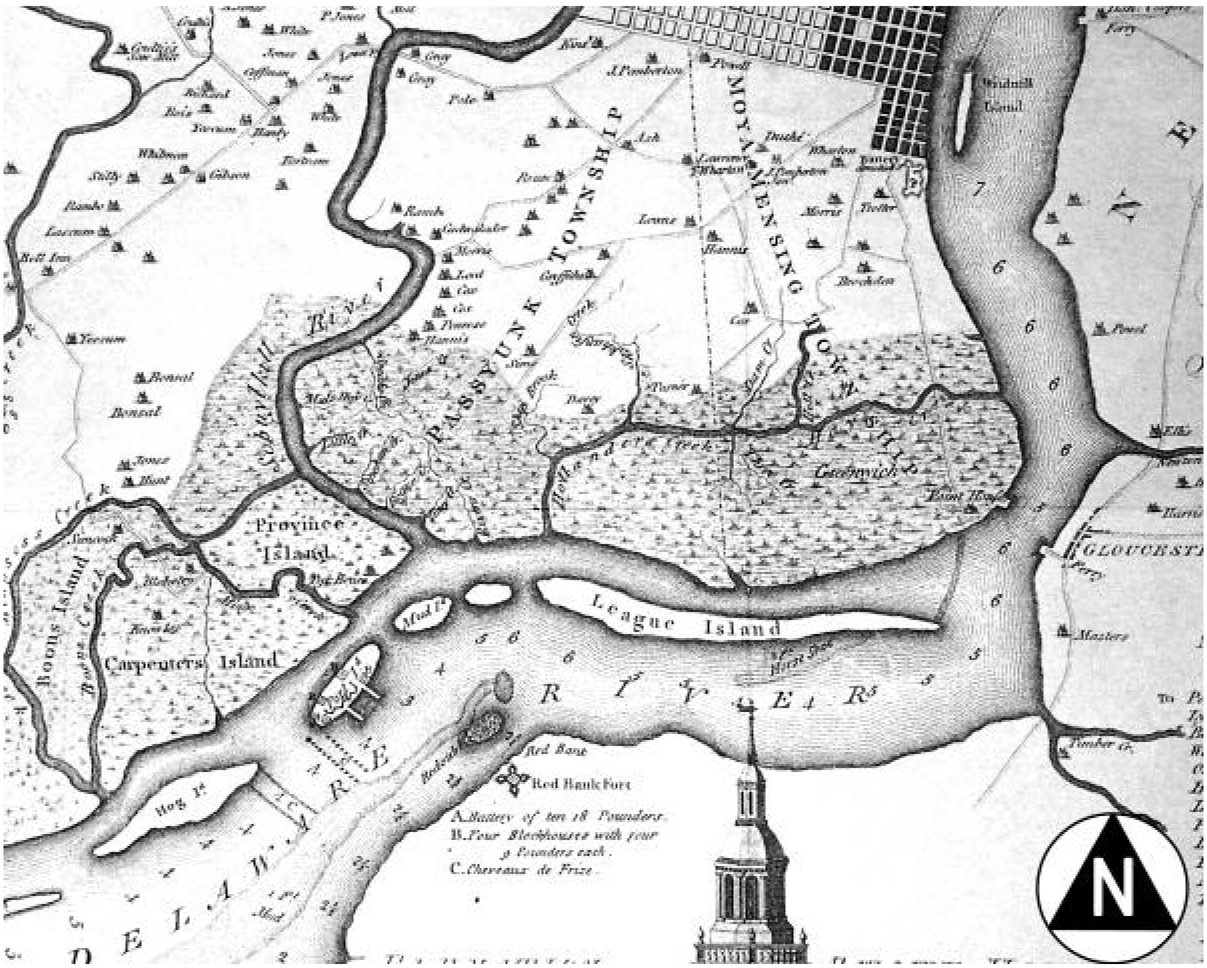


Figure 3.B.3. A plan of the city and environs of Philadelphia published in London, England, 1777 showing the marsh with one road extending down to the point.

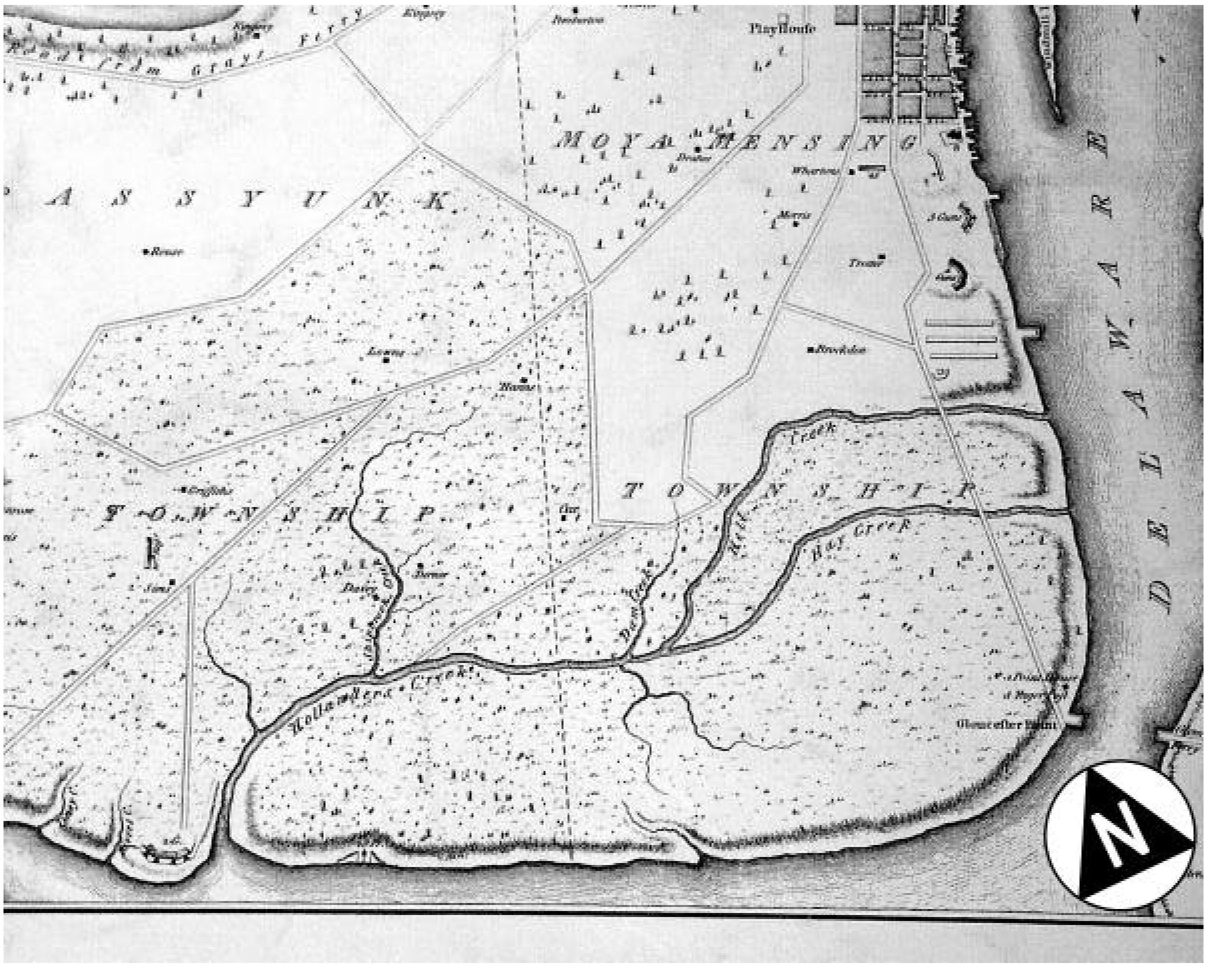


Figure 3.B.4. A map of Philadelphia and environs with His Majesty's Forces in 1779 now showing two roads leading into the marsh, one to lower Hollander Creek and one to Gloucester Point. However, the marsh appears to be undeveloped.

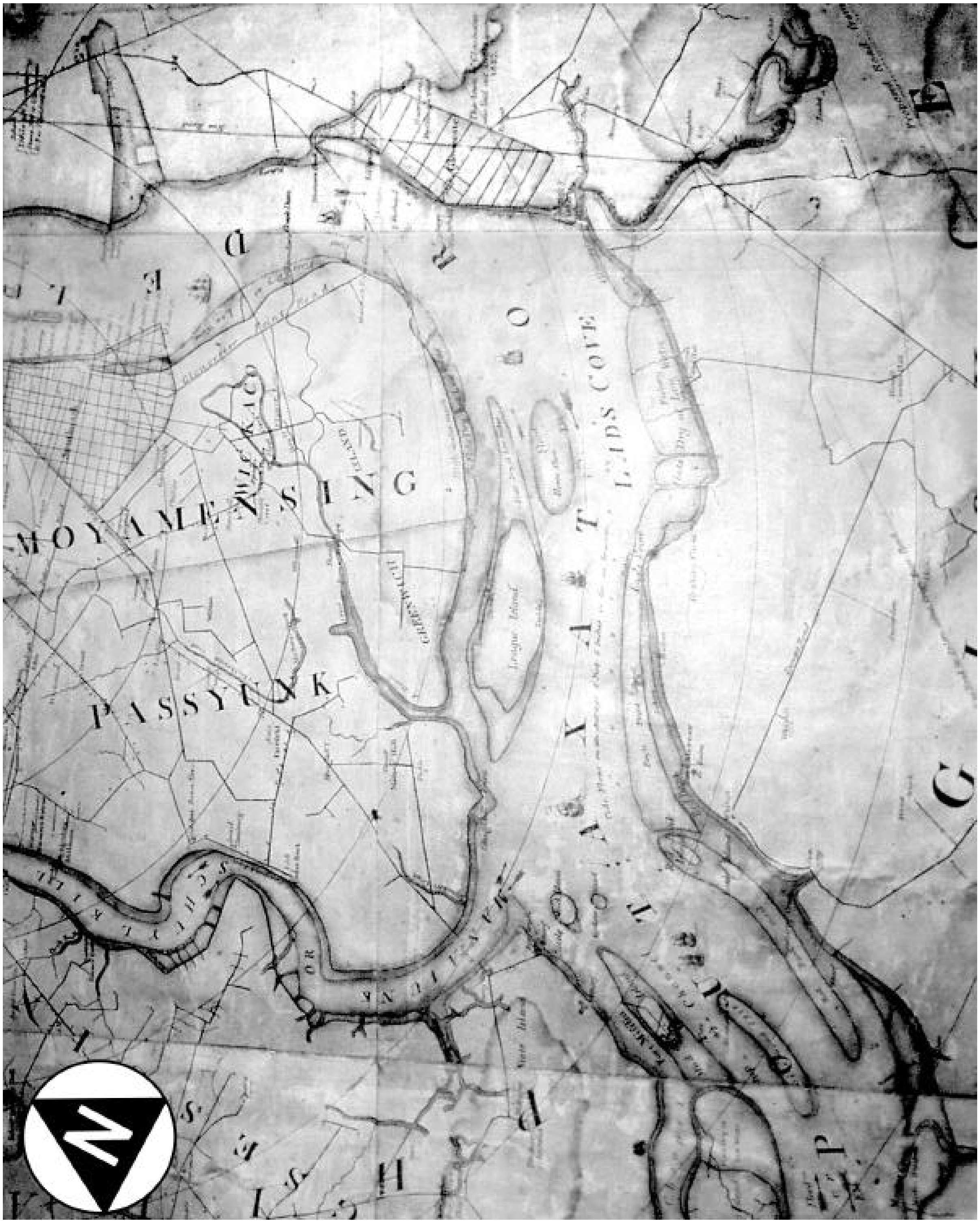


Figure 3.B.5. The plan of the City of Philadelphia and environs in 1809 showing the city grid moving inexorably south.

Figure 3.B.6. A map of the County of Philadelphia from a survey performed in 1839 showing a major reduction in the amount of tidal marsh. Many linear formations, probably ditches holding or draining water from the large marsh, are apparent.

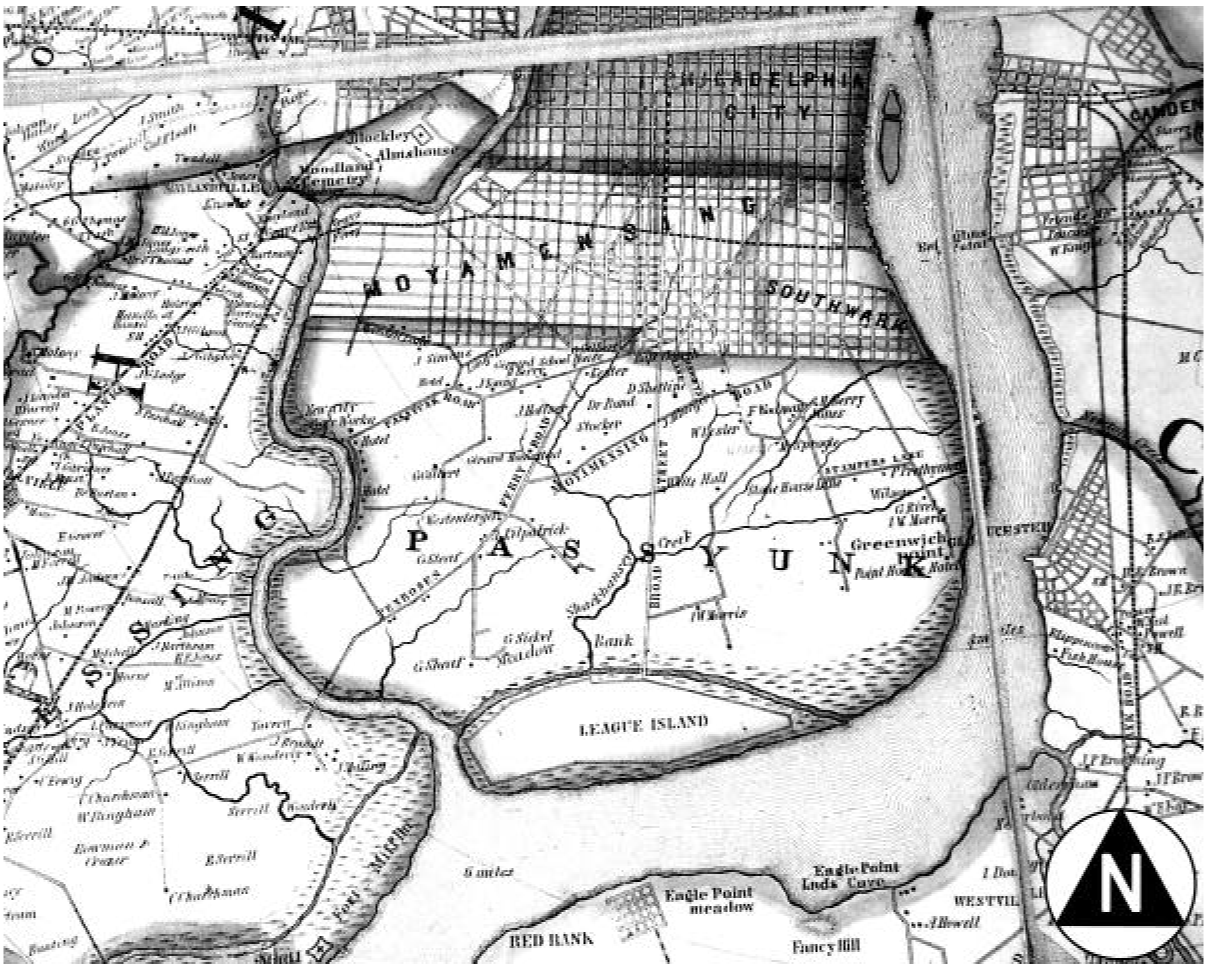


Figure 3.B.7. Map of the vicinity of Philadelphia from a survey in 1851. A major portion of the city now extends southward and Broad Street now extends to League Island.

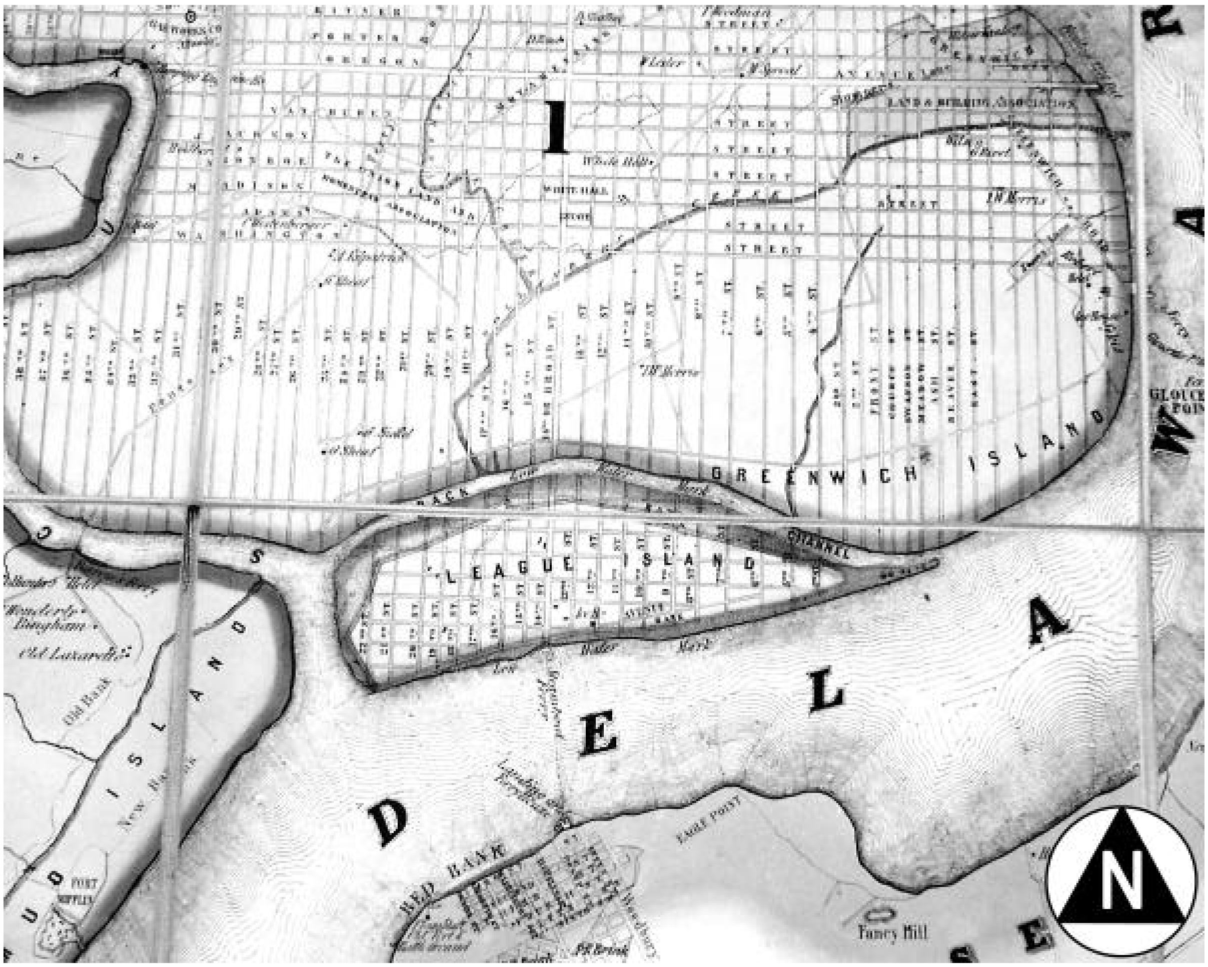


Figure 3.B.8. Map of the city in 1855 showing the city grid extending over the full extent of the marsh. Cross streets are only laid out on League Island, but it foretells the City's intention to completely drain and build on all of the neck of the Schuylkill.

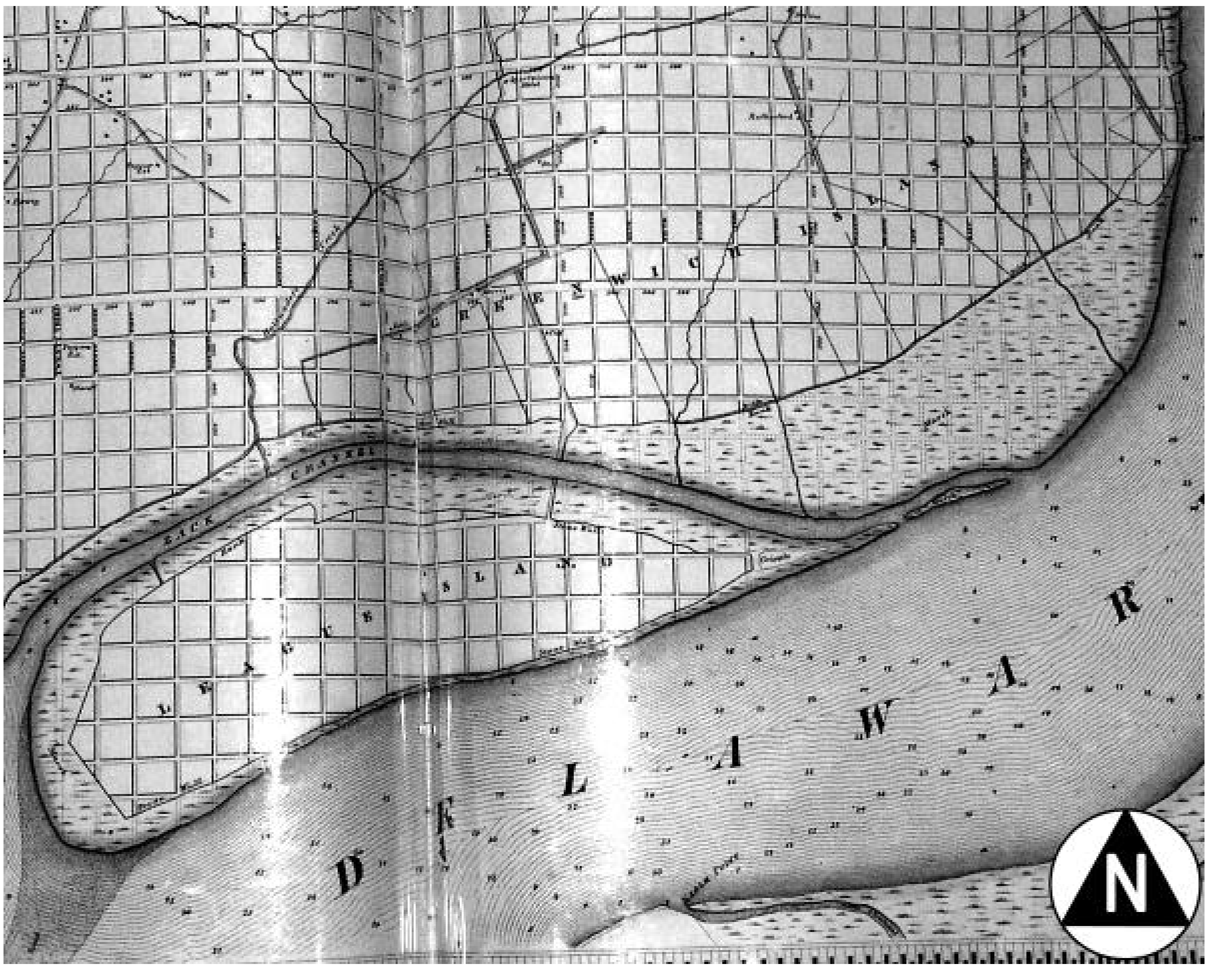


Figure 3.B.9. An atlas of the city in 1860 shows the grid extending through the existing marsh, including cross streets.

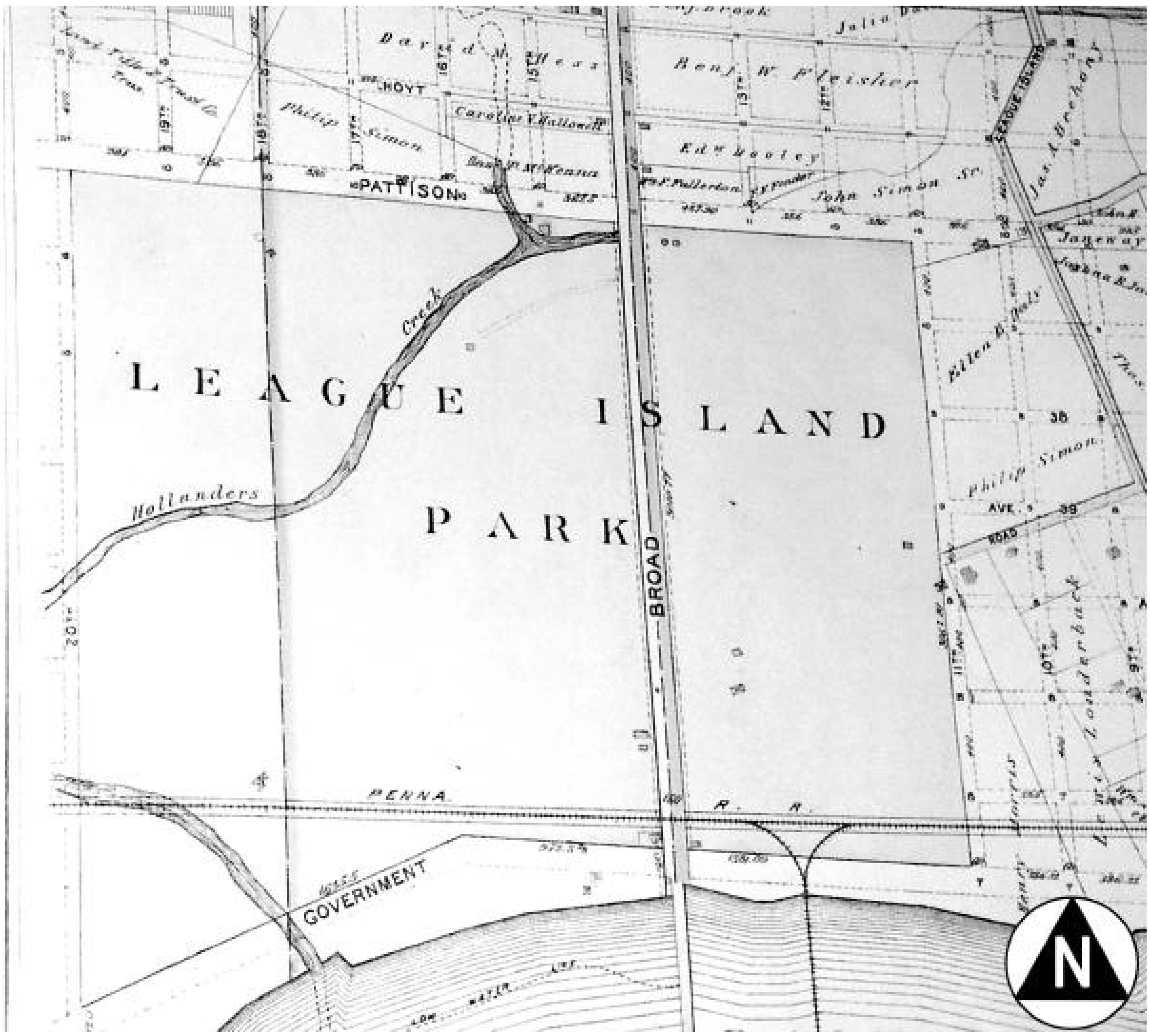


Figure 3.B.10. By 1910 the Bromley Atlas shows a full grid of streets and the area dedicated to League Island Park.

submerged plants (see Schuyler 1989). The intertidal areas (areas flooded and drained by the daily tidal cycles) would have supported dense stands of emergent plants. Spatterdock (*Nuphar advena*) was likely the most common species, with a variety of other plants, such as wild rice (*Zizania aquatica*) and various rushes and sedges (see Section 3.B.3.2). Mud flats may have been present along the parts of the tidal channels, as well. Different plant species would have occurred at the upper end of the marsh, in areas flooded only by storm tides.

Ancestors of the Lenape had inhabited this area for over 12,000 years (Amandus Johnson, Swedes in America 1638-1900, 1952), and upon contact by the Swedes it was the Lenape who greeted these European explorers. What began in the 16th century as nascent scientific exploration of new lands culminated in European competition for lands and trading goods in the New World. Settlements sponsored by European powers were routinely initiated in the 1600s. The intent was to identify resources which could be secured through trade and brought back to an ever expanding Europe. The first recorded voyage into present-day Delaware Bay was under the direction of Henry Hudson, who sailed the Half Moon into Delaware Bay in 1609 (Johnson 1952). The Dutch were also interested in the Delaware and by 1623 had established Fort Nassau on the site of present-day Camden (Van Sweeringen 1684). Fort Nassau was maintained as a fort and trading post (Smith 1862). It was during this decade that the Dutch West Indies Company began negotiations with the Swedes to join efforts in promoting expeditions to the New World (Siokalo 1945). In 1637, the first Swedish expedition resulted in the establishment of Ft. Christina (Wilmington, Delaware), named after the reigning queen of Sweden (Siokalo 1945). Within a 17-year period, there were 12 expeditions and New Sweden began to take on the configuration of a traditional settlement colony with colonies along the Delaware River and its many tributaries. Some of the larger settlements were at Holmesberg, Tinicum Island, Passyunk, Cinnaminson, and Swedesboro (Siokalo 1945). By 1643, Johan Printz was named governor of the Swedish colony in America. Printz set up a fort (New Gottenberg) and settlement at the present-day site of Tinicum Island west of the main mouth of the Schuylkill River (Smith 1862). By 1645, Hudde reported that the Swedes built a small fort on the west side of the Schuylkill River to control the river. This site has been identified as being near the current west side of the Penrose Avenue Bridge (Smith 1862). Conflict between the Dutch and Swedish continued through the mid-17th century.

Initially, the Swedish colony was based on the trade of furs, but the quality and quantity could not compete with the Dutch in the Hudson Valley (Lindestrom, An Account of the Delaware Indians Based on Survey and Notes, 1654-56, translated by Johnson 1957). In 1644, Printz sent 2,412 small and large beaver pelts to Sweden (Johnson 1957). Shortly after he reported "we have no beaver trade with the Indians, but only maize trade." From the beginning, the colony was not commercially successful, and the colony shifted to a more agricultural basis. The first water mill in the area was built on Cobbs Creek around this time, indicating the spread of the Swedes into the hinterlands of the Schuylkill watershed (FP Archives).

During the period of Swedish settlement, the land now occupied by FDR Park was in the partition denoted as Passyunk by "Grant of Lands Queen Christina of Sweden to Lieutenant Sven Schute, 20 August 1653" (FP archive hand tracing of the original). Passyunk included the land east of the Schuylkill River from its mouth upstream (Smith 1862). The name "Passyunk" was derived from a Native American name which meant "In the Valley." The area became a source of contention between the Swedish and Dutch settlements, with both sides attempting to establish buildings (Smith 1862). Andreas Hudde, a Dutchmen of Fort Nassau (now Camden) wrote in his journal for 1648, "some of the sachems came to me from the savages of Passyunk, who asked me why I did not build on the Schuylkill, that the Swedes has already them some buildings constructed"(Van Sweeringen 1684). By the census of 1680 there were 12 households in Passyunk (Van Sweeringen 1684).

The English made sporadic visits to and established small settlements in the lower Delaware Valley in the mid-17th century, but the main English occupation commenced with Quaker settlement (William Penn and others) after 1675 (Smith 1862). However, Swedish settlement patterns apparently continued after English political control.

In December of 1682, the first Assembly at Chester passed an act of naturalization for Swedes, Dutch and Finns. They swore allegiance to the King of England and obedience to William Penn as governor and received the same rights as the newly arriving English settlers. William Penn also noted that the Swedish people received them graciously and sold them provisions at a fair cost (Dunn and Dunn 1983).

In the same year, William Penn compiled a census of all inhabitants. Although few people responded, a census was completed for Passyunk Township. The census included all males and the property owned. What is immediately apparent is that most of the individual holdings were only marginally cleared. For instance, John Cock held 200 acres of which only 30 acres were cleared. At the time of the census he was 72, the oldest recorded inhabitant, and he had only cleared 15% of his holding.

William Penn noted the sparse settlements of the Swedes, even noting how they had built close to the marsh at the neck and used the marsh for grazing, noting specifically that the Swedes were primarily involved in husbandry. This presented an ideal situation for Penn and the new settlers. There was a vast forested territory which could easily be sold and subdivided, and a ready supply of provisions to help get the new settlers through the first years while they cleared the land and planted crops. At the time of Penn's arrival, the woods which would take his name were virtually uncut, and only modified by agriculture practices and use of fire by the Lenape.

Under the English, the area now occupied by FDR Park was part of Greenwich Island (Holme 1741). Belair, which still stands at the edge of FDR Golf Course, was built just above the marsh in the early part of the 18th century.

As deforestation followed settlement in the uplands, marsh diking and draining followed settlement along many tidal areas. Dikes were built to keep out tides, although some tidal flow probably occurred due to leakage through tide gates, dike failures or storm tides. The enclosed areas were still low and would have been nontidal marshes. The marsh and the associated health hazards and mosquitoes were hindrances to development, so the draining and filling of marshes began. Draining was done to increase land for building, crops or pasture, and to reduce disease. Vapors ("miasmas") from decaying material in marshes and swamps were considered to be causes of disease before the actual causes of various disease epidemics were understood (Raufer 1998). The yellow fever epidemic of 1793, which is estimated to have killed about one-tenth of Philadelphia's population, spurred marsh drainage (Raufer 1998). Even some of the larger channels were filled in, such as the eastern end of the channel separating Greenwich Island and League Island. A navigation map of the Schuylkill River (McClure 1835) showed spatterdock beds and mudflats along the lower Schuylkill River, but most of the banks had artificial dikes so that much of the surrounding marsh would have been drained. By 1839 (Ellet 1839), only the lower portion of Greenwich Island was still marsh. The drained areas became a mix of meadows (grazed pastures and/or nontidal marshes), houses, and vegetable crop lands (Belair House Inventory, 1745 FP Archives). During some periods, meadows were probably used as common pasturage for residents of an area. For example, court proceedings were recorded in Chester (Delaware County) in 1679 concerning fencing of common land (Smith 1862). Krider (1879) mentioned collection of many marsh and field birds in the "meadows below the city." Cope (1881) noted the abundance of some estuarine fishes (e.g., sticklebacks) in the ditches around Philadelphia.

By 1900, Hollander Creek stopped at Broad Street, and League Island Park is identified in its present location. In 1928, League Island Park was transferred by ordinance from the Department of Public Works to the Fairmount Park Commission. An article in the Bulletin (August 19, 1948) summarized the sentiment of the time.

> "League Island Park in S. Phila., just north of its name, is a monument to which it takes its name, is a monument to the skill of city engineers. They took 365 acres of swamp marsh land and between 1900 and 1921 converted it into a huge recreational center... League Island, about one league (three miles) in circumference and one league south of South St. was first named in 1671. Since that time with other islands and swamps, it has become fast land, after centuries of filling and grading."

By 1922 the marsh on Greenwich Island is gone and the pastoral landscape of FDR Park was now firmly in its place.

FDR Park was designed by the renowned American designer, Frederick Law Olmsted, who is credited with founding the field of landscape architecture and setting the standard for park design throughout the 20th century. He and his firm, Olmsted Brothers of Brookline, Massachusetts, became nationally known after their successful completion of Central Park in New York City. His designs were not only engineering marvels, but were also attempts to help cities cope with a number of social issues. He and other social reformers of the time believed public open spaces could be created which were open to all citizens of a city. Furthermore, by the citizens mingling in the public forum, the society could be rejuvenated and restored if not altogether changed into a middle class ideal. Although the social ideals of the reformers did not lead to the melding of class, the place of the public park in the modern city did take form, and FDR is an example of the late Victorian model for public open space (Fig. 3.B.11).

The FDR Park design was developed in 1914, covering the present site plus the land which is presently the site of the stadia to the east. The design called for a long alleé down Broad Street adjoined to a landscaped residential square. The symmetry of the city was reinforced by the long axial view which drew the visitor down south Broad Street and subsequently to the Naval Yard. At the park entrance, the rigid axial symmetry melded into the picturesque views of the park, which indeed brought nature into the city. Over the next year and a half the park was completed. Presently, it cannot be confirmed if the entrance alleé or a landscaped residential square were ever implemented.

The design of this park with picturesque views, curvilinear circulation route, play steads (as named in the plan), sports fields and fields was now in place. However, the park has seen many changes from the original design. In 1926, the Sesquicentennial Exposition was held in the park. The gazebo, boat house and the Swedish-American Museum date from the Exposition. Subsequently, about one-third of the park was sequestered for the municipal stadium, and in 1965 Interstate 95 (the Delaware Expressway) was built over the southern portion of the park, impacting the park land under and adjacent to the route. Recreational fields (tennis courts, ballfields, etc.) have been added to the park, the latest in 1998. Meadow Lake was originally used as a bathing pond. A swimming pool with treated water was built on the southern part of Meadow Lake. However, because of the saturated ground around the pool, it was subject to cracking, infiltration of ground and pond water into the pool and leakage of treated water into the pond. As a result, the pool was closed in 1996.

These changes have added a variety of new activities and buildings to the park. However, the lakes and open fields remain the hallmark of a park which is a testament to the legacy of Olmsted and the city which built this beautiful park in the densely populated south Philadelphia.

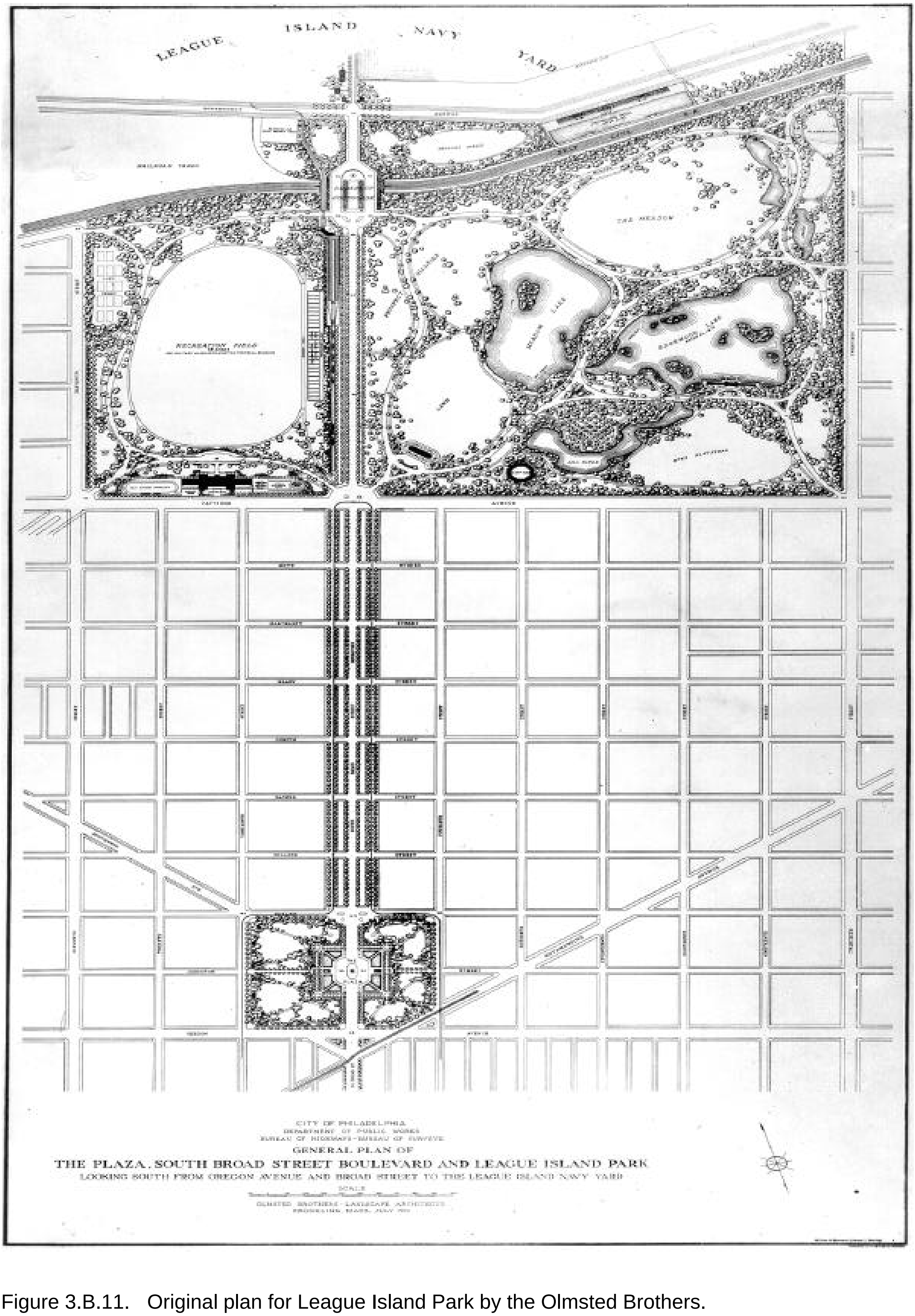


Figure 3.B.11.   Original plan for League Island Park by the Olmsted Brothers.

3.B.3. **Existing Conditions Inventory and Assessment**

3.B.3.1. **Introduction**

Existing information and new information collected as part of the 1998 inventory are discussed in Chapter 4 of Volume I. The comparison of information among parks provides strong evidence for pervasive disturbance throughout the Fairmount Park system, as well as individual differences among parks. In this section, more site-specific information on conditions in FDR Park are presented. This section focuses on condition and disturbance of vegetation of the park, faunal occurrence, and condition of ponds and lagoons. This information formed the basis for selecting restoration sites and specifying restoration activities to be done at these sites.

3.B.3.2. **Vegetation and Flora**

FDR Park was surveyed as part of the 1998 assessment by the Academy of Natural Sciences of Philadelphia, and the results of that assessment are presented in the following text. This information supplements the vegetation classification maps (Section 3.F.3) and list of plant species recorded in the park (Appendix A-1.1).

The emphasis of this park is on designed land, with 77% of its 348 acres as mowed lawns, ponds or managed for recreational purposes such as baseball, golf and tennis. Management involves frequent mowing, which does not promote the growth of native grasses and forbs. On the golf course, most of the area between fairways is heavily mowed, so the golf course does not provide much quality wildlife habitat. If mowing were performed on a less frequent basis, the park would be able to support a greater diversity of native vegetation, which in turn would increase its overall biodiversity. The recommendations outlined in the section on golf courses (Appendix C-3) should be implemented as part of the management of this course. The natural value of the park is also impacted by its proximity to Interstate 95 and other major transportation corridors as well as by trash and debris, which can be found throughout the area. Buffering natural lands from the disturbances of roads can be achieved by planting tall grasses and trees which would also enhance the aesthetic value of the park as well as add habitat for bird and insect species. The most interesting feature of FDR Park, and perhaps the areas that are the most biologically rich, are the ponds that weave through the central and southern sections. The ponds are nearly unique to the Fairmount Park system as they are tidally influenced by the Delaware River. They have been shown to support diverse plants and animals including *Heteranthera multiflora* and *Echinochloa walteri*, two endangered wetland species in Pennsylvania.

Excluding the ponds, most of the 45 acres of natural land in FDR Park is located in the southern part of the golf course and north of Interstate 95 and comprise woods, wetlands, old fields and shrub areas. The forest community is a mixture of exotic horticultural trees such as white mulberry *(Morus alba*), European alder (*Alnus glutinosa*), tree-of-heaven (*Ailanthus altissma*), and Siberian elm (*Ulmus pumila*), introduced Midwestern or Southern trees such as honey locust (*Gleditsia triacanthos*) and catalpa (*Catalpa speciosa*), and native trees including box-elder (*Acer negundo*), red oak (*Quercus rubra*), pin oak (*Quercus palustris*), red ash (*Fraxinus pennsylvanica*), hackberry (*Celtis occidentalis*), black willow (*Salix nigra*), red maple (*Acer rubrum*), black birch (*Betula lenta*), and black cherry (*Prunus serotina*). The areas adjacent to Hollander Creek and the lower part of Shedbrook Creek have a higher proportion of native species. West of this, the woods are an unusual mix, dominated by two exotics: white mulberry and Siberian elm. The exotic multiflora rose (*Rosa multiflora*) dominates the shrub layer of the forested areas. Obtuse-leaved privet (*Privet obtusifolium*), American elder (*Sambucus canadensis*), blackberry (*Rubus allegheniensis*) and cut-leaved blackberry (*Rubus laciniatus*) are also present. Common herbs and vines include goldenrod species (*Solidago* spp.), Japanese honeysuckle (*Lonicera japonica*), poison ivy (*Rhus toxicodendron*), white wood aster (*Aster divaricatus*), bedstraw (*Galium aporine*), purple dead nettle (*Lamium purpureum*), burdock (*Arctium lappa*) and white-snakeroot (*Eupatorium rugosum*). There is a hill (presumably fill) on the west side of this area, much of which is covered with *Phragmites australis*. The southern part of this area is used as a log dump and recycling area for the park. Much of this area is bare earth or rubble. There are small wet depressions along the north edge of the dump. Dumping of trash is evident in the area located northwest of the tennis courts, where the dumping of large debris such as appliances, car parts and building materials is extensive.

There are small fields, copses and wetlands within the golf course. The wetland located south of Shedbrook Creek and west of Hollander Creek can be classified as a small depression dominated by invasive species such as *Phragmites australis* and purple loosestrife (*Lythrum salicaria*). Parts of the area between the west limb of Shedbrook Creek and the hills within the golf course are not mowed or are mowed infrequently. This area contains a mix of old fields and small patches of woods. A small wetland at the north end of the wooded hill has several species of sedges and rushes.

The park proper is almost entirely landscaped with large specimen trees (both native and exotic species), and natural vegetation is present mainly in and around the ponds. North Meadow Lake can be classified as a cattail (*Typha latifolia*) marsh. This area appears to be functioning as good habitat for waterbirds. Invasive species which are prominent at this site include *Phragmites australis* and purple loosestrife.

The banks of the ponds have narrow bands of trees, including both native and exotic species. The cut-leaved raspberry is common in some parts of the park; however, this exotic species is relatively uncommon in the rest of the Fairmount Park system. Unshaded parts of the pond edges have emergent vegetation, including some plants which are rare in Pennsylvania. The state listed species many-flowered mud-plantain (*Heteranthera multiflora*) was common along the edge of the water at the southern part of Hollander Creek (east section), and was present along the northern part of Hollander Creek and along Edgewood Lake. The state listed species Walter's barnyard grass (*Echinochloa walteri*) and the umbrella sedge (*Cyperus oderatus*) were present along the shoreline of Hollander Creek. These three plants are mainly intertidal species in the state. The primrose-willow (*Ludwigia peploides*), sedges, rushes, and various herbs are also present in the water or on the shoreline of Hollander Creek and Edgewood Lake. Other aquatic plants recorded in the park include the emergent spatterdock (*Nuphar advena*) in the west section of Hollander Creek and coontail (*Certatophyllum demersum*), an introduced, submerged plant, which was found in South Meadow Lake and the west section of Hollander Creek.

While the ponds and lagoons support a variety of aquatic plants, the flora is diminished from that growing in the mix of tidal marshes, channels, tidal shores, and nontidal marshes which once occurred in the area (see Table 3.B.1). For example, the American lotus (*Nelumbo lutea*), a striking emergent aquatic plant, was recorded from South Philadelphia ("the Neck," Navy Yard, Greenwich Point) in the 19th century. The species is now very rare in the state and was not recorded in this survey.

Overall, FDR Park has potential for many restoration projects which range from simple tasks such as infrequent mowing and planting, which can improve the diversity of native vegetation, to more complicated projects such as lake dredging or wetland creation. The presence of several species which are rare in the state (including state-listed species) highlight the natural value of the park. The location of the park on the Coastal Plain and the limited natural lands in this part of the city make enhancement of the park an important part of natural lands restoration in the city.

3.B.3.3. **Community Mapping Results**

The community mapping initiative in FDR Park focused largely on how people use, or disabuse, this man-made park. Positive uses such as wedding photographs at the gazebo, the

Table 3.B.1. Potential flora of south Philadelphia based on historic records and the present flora of other tidal habitats in the Delaware Estuary. Species recorded during the 1998-1999 assessment period are noted with an *.

Submerged and Floating Aquatics

Elodea nuttallii (Nuttall's Waterweed)
Callitriche heterophylla (Water Starwort)
Najas flexilis (Northern Water-Nymph)
Najas gracillima (Slender Water-Nymph)
Potamogeton epihydrus (Ribbonleaf Pondweed)
Potamogeton natans (Floating Pondweed)
Potamogeton pectinatus (Sago Pondweed)
Potamogeton perfoliatus (Redhead Pondweed)
Potamogeton pusillus (Small Pondweed)
Potamogeton spirillus (Snailseed Pondweed)
Ranunculus longirostris (Beaked White Water Crowfoot)
Vallisneria americana (Wild Celery)

Herbaceous Emergents of Tidal Shores (S) and Marshes (M)

Acorus calamus (Sweet Flag)—M
Aeschynomene virginica (Sensitive Joint-vetch)—S
Amaranthus cannabinus (Water Hemp)—M
Alisma subcordatum (Southern Water-Plantain)—M
Ambrosia trifida (Giant Ragweed)—M
Asclepias incarnata (Swamp Milkweed)—M*
Aster lanceolatus (Eastern Lined Aster)—M
Aster puniceus (Bristly Aster)—M
Bidens bidentoides (Southern Estuarine Beggar-ticks)—S
Bidens coronata (Tickseed Sunflower)—M
Bidens frondosa (Beggar-ticks)—S,M
Bidens laevis (Bur Marigold)—S,M
Cardamine pensylvanica (Pennsylvania Bittercress)—S
Carex hyalinolepis (Shore-Line Sedge)—S
Cyperus engelmannii (Engelmann's Flatsedge)—S,M
Cyperus bipartitus (River-Shore Umbrella Sedge)—S
Cyperus brevifolioides (Umbrella Sedge)—S
Cyperus polystachyos (Many-Spiked Flatsedge)—S,M
Cyperus odoratus (Flatsedge)—S,M*
Echinochloa walteri(Walter's Barnyard Grass)—S*
Elatine americana (Waterwort)—S
Eleocharis erythropoda (Red-Based Spike-Rush)—S
Eleocharis obtusa (Obtuse Spike-Rush)—S

Table 3.B.1 (continued). Potential flora of south Philadelphia based on historic records and the present flora of other tidal habitats in the Delaware Estuary. Species recorded during the 1998-1999 assessment period are noted with an *.

Herbaceous Emergents of Tidal Shores (S) and Marshes (M)

Eleocharis palustris (Creeping Spike-Rush)—S,M

Eleocharis quadrangulata (Four-Angled Spike-Rush)—S

Eriocaulon parkeri (Parker's Pipewort)—S

Eryngium aquaticum (Marsh Eryngo)—M

Gratiola neglecta (Hedge-Hyssop)—S

Helenium autumnale (Common Sneezeweed)—S

Heteranthera multiflora (Multiflowered Mud-Plantain)—S,M*

Heteranthera reniformis (Common Mud-Plantain)—S,M

Hibiscus moscheutos (Rose Mallow)—M*

Impatiens capensis (Jewelweed)—M*

Isoetes riparia (Riverbank Quillwort)—S

Juncus acuminatus (Sharp-Fruited Rush)—S

Leersia oryzoides (Rice Cutgrass)—M*

Limosella australis (Awl-Shaped Mudwort)—S

Lindernia dubia (False Pimpernel)—S

Lobelia cardinalis (Cardinal Flower)—M

Ludwigia palustris (Common Water-Purslane)—S

Lycopus americanus (Water Horehound)—S,M

Mikania scandens (Climbing Hempweed)—M

Nelumbo lutea (American Lotus)—S

Nuphar lutea (Spatterdock)—S,M*

Orontium aquaticum (Goldenclub)—S

Peltandra virginica (Arrow Arum)—S,M

Pilea pumila (Clearweed)—M

Polygonum amphibium (Water Smartweed)—S

Polygonum arifolium (Halberd-Leaved Tearthumb)—M

Polygonum punctatum (Dotted Smartweed)—S,M

Polygonum sagittatum (Arrow-Leaved Tearthumb)—M

Pontederia cordata (Pickerel-weed)—S,M

Rorippa palustris (Yellow Watercress)—S

Rumex altissimus (Tall Dock)—S

Sagittaria calycina (Hooded Arrowhead)—S

Sagittaria graminea (Grass-Leaved Arrowhead)—S

Sagittaria latifolia (Common Arrowhead)—S,M

Sagittaria rigida (Sessile-Fruited Arrowhead)—S

Sagittaria subulata (Subulate-Leaved Arrowhead)—S

Schoenoplectus fluviatilis (River Bulrush)—S,M

Schoenoplectus pungens (Common Threesquare)—S*

Table 3.B.1 (continued). Potential flora of south Philadelphia based on historic records and the present flora of other tidal habitats in the Delaware Estuary. Species recorded during the 1998-1999 assessment period are noted with an *.

Herbaceous Emergents of Tidal Shores (S) and Marshes (M)
Schoenoplectus smithii (Smith's Bulrush)—S
Schoenoplectus tabernaemontani (Softstem Bulrush)—S,M
Sium suave (Water Parsnip)—M
Sparganium eurycarpum (Giant Bur Reed)—M
Typha angustifolia (Narrowleaf Cattail)—M
Typha x *glauca* (Hybrid Cattail)—M
Typha latifolia (Common Cattail)—M*
Zizania aquatica (Southern Wild Rice)—S,M

American Swedish Historical Museum, active recreation opportunities (tennis, baseball), boating on Edgewood Lake, and a small sledding hill adjacent to Broad Street were noted. Negative items such as graffiti on benches, buildings and trees, trash in the ponds, invasive vegetation, unsafe play equipment, the presence of illegal all-terrain vehicles (ATVs), improperly discarded fishing line, and the abandoned swimming pool were noted and mapped. Also mentioned is the negative impact of the park's use for parking for large events at the neighboring stadia.

Community mapping participants also noted improvements they would like to see occur in FDR Park, including construction of the park's environmental education center, more wildlife education and activities for children, and general park clean-ups and tree plantings. Additional suggested improvements include the construction of more restrooms and drinking fountains, speed bumps to slow vehicular traffic, more directional and regulatory signage (in multiple languages), and the creation of an island and/or perches for wildlife. Some participants also noted the importance of addressing the condition of the closed swimming pool (either repair or demolish it) and an interest in being able swim in Meadow Lake.

In summary, the community mapping initiative undertaken in FDR Park provided valuable information about park uses that aided in the selection of natural lands restoration sites.

3.B.3.4. **Fauna**

The following sections provide specific information on the fauna of FDR Park, as indicated by the ANSP 1998 inventory (see Volume I) and other sources of information. This information is important in determining links between disturbance, vegetation, and fauna, which are used to select restoration sites and activities. The information also indicates significant sites which need to be protected because of faunal occurrence.

Birds. FDR Park was surveyed for birds on 1 and 9 June 1998. Located in the heart of South Philadelphia between the sports complex, Interstate 95, and other transportation corridors, FDR Park is heavily impacted. Much of the park is now managed for recreational purposes such as picnicking, baseball or golf. Several ponds and lagoons weave through the central and southern sections, while a loop road with side extensions to parking areas permits vehicular traffic throughout much of the park. The least impacted area, in the southwestern corner, is characterized by *Phragmites* and a forest of white mulberry and Siberian elm. Mowed grass, substantial amounts of garbage, and high levels of human use all combine to limit the attractiveness of FDR Park to most species of birds.

In spite of these shortcomings, the total species count for probable breeders in the park is 38. Six additional summer residents were found in abundances not encountered elsewhere in the Fairmount Park system (Herring and Ring-billed Gulls, Double Crested Cormorant, Black-crowned Night Heron, Great Egret, Great Blue Heron). A total of 125 individuals of the indicator species were observed during the survey (see Appendix A-2.2 in Volume III). A number of species were only observed in the unmowed areas of natural vegetation in the southwestern section, including Swamp Sparrow, Willow Flycatcher, and Yellow Warbler. A few species, such as the Warbling Vireo, are found in trees bordering Hollander Creek in the southwestern section. While FDR Park may not have the most abundant wildlife, it is extremely valuable for the relatively rare species that breed nearly exclusively there, as opposed to the remainder of the Fairmount Park system. Interestingly, the only sizable pheasant population within Philadelphia seems to be surviving by using the unmaintained areas within and next to the golf course, both within the park and adjacent to the park to the south of the apartment complex.

While the 1998 assessment focused on breeding birds, FDR Park is also used by migrating and wintering birds. The presence of ponds, marshes, old fields, woods and horticultural plantings provide stopover points within the highly urbanized surrounding area for a variety of species, including ducks, grebes, sandpipers, gulls, hawks, warblers and sparrows (Philadelphia mid-winter bird count, Philadelphia migration survey). For example, a variety of migrating or wintering ducks feed in South Meadow Lake. Edgewood Lake is used largely as a resting spot for many gulls and geese. Fish-eating species, such as cormorants and herons, also feed in the lake. Peregrine falcons, which nest on the Interstate 95 bridge, have been observed hunting within the park (R. Horwitz, pers. comm.).

Canada geese are common winter residents, with about 700 birds present in January 2000. The geese feed both outside the park and on the golf course and lawns in the park, as well as rest in ponds and lawns in the park. Numbers have apparently increased in recent years, as indicated by annual counts in early January made from 1987-2000 (Philadelphia mid-winter bird count, unpublished data). About 750-1100 birds were counted in the park in 1998-2000 censuses. Less than 200 birds were counted in 1987-1989 counts (only 35 in 1989), about 200-300 geese in the 1990-1993 censuses, and 300-400 birds in 1994-1997 censuses. These numbers, along with numbers of wintering gulls, are expected to contribute significant nutrients to the ponds in the park, although the magnitude of various sources of nutrients has not been quantified.

While one imagines what bird life would be had Olmsted's original plan for the park (with its more extensive natural areas) been kept in place, the continued existence of so much and so varied a bird life is a testament to the birds' resilience. Their continued presence also indicates that some of the ways the park is currently being managed is beneficial to wild birds. Certainly, FDR Park may hold some wonderful and unique opportunities for natural lands restoration, in spite of its small area and high recreational use.

Mollusks. The land snail records from the 1998 assessment (see Volume I) represent the first known survey in the park. Eight species, including three native species, were found. The native species were found in leaf litter along the edge between the golf course and park. All of the native species represent widespread Holarctic species associated with meadows and grasslands.

Fish. Recent samples of fish had been taken in Edgewood Lake, so that relatively little fish sampling was done in the 1998 survey. These earlier surveys (see Volume I, Section 4.E.7) indicated a mix of native (gizzard shad, brown bullhead, golden shiner, pumpkinseed) and introduced species (channel catfish, green sunfish, largemouth bass, bluegill, crappies) commonly found in ponds in this area. These surveys also found several estuarine species, including alewife, white catfish, and white perch which probably entered through the tide gate. However, these species can sustain themselves in freshwater ponds and lakes, so it is not clear whether there is ongoing exchange of these fish between the river and park ponds. American eels were collected, as well. Eels spawn in the ocean, so they presumably entered the ponds through the tide gate. The 1998 ANSP assessment found similar species, plus a few species not previously reported. A green sunfish (*Lepomis cyanellus*), an introduced sunfish typical of small ponds and streams, was found in Shedbrook Creek. Two other species, the Eastern mosquitofish (*Gambusia affinis*) and the banded killifish (*Fundulus diaphanus*), were found in the east section of Hollander Creek (i.e., above the culvert to the tide gate) in October 1999. The mosquitofish is an introduced species which appears to be spreading in the area. The banded killifish is a common species in intertidal and local stream systems.

Historically, a variety of species, now rare in the state, were found in marshes along the Delaware River (see Volume I, Section 4.E.7 and Appendix A-6.1). These include several small sunfishes, sticklebacks, and the Eastern mudminnow. None of these species was found in the present survey.

Reptiles and amphibians. The 1998 inventory recorded several species of turtles and frogs in the ponds and lagoons of FDR Park. These include the red-bellied turtle (*Pseudemys rubiventris*), a state-listed threatened species nearly restricted to the Coastal Plain in Pennsylvania. Turtles were most commonly observed basking in Pattison Lagoon. Since turtles hibernate in shallow sediments, retention of hibernating sites would be necessary if dredging of the ponds is undertaken. Bullfrogs and green frogs, large species of permanent waterbodies which do not depend on fishless ponds for reproduction, were found. The red-eared slider (*Trachemys scripta*), an introduced turtle, was also found. Two species of snakes (deKay’s snake and Eastern garter snake) were found in the park. Both species are capable of surviving in urban fragments.

3.B.3.5. **Ponds and Lagoons**

Edgewood Lake.

FDR Park

The waterbodies of FDR Park (including the golf course) are relics of the tidal creek system which once existed along the Delaware and lower Schuylkill rivers. Once shaped by flood and ebb tides, their channels have been modified by filling and excavation during park construction. As a result, the stream geomorphologic analysis done in other parks was not applicable to these ponds. Investigations of water and sediment depths and sediment chemistry in the ponds provided more useful information for restoration and habitat enhancement. The location of the following waterbodies can be seen in the Base Map, Section 3.F.

The eastern (park) section contains four interconnected waterbodies:

- the east section of Hollander Creek, which is connected to the Delaware River through a tide gate to the Reserve Basin of the Naval Yard;
- Edgewood Lake, the largest pond in the park;
- the “Pattison Lagoon,” which is a shallow lagoon connecting to the north end of Edgewood Lake by a narrow channel; a storm sewer empties into the northern part of the lagoon;
- North Meadow Lake, which is a shallow marsh connected to Edgewood Lake and South Meadow Lake;
- South Meadow Lake, connected to North Meadow Lake through a small channel.

Edgewood Lake, North Meadow Lake and South Meadow Lake have concrete linings and edging. The concrete appears mainly intact in South Meadow Lake. The concrete along part of the edge of Edgewood Lake (e.g., southern edge) is broken; the concrete is not visible at the surface of much of the shoreline, either because it has been covered by earth or has been removed. As originally built, the two parts of Meadow Lake were a single pond used as a bathing pond. Subsequently, the ponds were split. Later, a swimming pool was built in the southern part of South Meadow Pond, further reducing its size. Because of the low level of the area and frequent soil saturation, the pool had frequent problems with cracking and infiltration of pond water in the pool and leakage of treated pool water into the ponds. As a result, the pool was closed in 1996.

The golf course contains two main waterbodies:

- the west section of Hollander Creek, at the southeast end, which is now connected through a pipe to the Reserve Basin-east section Hollander Creek connector. At one time, there was a pipe connecting the northeast end of this section with the northern part of the east section of Hollander Creek, i.e., passing under the perimeter road between the park and golf course (Pennoni 1973). Pennoni (1973) reported that this pipe was partly blocked and recommended filling the pipe.
- Shedbrook Creek, which has several branches which extend to the north and west edges of the golf course. At its southeast end, Shedbrook Creek is connected to Hollander Creek through a pipe.

Because of the 6-ft tidal range in the Reserve Basin (which has a water surface elevation of -6.2 ft, according to the most recent city survey), the typical surface elevation of the ponds (recorded at -5.6 ft) is below the mean high tide level of the Reserve Basin (City of Philadelphia topographic survey). Hence, restoration of full tidal flow would flood parts of the park, including much of the golf course and part of the boathouse.

The creeks drain FDR Park and portions of the surrounding area through the tide gate into the Reserve Basin. Because of problems with flooding after storms, several changes in pond circulation and drainage have been made to promote drainage and increase circulation within the ponds. Repair of the tide gate to provide better closure was recommended by Pennoni (1973). It was subsequently repaired, although the date of repair has not been ascertained. Currently, the tide gate is designed to open to allow drainage of the ponds in the park, but to close on rising tides to prevent tidal flooding of the park. Because of incomplete closure, there is said to be some influx of tidal water into the park, although a tidal rise and fall is not obvious in the ponds. Pumping systems were built to allow pumping of storm flows into street storm sewers and to increase circulation of pond and lagoon water. Water is pumped from the east end of Edgewood Lake into the northern part of Meadow Lake, which now acts as a filtration wetland. The water flows from North Meadow Lake into South Meadow Lake, where it is pumped into the eastern part of the Pattison Lagoon, from which it can flow back into Edgewood Lake.

While Pennoni (1973, 1992) and ANSP (1992) provide some information on the ponds, no recent information on pond and sediment depths were located. A cursory survey of depths (Table 3.B.2) in the main pond system (Edgewood, Pattison Lagoon, and South Meadow Lake) was conducted on 23 November 1999. Depths were measured using a 4-m pole. Because of the hard lining of the ponds (preventing penetration of the pole), the water depth and depth of soft sediments could be determined.

The maximum water depth recorded in Edgewood Lake was 1.2 m (about 4 ft). Soft sediments were relatively thin near shore, but were up to 1.96 m (about 6.5 ft) deep farther from shore. The deepest sediments were found in the northwestern part of the lake, offshore of the boat house

Table 3.B.2. Summary of measurements of water and sediment depths in FDR ponds, taken on 23 November 1999. Distances are from each end of the transect. Point labels include the percent of the distance across the lake, e.g., the midpoint of the transect is 50%.

Lake		Distance (m) from end 1	Distance (m) from end 2	Water depth (m)	Sediment depth (m)	Basin depth (m)	Sample Type*
Edgewood	**Transect 1**	**Gazebo to Outlet Bridge**					
	12%	40	307	1.14	0.63	1.77	
	23%	80	267	1.05	1.22	2.27	
	35%	120	227	1.06	1.04	2.10	
	46%	160	187	1.05	2.28	3.33	S, I, A
	58%	200	147	0.95	2.20	3.15	
	69%	240	107	0.86	1.30	2.16	
	81%	280	67	0.85	0.17	1.02	
Edgewood	**Transect 2**	**Boathouse to South Shore**					
	13%	30	195	1.04	0.90	1.94	
	27%	60	165	1.12	1.26	2.38	S
	40%	90	135	1.24	1.96	3.20	
	53%	120	105	1.15	0.83	1.98	
	67%	150	75	1.00	0.90	1.90	
	80%	180	45	1.00	0.63	1.63	
Edgewood	**Transect 3**	**Concrete Platform (W Side) to Channel to Meadow Lakes**					
	12%	40	292	1.00	0.68	1.68	
	24%	80	252	1.17	1.13	2.30	S, I
	36%	120	212	1.18	1.05	2.23	
	48%	160	172	1.18	1.37	2.55	
	60%	200	132	1.12	0.46	1.58	
	72%	240	92	1.05	0.82	1.87	S
	84%	280	52	0.93	0.35	1.28	
Pattison Lagoon	**Transect 1**	**Bridge to Small Point on North Side**					
		15		0.43	0.90	1.33	
		30		0.38	1.04	1.42	
Pattison Lagoon	**Transect 2**	**Small Point on North Side Across to South Side**					
	20%	20	80	0.25	1.05	1.30	
	40%	40	60	0.28	1.44	1.72	S, I
	60%	60	40	0.32	0.98	1.30	A

Table 3.B.2 (continued). Summary of measurements of water and sediment depths in FDR ponds, taken on 23 November 1999. Distances are given from each end of the transect. Point labels include the percent of the distance across the lake, e.g., the midpoint of the transect is 50%.

Lake		**Distance (m) from end 1**	**Distance (m) from end 2**	**Water depth (m)**	**Sediment depth (m)**	**Basin depth (m)**	**Sample Type***
	80%	80	20	0.18	0.30	0.48	
Pattison Lagoon	**Transect 3**	**Sw of Storm Water Outlet**					
	50%	center		0.27	1.10	1.37	S
South Meadow	**Transect 1**	**Se Shore (Near Old Swimming Pool) to NW Shore**					
	17%	20	101	0.99	0.09	1.08	
	33%	40	81	1.18	0.00	1.18	
	50%	60	61	1.17	0.00	1.17	
	66%	80	41	1.08	0.00	1.08	
	83%	100	21	0.97	0.00	0.97	
	99%	120	1	0.50	0.00	0.50	
South Meadow	**Transect 2**	**Channel to N. Meadow to South Side of Pond**					
	14%	25	155	1.05	0.00	1.05	
	28%	50	130	1.10	0.00	1.10	
	42%	75	105	1.23	0.00	1.23	A
	56%	100	80	1.24	0.00	1.24	
	69%	125	55	1.16	0.00	1.16	
	83%	150	30	1.04	0.00	1.04	
	97%	175	5	0.65	0.03	0.68	S

*S = Sediment sample; I = Invertebrate sample; A = Algal sample (water column).

and west of the channel from the Pattison Lagoon. Pattison Lagoon was very shallow, with a maximum depth of about 0.43 m (about 1.5 ft) and less than 0.27 m (0.9 ft) of water recorded in the upper half of the lagoon. The surficial sediments of Edgewood Lake were usually highly organic, while deeper sections contained more sand. It is not known whether this is due to changes in types of inputs (e.g., earlier inputs of sand following construction and subsequent accumulation of decaying organic material) or to physical sorting. In contrast, South Meadow Lake had relatively little sediment (maximum depth of 9 cm). Water depths of up to 1.24 m (about 4 ft) were recorded. While the basin depth (water plus accumulated sediment) of Edgewood Lake is relatively deep (up to 3.3 m, i.e., about 11 ft), the maximum water depth found was less than that at South Meadow Lake. Soft sediment in the ponds would consist of organic (leaves, etc.) and inorganic (e.g., sand and clay) material washed in from the park and from the storm sewer outlet to Pattison Lagoon, and organic material produced in the ponds (e.g., decaying portions of algae and higher plants).

Surface sediment samples were taken in several spots (Table 3.B.3) using a Ponar dredge. Samples were analyzed for nutrient and heavy metal concentrations (Table 3.B.3). These may be compared with earlier measurements of sediment and water chemistry (Tables 3.B.4-3.B.7, taken from ANSP 1992). Nutrient concentrations in sediments were very high. Although measurements were not made, the appearance of sediments indicated that the sediment was mainly anoxic (no dissolved oxygen). Qualitative observations of benthic macroinvertebrates were made in samples from Edgewood Lake and Pattison Lagoon. Relatively few organisms were found. The sample from Pattison Lagoon had much decaying leaf material and contained several taxa of oligochaete worms, several groups of fly larvae (chironomids and ceratopogonids), water mites, harpacticoid copepods and a waterflea (the cladoceran *Leydiga*). The Edgewood Lake sample had little coarse particulate material and low densities of midges, worms and copepods.

Sediments were analyzed using EPA approved methods for organic carbon, total nitrogen and phosphorus, and a suite of trace metals (Table 3.B.3). There were variations in many parameters between sites and overall levels of some metals were elevated. However, there were limited number of samples to make firm conclusions pertaining to overall sediment quality. Organic carbon (OC), total nitrogen and phosphorus were highest in the North Lagoon site compared to the other sites. In addition, trace metal levels of lead (Pb), cadmium (Cd), and zinc (Zn) were higher at this site (Table 3.B.6). The two storm sewers that empty into this lagoon may be responsible for the elevated levels. The sample from South Meadow Lake had little organic material and lower concentrations of nutrient and metals (except chromium) than the Edgewood Lake and Pattison Lagoon samples. Since there was little total sediment material in the pond, this indicates the lower nutrient loading of South Meadow Lake relative to the other ponds. Levels of trace metals are similar to those measured in the same ponds in 1992 (ANSP 1992). The levels in the lagoon and pond sediments can also be compared to sediment samples in the adjacent Philadelphia Naval Yard's Reserve Basin and lower tidal Schuylkill River (Table 3.B.3). Concentrations in FDR Park ponds were generally higher than the average value for the tidal Schuylkill River, and comparable to those within the Reserve Basin (Boyd et al. 1998).

Analyte concentrations were compared to guidance values from Long et al. (1995), which are used to predict the probability of adverse biological effects (Table 3.B.8). The first value (Effects Range - Low or ER-L) is designated as the lower 10^{th} percentile of apparent effects. This value represents the concentration above which adverse effects to benthic organisms may begin or are predicted for sensitive life stages. The second value (Effects Range - Median or ER-M) is designated as the median of apparent effects. This value represents the concentration above which adverse effects are frequently or always observed in benthic organisms. While it is recognized that these values were derived using mainly estuarine chemical-biological effects data, they do provide a tentative framework and guidance to assess the level of contaminants in the tidal freshwater portion of the Delaware River. These values are similar to those (TELs and PELs) derived for freshwater systems in Canada by Smith et al. (1995).

Cadmium (Cd) levels were below the ER-L except in one sample from the North Lagoon. In all cases, lead (Pb) and zinc (Zn) levels were above the ER-M, while for Cr only two samples were above the ER-L. In some cases, both Pb and Zn were five times higher than the ER-M concentration. Copper (Cu) and nickel (Ni) levels were generally between the ER-L and ER-M concentration. These data suggest that the concentrations of metals in the sediments could have an impact on the benthic community. Additional sampling for community structure and sediment bioassays should be obtained to evaluate whether the sediments have an adverse effect to organisms. While the sediment levels of trace metals would not make these sediment hazardous waste, they do pose a potential impact to biological communities and this could be an issue for any future dredging.

Table 3.B.3. Concentrations of nutrients and metals in surface sediment samples, as microgram per gram of dry weight (µg/g dw), unless otherwise indicated, from ponds in FDR Park taken on 23 November 1999. Substances are total nitrogen (TN), organic carbon (OC), total phosphorus (TP), carbon-nitrogen ratio (C/N), cadmium (Cd), lead (Pb), copper (Cu), chromium (Cr), nickel (Ni), zinc (Zn) and iron (Fe).

Site ID	**Chem Sample ID**	**TN (% dw*)**	**OC (% dw)**	**TP (% dw)**	**C/N (molar)**	**Cd (µg/g dw)**	**Pb (µg/g dw)**	**Cu (µg/g dw)**	**Cr (µg/g dw)**	**Ni (µg/g dw)**	**Zn (µg/g dw)**	**Fe (wt %)**
Edgewood Lake	9170	0.50	6.3	0.115	14.7	2.8	308	348	80	69	832	3.7
Edgewood Lake	9171	0.67	7.0	0.113	12.3	2.7	298	333	79	67	808	3.7
Edgewood Lake	9172	0.48	6.1	0.075	14.9	1.9	224	252	58	54	605	3.0
Pattison Lagoon	9173	0.70	8.6	0.102	14.4	3.5	362	199	56	54	807	3.4
Pattison Lagoon	9174	0.74	10.0	0.142	15.8	5.7	527	254	66	65	1,144	4.3
South Meadow Lake	9175	0.10	2.5	0.056	29.4	1.0	113	81	117	23	439	2.3
Comparisons with sediments from nearby sites (from Boyd et al. 1998)												
Schuylkill River (16 stations from just above Bartram's Garden to mouth			4.1			1.3	90	53	49	28	298	
Reserve Basin (29 samples)			5.5			3.5	342	391	129	68	1,417	

*dw=dry weight

Table 3.B.4. Results of field measurements of physical parameters made in FDR Park ponds (ANSP Stations 1-7) on 24 September 1992.

Location	**Station**	**Date Collected**	**Time Collected**	**D.O.* (mg/L)**	**pH**	**Temp.* (EC)**	**Cond.* (μmhos)**	**Secchi* (m)**	**Depth (m)**
Edgewood Lk.	1	9/24/92	12:25	12	9.92	18	290	0.3	1.3
Edgewood Lk.	2	9/24/92	12:50	14	10.07	18	290	0.3	1.0
Edgewood Lk.	3	9/24/92	13:10	14.4	10.07	18	300	0.3	1.1
Pattison Lagoon	4	9/24/92	14:25	13.6	9.7	18.5	300	0.3	0.4
Pattison Lagoon	5	9/24/92	14:40	13.7	8.75	19.5	450	0.4	0.5
S. Meadow	6	9/24/92	16:10	15.5	8.81	20.5	435	0.2	0.2
S. Meadow	6 DUP	9/24/92	16:10	15.5	8.7	20.5	440	0.2	0.2
Hollander Ck.	7	9/24/92	16:50	4.9	7.12	23	328	1.1	1.5

* D.O. = dissolved oxygen concentration as milligrams per liter; Temp. = temperature; Cond. = conductivity measured in micro mhos (a mho is the practical unit of conductance equal to the reciprocal of the ohm); Secchi = depth below the surface at which a standard black and white disk can no longer be seen; this is a standard measure of transparency.

Table 3.B.5. Results of water quality parameter analyses of samples collected from FDR Park ponds (ANSP Stations 1-7) on 24 September 1992.

Location	Sta.	Date	Total Hard.* mg/L	Alk.* mg/L	NO_2* mg/L	NO_3* mg/L	TP* mg/L	TKN* mg/L	NH_3-N* mg/L	Turb* NTU	Total Colif./* 100 ml	Fecal Colif./* 100 ml	TDS* mg/L	$CBOD_5$* mg/L	Cu* mg/L	Cr* mg/L	Cd* mg/L	Pb* mg/L	Ni* mg/L
Edgewood Lk.	1	9/24/92	100	60	bdl	bdl	0.303	3.94	bdl	32	**	**	231	12.5	0.008	0.002	0.0002	0.015	0.004
Edgewood Lk.	2	9/24/92	100	58	0.007	0.048	0.311	3.86	bdl	30	240	240	220	8.8	0.006	0.002	0.0006	0.007	0.004
Edgewood Lk.	3	9/24/92	100	58	bdl	bdl	0.314	3.94	bdl	32	**	**	221	12.8	0.007	0.002	0.0004	0.008	0.004
Pattison Lagoon	4	9/24/92	100	70	0.01	0.039	0.318	4.07	bdl	30	<2	4	231	15.9	0.008	0.003	0.0002	0.013	0.004
Pattison Lagoon	5	9/24/92	108	162	0.043	0.113	0.285	3.9	0.58	15	**	**	330	11	0.003	0.001	0.0002	0.007	0.002
S. Meadow	6	9/24/92	184	116	0.007	0.032	0.3	4.65	1.03	19	7	22	325	8.4	0.009	0.003	0.0001	0.009	0.003
S. Meadow	6 DUP	9/24/92	160	116	0.007	0.03	0.313	4.9	0.99	19	13	17	309	7.9	0.009	0.003	0.0001	0.009	0.003
Hollander Ck.	7	9/24/92	108	60	0.129	2.618	0.165	0.32	0.03	3	30	50	231	1	0.004	0.001	0.0002	0.002	0.003
Detection Limit			1	1	0.003	0.02	0.01	0.1	0.01	1	2		10	0.3	0.001	0.0001	0.001	0.001	0.001
Date Analyzed			9/30/92	9/29/92	9/25/92	9/25/92	9/28/92	10/1/92	10/1/92	9/26/92	9/25/92	9/25/92	9/25/92	9/26/92	10/1/92	10/2/92	10/3/92	10/2/92	10/4/92

bdl = Below detection limit.

* Total Hard. = Total Hardness; Alk. = Alkalinity; NO_2 = nitrite; NO_3 = nitrate; TP = Total Phosphorus; TKN = Total Kjeldahl Nitrogen; Turb. = Turbidity; Total. Colif. = Total Coliform; Fecal Colif. = Fecal Coliform; TDS = Total Dissolved Solids; CBOD5 = 5-day Chemical and Biological Oxygen Demand; Cu = Copper; Cr = Chromium; Cd = Cadmium; Pb = Lead; Ni = nickel.

** Analysis not requested.

Table 3.B.6. Results (in mg/kg dry weight) of analyses (metals and total petroleum hydrocarbons [TPH]) of sediment samples collected from FDR Park ponds (ANSP Stations 1-7) on 24 September 1992.

Location	Station	Date	Cu (mg/Kg)	Cr (mg/Kg)	Cd (mg/Kg)	Pb (mg/Kg)	Ni (mg/Kg)	TPH (mg/Kg)
Edgewood Lk.	1	9/24/92	**	**	**	**	**	**
Edgewood Lk.	2	9/24/92	**	**	**	**	**	**
Edgewood Lk.	3	9/24/92	350	92.3	3.49	407	65	<130
Pattison Lagoon	4	9/24/92	248	55	3.55	500	45.3	300
Pattison Lagoon	5	9/24/92	**	**	**	**	**	**
S. Meadow	6	9/24/92	863	75.9	3.41	336	63.6	<130
S. Meadow	6 DUP	9/24/92	854	68.3	3.55	317	57.6	<150
Hollander Crk.	7	9/24/92	149	52.9	2.54	208	44	190
Detection Limit			0.2	0.2	0.02	0.2	0.2	
Date Analyzed			10/1/92	10/2/92	10/3/92	10/2/92	10/4/92	10/1/92

*Cu = copper; Cr = chromium; Cd = cadmium; Pb = lead; Ni = nickel; TPH = total petroleum hydrocarbons.

** Analysis not requested.

Table 3.B.7. Concentrations (µg/Kg dry wt.) of PCBs in sediments collected 24 September 1992 from FDR Park ponds (ANSP Stations 1-7).

Location	Station	AROCLOR						
		1016	1221	1232	1242	1248	1254	1260
Edgewood Lake	3	<50	<50	<50	<50	<5	220	<50
Pattison Lagoon	4	<40	<40	<40	<40	<40	230	<40
S. Meadow	6	<50	<50	<50	<50	<50	<50	<50
S. Meadow	6dup	<60	<60	<60	<60	<60	270	<60
Hollander Creek.	7	<30	<30	<30	<30	<30	<30	<30

Table 3.B.8. Sediment effects levels used in this study.

Contaminant	ER-L[1]	ER-M[1]
Arsenic (As)	33	85
Cadmium (Cd)	5	9
Antimony (Sb)	2	225
Chromium (Cr)	80	145
Copper (Cu)	70	390
Lead (Pb)	35	110
Mercury (Hg)	0.15	1.3
Nickel (Ni)	30	50
Zinc (Zn)	120	270

[1]Effects Range-Low (ER-L) and Effects Range-Median (ER-M); Long et al. (1995).

Some water quality data from 1972 and 1992 are reported in Pennoni (1973) and ANSP (1992). These generally indicated high daytime dissolved oxygen concentrations, which is expected in highly productive systems. Night-time dissolved oxygen levels may fall due to respiration by algae and other organisms, but no night-time data were reported. In the 1972 samples, daytime dissolved oxygen was very low (1.5 mg/L) in Hollander Creek near the culvert to the Reserve Basin, indicating the influx of water of poor quality from the Reserve Basin.

Observations on submerged macrophytes were made at the time of depth determination. No submerged macrophytes were found in Edgewood Lake or Pattison Lagoon. Beds of coontail (*Ceratophyllum demersum*) were found in South Meadow Lake. Coontail was found in South Meadow Lake and was abundant in Pattison Lagoon in the 1992 survey (ANSP 1992). Water column samples were taken from Edgewood Lake, Pattison Lagoon, South Meadow Lake, and Hollander Creek (east section, near culvert to tide gate) on 23 November 1999. Qualitative assessments of algal communities in the ponds were made based on these samples collected on the same date.

The Pattison Lagoon and Edgewood Lake had very similar algal assemblages. The algal flora of these sites were highly dominated by green algae, especially non-filamentous forms (*Scenedesmus*, *Tetrastrum*, *Pediastrum*, *Tetraedron*, *Ankistrodesmus*, *Dictyosphaerium*, etc.). They also had:

- several moderate to large populations of blue-green algae (*Anabaena*, *Merismoepedia*, *Schizothrix*, and other blue-green coccoid colonial forms);
- many flagellated forms, especially euglenoids (*Euglena*, *Leptocincus*, *Cryptomonas*, *Peridinium*).

In general, the floras of these two ponds are probably the result of abundant nutrients.

South Meadow Lake had much less algal material, mostly diatoms with many different forms, though there were not many filamentous diatoms. The non-diatom algae were mostly colonial forms (*Pandorina*, *Scenedesmus*, *Pediastrum*); no blue-greens were observed in the initial scans. The lower amount of algal material, richer diatom flora and lack of blue-greens would probably indicate much lower nutrients than the other stations.

The Hollander Creek sample was taken near the culvert to the tide gate. This sample had the largest amount of material, over double that of other samples. However, much of it was undifferentiated organic “ooze.” This sample had most of the forms mentioned for the Pattison Lagoon and Edgewood Lake, though the Hollander Creek sample had higher numbers and much less blue-green material. In addition there were more diatoms than the other samples, but many fewer forms. Several diatom filamentous forms (*Melosira* spp., *Fragilaria*) were very abundant.

This sample probably represents the effect of higher nutrients than the other samples, based mostly on the greater amount of material and abundant diatom filamentous forms. There was an abundant diatom flora, but it was not rich in species. The possibly lower amount of blue-green algae that were present; however, might be related to specific differences in nutrients (especially nitrogen forms). This difference may reflect input of water from the Schuylkill River, in contrast to internal and watershed nutrient loadings of the pond samples.

Algal samples were taken in September 1992 (ANSP 1992), prior to the installation of the new pumped circulation system. Chlorophyll *a* concentrations (a measure of algal abundance) were very high in Edgewood Lake (mean of 287.4 mg/m^3) and Pattison Lagoon (mean of 273.3 mg/m^3). These concentrations are indicative of hypereutrophic conditions (extremely high nutrient conditions, see Glossary). Concentrations in South Meadow Lake were lower (mean of 41.4 mg/m^3). Edgewood Lake and Pattison Lagoon had similar algal communities, dominated by various blue-green algae (especially *Gomphosphaeria wucheriae*, *Nostoc commune*, and *Loefgrenia anomala*). Some cryptophytes (e.g., *Cryptomonas*), green algae and centric diatoms were also frequent. The abundance of nitrogen-fixing blue-green algae was considered indicative of nitrogen limitation in the ponds. The 1999 samples differ in dominance by green algae instead of blue-greens, and by different common blue-green taxa. Since blue-green algae are typically most abundant in late summer and early fall, the difference may reflect sampling time rather than a real temporal change.

In the 1992 samples, the algal community of South Meadow Lake was dominated by the flagellated cryptophyte (*Cryptomonas acuta*) and large populations of a green alga (*Kirchneriella lunaris*). Pennate diatoms, other green algal species and other flagellated euglenoids were also common. High densities of zooplankton were found, which may have grazed algal populations. Large mats of *Hydrodictyon* (a net-like green alga) were present along the shore of South Meadow Lake. The 1999 samples were similar in the rarity of blue-green algae and abundance of diatoms, but more green algae were found in the 1992 samples. At the time of 1992 samples, South Meadow Lake had little inflow and was reduced in size, so the observed conditions may not have been representative.

The creeks in the golf course (west section of Hollander Creek and Shedbrook Creek) were not characterized intensively in the 1998-1999 assessments. During normal flow periods, these creeks have no perceptible flow, though they would drain storm water into the Reserve Basin. Observations during faunal sampling indicate that these are relatively shallow, with accumulation of soft sediments on the bottom. Emergent and submerged macrophytes (e.g., coontail, *Ceratophyllum demersum*) were observed in these waterbodies.

In summary, the lagoons and ponds of the east (park) section are largely artificial, but nonetheless support a variety of plants and animals. Edgewood Lake and Pattison Lagoon show evidence of very high nutrient concentrations and accumulation of sediments (along with nutrients) in their sediments. Much of the original volume of these ponds has been lost to sediment accumulation. North Meadow Lake is currently managed as a wetland, and its role in filtering particulate matter from Edgewood Lake probably contributes to the lower sediment accumulation in

South Meadow Lake. The creeks in the golf course were likely highly modified during park and golf course construction, and their hydrology is entirely shifted from the original tidal state.

3.C. APPLICATION OF RESTORATION GOALS

3.C.1. Overview

Most of FDR Park is actively managed as landscaped park area, recreational fields and golf course. The park is also affected by runoff from the Interstate 95 bridge. Nonetheless, the park contains natural areas or unused lands that can be restored to provide more natural function without affecting other park uses. Unlike the stream valley parks, FDR Park is located on the Coastal Plain, and the park contains a remnant of the earlier tidal creek system. Although the ponds and channels are regulated by a tide gate and have little tidal fluctuation, some of the creeks and ponds support intertidal plants which are rare in Pennsylvania. The southwestern section of the park is currently not actively managed, with part of it used as a log recycling area. Most of this section is highly disturbed with evidence of filling and with many exotic plants, although areas of native vegetation occur. Portions of the golf course which are not part of fairways have regrown to old field vegetation as well.

Because of the other activities at the park, the small area of natural lands, and the degree of modification of the pre-existing landscape, the main goal of natural lands restoration is enhancement of existing resources. Target groups which can be enhanced by restoration activities include:

- Aquatic animals, e.g., fishes and macroinvertebrates. Restoration of the pond-creek system to a full tidal regime is not feasible given the structures within the park. However, several activities would enhance the ecological value of the ponds and lagoons. Because of the link between this pond-creek system of the park and the Delaware Estuary, these enhancements would be of regional importance.
- Intertidal plants. Maintenance and possibly enhancement of the state-designated rare plants in the park are important objectives.
- Native vegetation. Expansion of the few small patches of native vegetation and replacement of the exotic-dominated patches with native plants would be beneficial, particularly because of the paucity of natural lands in the Coastal Plain of the city. This vegetation will provide habitat for a variety of animals, as well.
- Birds. The park already serves as an important breeding, migratory and wintering area for land and water birds. These functions can be enhanced by increasing natural lands, enhancing woods, and by wetland enhancement.

Specific activities which are recommended to achieve these objectives are summarized in Section 3.E.

3.C.2. General Restoration Activities

3.C.2.1. Exotic Control

A habitat type that is becoming increasingly common in the Fairmount Park system is the exotic-dominated forest, shrubland and riparian zone. Exotic species are defined as those species which have been intentionally or accidentally introduced into an area outside its natural range. These species are most frequently found in open areas—forest edges, canopy gaps, along streambanks and riparian zones—but also occur in the herbaceous and shrub layer in forests with native canopy species and on disturbed slopes. Exotic species that were found invading natural lands in FDR Park during the 1998 survey are included in Appendix A-1.1 in Volume III. Exotic species of concern out-compete native plants for resources and can become very aggressive. The control of these species applies to all areas of the park system, since exotic species are well established in each of the parks surveyed. The control of exotic species can be labor-intensive, and volunteer help can be effective. However, volunteer control may not be effective at some sites (e.g., sites with poor access) or for some techniques (e.g., herbicide application). The method of control is dependent upon the species involved and can include cutting, burning, herbiciding and/or covering the area with plastic (DeLoach 1997, FNPCI 1998). Replanting of native species is highly recommended in areas where exotic removal has taken place, in order to increase shade and decrease reestablishment of exotics. However, exotic control is valuable even where planting is not feasible immediately, to prevent further spread into adjacent areas. This is particularly important around areas with restoration plantings. In the list of restoration activities, exotic/invasive control refers to control without planting.

Sites where exotic control has been initiated must be monitored following control. New shoots of exotic growth should be pulled to prevent further invasion. Due to the aggressive nature of most exotic species, it is essential that monitoring activities be well-planned and followed. Repeated application of control measures may be necessary for some species.

3.C.2.2. **Planting**

Planting of native trees, shrubs or herbaceous species is a primary restoration technique for different habitats throughout the park. While natural regeneration can provide new growth in many situations, planting can provide more rapid development of shade to reduce growth of exotics, more rapid cover to reduce erosion, and provide species which are unable to colonize the site. Typically, planting is done in sites that have been cleared of exotics. In the classification of restoration activities, it is assumed that control of exotics will be necessary prior to planting in most cases.

Selection of plants should be based on the habitat conditions of the site. A list of native species which are suitable for this area and the habitat requirements and resource demands for each are given in Appendix C-1 in Volume III. Selection of the type of stock to use (e.g., seeds, plugs, size of tree, bare root or balled root) will depend on the species to be planted, site conditions (e.g., risk of deer damage), site access and other logistical issues (Sauer 1998). Soil preparation, e.g., tilling and mulching, may be desirable to improve planting success and reduce weeds. Follow-up maintenance, such as watering and weeding, can also increase planting success.

In the categorization of restoration activities, planting is designated where it is the primary restoration activity. Planting is also routinely part of other restoration activities, such as gully repair and wetland creation. *Forest planting* involves planting a mix of trees, shrubs and herbs and is appropriate on newly cleared areas. *Tree planting* is recommended to increase representation of specific tree species, to establish riparian woods on unforested flood plains, to provide shade and cover to control exotics and reduce erosion. *Shrub planting* may be done to improve understory conditions and introduce specific species of shrubs. *Herbaceous planting* is recommended for establishment of meadows and to improve understory diversity in areas where herb diversity has been reduced.

3.C.2.3. **Trash**

Illegal dump site.

FDR Park

In the Fairmount Park system, trash includes a wide and varied array of items. It can range from litter in the form of garbage to dumping of used automobiles and large appliances. There is a park log dump west of the tennis courts in FDR Park. Trash dumping is a problem at the southern border of the park, i.e., under the Interstate 95 viaduct. If an area appears to be a dump, it will seem an acceptable place to dispose of unwanted household appliances, yard waste and vehicles and the boundaries of these sites will eventually expand into natural lands. Piling of waste is not only unsightly, but it also compromises ecosystem integrity. Soils will become covered and/or compacted in the area, which will prevent growth of vegetation. Exotic plant species thrive in disturbed soils and full sun. Yard waste, containing seeds and root fragments of invasive plants, also adds to the presence of exotic species. The first step in this activity is to block access to such sites, such as by controlling access with permanent structures at points of entry. Cleanup can be an opportunity for volunteer groups, if the clean-up does not require heavy machinery or dangerous equipment. Removal of all debris from the site and proper disposal off site is required. Since the area will most likely be inundated with exotic species, replanting of natives should not begin until the exotics are removed and disposed of off site. The soil should not be tilled since an exotic seed bank will be present and this could cause regrowth of exotic species. The soil should not be left exposed or unplanted as this provides aggressive species with the opportunity to invade the area. The site should be replanted with native species that are appropriate for the habitat type which would have naturally occurred in the area. This type of restoration, as with other heavily disturbed areas, needs to be monitored consistently. Any exotics that may grow back, must be killed in order to ensure the success of the native plantings.

3.C.3. **Habitat-Specific Restoration Activities**

3.C.3.1. **Forested Uplands**

Forested area.

FDR Park

Forested uplands have been fragmented in recent years by adjacent construction activities, overall development and park landscaping. Forest regrowth is occurring on some formerly cleared or mowed areas such as the area south of the golf course. These sites may show long term effects of the earlier disturbance, and they may be vulnerable to exotic species. Not only does the forested upland habitat type support plants and animals, it also acts as a buffer for storm water runoff and prevents slope erosion.

FDR Park has relatively little woodland, and exotic species are dominant in much of what exists. Enlargement of woods and enhancement of native species is an important goal for restoration in the park. Both natural and anthropogenic influences on forested uplands have affected the stability of these woods. In areas where trash dumping and encroachment of recreational activities are issues, the wooded areas become fragmented, creating open habitat for exotic, aggressive tree species. Although the canopy in these areas may persist, there will not be any regrowth of the understory and herbaceous layer once exotic species become established.

Restoration in forested uplands is recommended to increase biodiversity of forested flora and fauna. In addition to exotic control, replanting and trash removal, the following activities can be included as restoration actions in the forested upland habitat: increasing forest area by decreasing the area that is currently mowed or managed, and replanting.

The benefits of restoration in forested areas include creating habitat and increasing biodiversity, since small patches of woods do not provide suitable habitat for many animal species. Replanting or removal of exotics in any area requires monitoring of the site. Restoration areas should be protected from vandalism by barriers and community members should be made aware of the restoration and the expected outcomes so they can participate in the monitoring efforts.

3.C.3.2. **Non-forested Uplands/Meadows**

Forest edge.

FDR Park

Non-forested uplands restoration includes lands which are not wetlands, forests or riparian zones. More specifically, non-forested uplands includes edges of forests, where invasive and exotic plants can dominate, meadow habitats, where herbs and forbs are dominant, and managed (e.g., mowed) lands which are no longer actively used.

Forest edges in the Fairmount Park system are often highly disturbed as they are typically small and linear and are adjacent to lawns, highways and structures which are often targets for trash dumping and vandalism. These areas are susceptible to invasion by exotic species, which are able to thrive in a broad range of habitat types with varying environmental conditions, especially in unshaded areas. Edges are an example of a place where exotics can outcompete native species for available resources, since natives are less tolerant of disturbances. This poses a problem, since the edge of a forest acts as a buffer for the interior of the woods. If the perimeter of the woods hosts exotics and fragmentation of wooded areas continues, the interior of the forest will be negatively impacted, as the seed source for exotics is present. However, if the edge is managed effectively, it can serve as a first line of defense against disturbance in healthy stands of forest. Well-managed edge habitats can also provide foraging areas for some woodland species (e.g., butterflies feeding on flowers) and habitat for a variety of species. Common species presently found along the edge of wooded areas in the FDR Park include non-natives such as tree-of-heaven (*Ailanthus altissima*), princess tree (*Paulownia tomentosa*), Norway maple (*Acer platanoides*), paper mulberry (*Broussonetia papyrifera*), white mulberry (*Morus alba*), multiflora rose (*Rosa multiflora*), wineberry (*Rubus phoenicolasius*), Japanese stilt grass *(Microstegium vimineum*), Japanese honeysuckle (*Lonicera japonica*), oriental bittersweet (*Celastrus orbiculatus*), and natives such as box elder (*Acer negundo*), grape vines (*Vitis* spp.) and poison ivy (*Toxicodendron radicans*). Mile-a-minute (*Polygonum perfoliatum*) is spreading within the park, mainly along edges.

Meadows are an under-represented habitat type in the Philadelphia area. Where present, they support a wide variety of bird species and invertebrates which may otherwise be absent from an urban setting. These sites are open and are often located near major roads or trails making them accessible to vandals. In many sections of the park, meadows have become a waste disposal ground for vehicles and large appliances. In order to preserve this habitat type in the landscape, we must take an active role in maintaining lands as open meadows and preventing them from succeeding into wooded areas or being destroyed by vandalism.

In an undisturbed area, succession is a natural process in which one group of species replaces another group over a given period of time, following fire or some other natural disaster, which acts as a catalyst. Following the disturbance, grasses, annual herbs and some perennial herbs will typically be the first community type to become reestablished in the landscape. Perennial herbs will increase over time, followed by replacement woody species such as shrubs and small trees. These, in turn, will be replaced by large trees (including large specimens of some mid-successional species such as tulip poplar, plus late successional species). Eventually, if no other disturbance occurs, a closed canopy will result. In areas of disturbance, where land was used for agriculture or development and where fire has been suppressed, the natural process of succession has been interrupted and exotic plants have outcompeted native species. Exotic species occur frequently in areas of high soil fertility, such as abandoned agricultural fields and disturbed areas. The vegetative community composition is dependent upon the level of disturbance and the length of time that the area has lacked a management regime. It is currently not known whether these exotic-dominated old fields will eventually be replaced by late successional stages with more native species, or whether the exotics can arrest or greatly delay successional patterns.

Non-native forbs such as goutweed (*Aegopodium pedagraria*), garlic-mustard (*Alliaria petiolata*), Canada thistle (*Cirsium arvense),* purple loosestrife (*Lythrum salicaria*) and lesser celandine (*Ranunculus ficaria*), as well as non-native grasses such as Japanese stilt grass (*Microstegium vimineum*) and Kentucky bluegrass (*Poa pratensis*), take advantage of these open habitats and will outcompete native mustards (*Brassica* spp.), milkweed (*Asclepias syriaca*), butterflyweed (*Aeslepias tuberosa*), native asters and native grasses such as bluestems, rushes and sedges.

Areas which are not presently used for recreation, but are being mowed could be managed as meadows by mowing infrequently and possibly burning the area to promote plant diversity. Replanting of these areas is also recommended to establish native species and deter exotic species.

Restoration Activities. The actions recommended as part of the restoration plans for non-forested uplands are grouped and described according to their functions in the following paragraphs.

Protection of natural lands is the first step in restoring and maintaining native biodiversity. High quality meadows and forest edges need to be protected from exotic invasion and should also be monitored to ensure against future disturbance. Other types of activities include control of invasive plants, replanting, management to maintain meadows (prevent forest succession), trash removal, control of access, and storm water management. Activities which are similar to those in other habitats are discussed elsewhere in this document.

Protection:

Protect/Monitor- This action is recommended for meadows and edges that presently support native plant and animal species and do not appear to be disturbed. These areas are identified in the restoration site lists (Table 3.D.1) and site assessments (Section 3.E) , and should be protected from human impact. No specific restoration activities are identified for these sites at this time. They should also be monitored for human disturbance and invasion by exotic species. Other significant sites for which restoration actions are recommended should also be protected and monitored.

Active Management:

Edge Management- The recommendation for edges is to remove the exotic vegetation and replant the area with more appropriate native species. It is also recommended that trash be removed from these areas.

Release-This action is recommended for lands that are currently mowed, but are not actively being used for recreational purposes. Depending on the adjacent land uses, visual aesthetics, etc., different management regimes may be used for released area. Infrequent mowing of an area will promote the growth of native plant species and prevent succession by trees and shrubs. Any decrease in the frequency of mowing can increase the height and diversity of vegetation and increase water retention. Mowing only once a year will suppress trees, but allow herbaceous cover. These areas can act as buffers to woods, wetlands and riparian zones. Alternately, mowing may be stopped and the area may be planted with trees or shrubs or allowed to revert to forest. Monitoring for invasion by exotic species should be done in release areas. Planting release sites is advisable to reduce open space for exotics. Once areas are released, management options are similar to those for the following activity, meadow management.

Meadow Management-This is recommended to maintain meadow sites The action promotes the protection of established meadows by seasonal mowing, burning, or tree removal. Meadow management encompasses the removal of exotics and the replanting of natives, prescribed burning, preferably in the spring and managed mowing to be performed once a year. Hand-cutting or girdling of trees can be done to prevent forest succession. This can be done by volunteers and in areas inaccessible to mowers. These activities can enhance existing meadows. These meadows will provide habitat for native fauna and will protect adjacent slopes and forests from the negative impacts of storm water runoff. A management plan for maintaining an area as a meadow must be drafted and followed throughout the year or the area will once again become inundated with exotic species and trash. Barriers and signs should be place around the restored area to make community members and users of the park aware of the many benefits of open meadow habitats and to avoid the perception that these areas have been abandoned.

Replanting and Exotics Control:

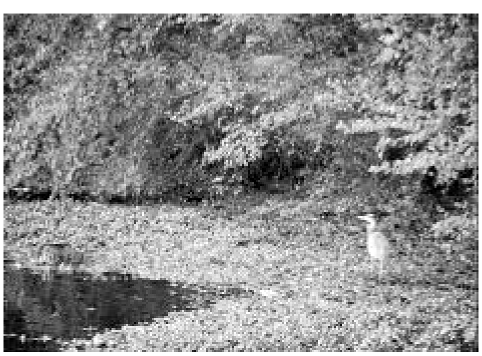
Invasive/Exotic Control- This action is recommended in those areas where there are minor invasive/exotic issues, the removal of which would promote native vegetation regrowth. This does not include any replanting. For example, this is recommended to reduce spread of mile-a-minute.

Remove Exotics/Replant Natives-This action implies that once the exotic plants are removed from an area, the area be planted with appropriate native species. This differs from the *invasive/exotic control* action as it includes replanting of natives as part of the activity. Herbaceous plants can be established by seeding or transplanting plugs. While the former may be less expensive, the latter is apt to be more successful, especially when competing with exotics species.

Remove Structure/Replant Natives- Where a dilapidated man-made structure is impeding the growth of native species, it is suggested that this structure be removed and native plants be put in its place.

3.C.3.3. **Riparian Zones**

Riparian zones are areas adjacent to a body of water which are influenced at least periodically by flooding (Mitsch 1993). They serve as ecotones between aquatic and terrestrial communities and are important areas for animal refuge and migration. Plant communities of riparian zones are usually diverse due to the gradients in moisture. Riparian areas are valuable to people because they can slow the flow of water during a storm event and prevent flooding.



Great Blue Heron in a riparian zone.

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In the highly managed FDR Park, the banks of the ponds are particularly important as natural areas. The natural vegetation of these riparian zones has been altered in such a way that they are no longer able to function as they should. The pond edges and shorelines are habitat for several rare plants, which need unshaded conditions. The restoration activities for riparian zones in this project include removing invasive species, regrading the banks where necessary and replanting with native forest corridors at least 35 feet in width (if feasible) to serve as a functional riparian zone. Management of some parts of the shoreline as wet meadows to support these species and maintenance of trees and shrubs in other parts of the shorelines can enhance natural vegetation. Riparian zone management will also need to balance needs for lake access (e.g., for fishing) and for vistas across the ponds.

3.C.3.4. **Wetlands**

Cattail wetlands.

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Wetlands are defined as transitional lands between aquatic and terrestrial habitats where saturation with water leads to characteristic soil types and plant and animal communities. These areas are biologically rich, and development and potential impacts on wetlands are regulated by the Federal government under the Clean Water Act. The vegetation and biological function of wetlands is directly related to physical topography and hydrology, so that wetlands in Fairmount Park have been tremendously impacted by the earlier agricultural development and subsequent urban development of the area. For the same reasons, new wetlands may be created or existing wetlands modified by changing hydrology and other factors. The resultant vegetation will depend on the pre-existing conditions and the restoration activities used. In this section, relationships between environmental factors and vegetation are discussed, in order to present various options for wetland enhancement in FDR Park.

According to the U.S. Fish and Wildlife Service (FWS), the following three criteria must be met in order for an area to be considered a wetland for regulatory purposes: 1) the land must be dominated by hydrophytic vegetation; 2) the soils must be categorized as hydric; and 3) the land must be saturated with water for some time during the growing season. There are other biological, physical and chemical factors such as light, temperature, and man-induced disturbances which alter the community composition and overall biodiversity of wetlands.

Wetlands are classified into the following five systems by the FWS; Marine, Estuarine, Lacustrine, Riverine and Palustrine. These systems are partly distinguished from one another based on their level of tidal influence and also the amount of salinity present from the ocean. Marine systems have saltwater, tidal flows. Estuarine systems are tidal systems with a mix of fresh water and oceanic water producing brackish conditions (this definition is more restrictive than the standard ecological definition, which considers freshwater tidal systems as estuarine as well). Lacustrine wetland systems are defined as permanently flooded lakes, ponds and reservoirs. These areas may be deep and may experience considerable wave action. Riverine systems are defined as wetlands which are contained within a natural or man-made channel. Palustrine systems are defined as vegetated wetlands less than two meters deep which have no tidal influence.

The majority of wetlands found in the Fairmount Park system can be classified as palustrine wetlands, according to the FWS classification system. Larger wetlands in the park (apparent on the aerial photographs used to develop the vegetation maps) are identified on the vegetation maps. Wetlands can be broadly categorized as swamps, marshes, or open water areas. Swamps are defined as areas with a woody canopy, while marshes are unshaded and dominated by herbaceous vegetation. These types may be further categorized on the basis of vegetation cover, which is strongly controlled by the depth and frequency of inundation with water (Table 3.B.4). Marshes were categorized as cattail (*Typha* sp.) marsh, *Phragmites* marsh, intertidal marsh, sedge/rush/grass marshes, and wet meadows. These types roughly follow a gradient from deeper and more frequent inundation to less frequent inundation. FDR Park contains a mix of wetland types, including *Phragmites* marsh, cattail marsh, and several small open sedge-grass marshes and swampy wetlands in the area north and west of the tennis courts . Within the park, tidal flow has been cut off from Hollander Creek to the Schuylkill River by means of a tidal gate. Historically, the park consisted largely of intertidal marsh supporting a variety of plant species (Table 3.B.1), most of which are specific to tidal marshes in this area. Ditching, diking and filling replaced most of the intertidal marshes with various nontidal wetlands and with non-wetlands. As part of park development, the tide gate was installed and the ponds and lagoons were excavated. A remnant of the intertidal flora still exists in Hollander Creek, although the tidal range is much reduced. Some areas with wetland hydrology may be maintained as lawns by mowing, which may be the case along the golf course and the ballfield areas of the park. Table 3.B.9 illustrates the types of wetlands in Fairmount Park, the functions of the habitat type, the restoration recommendations, and the benefits of restoration. These represent both existing types and potential models for restored or newly created wetlands.

It is especially important to promote and highlight the ecological importance of wetlands in urban settings. Wetlands can provide a number of environmental benefits, including reduction of storm flows by water storage, supply of water during low flow conditions, purification of water (by storage or removal of nutrients and other substances), and support of a variety of plants and animals. For example, North Meadow Lake is currently maintained as a marsh which filters water circulating through the Edgewood Lake-Meadow Lake-Pattison Lagoon system. These wetlands also support numerous plant and animal species that may otherwise be absent from an urban setting. Some of the low-lying woods in FDR Park (e.g., in the southwest part of the park) may include areas that could be classed as wetlands, depending on their soils and degree of inundation. Because of the gradation in these characters, the vegetation survey did not distinguish wetland and non-wetland floodplain forests, except where there were marked differences in vegetation (e.g., presence of herbaceous wetland plants), standing water, etc. There are small patches of sedge/rush/grass marshes scattered throughout the park, including a few in FDR Park; however, most of these were too small to be mapped.

Hydrology. This factor is often the most difficult to quantify in the field. However, it is the most critical since the presence or absence of water determines whether soils will be hydric and vegetation hydrophytic. Water can originate from various sources, including but not limited to: storm water runoff, precipitation, headwater or backwater flooding, tidal influence and groundwater. These sources can operate independently, but in many cases wetlands are controlled by a combination of hydrologic factors. Topography, soil type and vegetative cover are all factors that have been shown to affect the hydrology of a wetland. The frequency and length of time of saturation or flooding is highly dependent upon the position of the wetland in the landscape and the land use history of the area. If a wetland is located in a floodplain area or riparian zone, it may stay more wet for a longer period of time than a wetland whose elevation is far above the floodplain. Man-made structures, such as tidal gates and natural obstacles can also alter the water holding capacity of a wetland. Soils and vegetation in turn also affect the amount of water that can be held by a wetland. Clay soils, for example, hold water for a much longer period of time than do sandy or loamy soils, due to the fact that they absorb and release water at a much slower rate. In general, more densely vegetated wetlands are able to hold more water because plant cover slows water flow.

Table 3.B.9. Classification of wetland types in the Fairmount Park system, with relative importance of various types of benefits and major restoration activities.

	Type and Vegetation	Hydrology	Functions					Potential Restoration Activities	Abundance in FPC
			Storm water Retention	Source at Base Flow	Water Quality	Floral Biodiversity	Faunal Biodiversity		
Open Water									
	Permanent pond	Permanent standing water	Depends on basin capacity	Yes	Yes	Submerged macrophytes, algae	Important to fish and other groups.	Enlargement, habitat improvement, dredging, nutrient control; faunal or floral reintroduction	Small, artificial ponds
	Vernal pond	Seasonal standing water	Variable	Late winter and spring	Variable	Variable	Spawning sites for some reptiles, amphibians, and other groups	Controlling hydrology to produce specific requirements; faunal or floral reintroduction	Rare or absent
Marsh									
	Intertidal	Fluctuating saturation	Little	No	Yes	Variable; supports regionally rare species	Important for fish, birds, other groups	Controlling hydrology	Local
	Phragmites	Variable	Tolerant of occasional inundation	No	?	Low	?	Invasive control and replanting	Fairly common
	Cattail	Permanent, shallow standing water	Tolerant of occasional inundation	Yes	Yes	Low-moderate	Important for some groups	Enlargement, habitat enhancement, exotic control	Fairly common

Table 3.B.9 (continued). Classification of wetland types in the Fairmount Park system, with relative importance of various types of benefits and major restoration activities.

	Type and Vegetation	Hydrology	Functions					Potential Restoration Activities	Abundance in FPC
			Storm water Retention	Source at Base Flow	Water Quality	Floral Biodiversity	Faunal Biodiversity		
	Sedge-Grass-Rush	Seasonally saturated soil	Intolerant of long periods of standing water; locally small sites with little storage capacity	Yes	Yes	High	Important for some habitat specialists	Enlargement, habitat enhancement, exotic control, floral reintroduction	Some very small patches
	Exotic (Japanese knotweed, lesser celandine)	Variable	Variable	Variabl e	?	Low	Probably low	Exotic control and replanting	Common
Swamp or Marsh									
	Skunk cabbage	Permanently wet soil	Intolerant of long periods of standing water and storm flows	Yes	Yes	Moderate	Important for some habitat specialists	Maintain hydrology, promote forest cover	Common, mostly small seeps

Table 3.B.9 (continued). Classification of wetland types in the Fairmount Park system, with relative importance of various types of benefits and major restoration activities.

	Type and Vegetation	Hydrology	Functions					Potential Restoration Activities	Abundance in FPC
			Storm water Retention	Source at Base Flow	Water Quality	Floral Biodiversity	Faunal Biodiversity		
Swamp									
	Large tree dominated: Silver maple, red maple sycamore, box elder, ash, etc.	Intermittently wet soil	Tolerant of short periods of inundation	Yes	Yes	Moderate-High	Important for many groups; depends on amount of standing water, etc.	Maintain hydrology, exotic control and replanting, control erosion, sedimentation	Common on floodplains; gradation with non wetland floodplain forests
	Shrub dominated: alder, buttonbush	Intermittently wet soil	Tolerant of short periods of inundation	Yes	Yes	Can support uncommon species	Important for some habitat specialists	Maintain hydrology, exotic control and replanting, control erosion, sedimentation	Absent?
	Misc.: e.g., lizardtail	Intermittently wet soil	Tolerant of short periods of inundation	Yes	Yes	Can support uncommon species	Important for some habitat specialists	Maintain hydrology, exotic control and replanting, control erosion, sedimentation	Rare (e.g., Rhawn Street wetland)

In FDR Park, the original hydrology has been almost completely transformed by the construction of the tidal gate. However, much of the area retains its basic wetland history– low elevation and saturated soils. The persistent hydrologic problems of the park (e.g., Pennoni 1973) are basically those of building in a wetland, exacerbated by urban runoff from roads, buildings, and lawns in the park and from the adjacent city.

Structure/Type of Wetland. Wetlands not only depend on the presence of water, but are also affected by the amount and periodicity of wetting, which is important to consider in regard to restoration and planning activities. The amount of water will determine the floral and faunal composition on the site and the overall functioning of the wetland. Classification criteria for hydrologic zones, based on the frequency and duration of inundation or saturation of the soil during the growing season, have been developed by federal agencies and implemented by wetlands scientists. Classifications range from zone 1, areas which are labeled "permanently inundated" to zone 6, which are "intermittently or never inundated." Table 3.B.10 presents a classification system for non-tidal areas.

Table 3.B.10. USFWS Classification of wetland types on the basis of frequency of inundation.

Zone	Classification	Duration	Comments
1	Permanently inundated	100%	Inundation <6.6. f. mean water depth
2	Semipermanently to nearly permanently inundated or saturated	>75%- <100%	Inundation ≤ 6.6 ft mean water depth
3	Regularly inundated or saturated	>25%- 75%	
4	Seasonally inundated or saturated	>12.5%- 25%	
5	Irregularly inundated or saturated	≥5%- 12.5%	Many areas with this characteristic are not wetlands
6	Intermittently or never inundated or saturated		Areas with this characteristic are not wetlands.

U.S. Army Corps of Engineers, Wetland Delineation Manual, 1987.

Soil Chemistry and Composition. Soil composition and chemistry strongly affect the types of flora and fauna that can be found in a wetland. Hydric soils are defined as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (Federal Register, July 13, 1994). Anaerobic conditions refer to the effect of microbial activity in wet soils which causes a depletion of oxygen. Decomposition is generally slow in these oxygen-depleted areas, and partially decomposed plant materials tend to accumulate in areas of little water movement. Soils that result from this process are called histosols. In areas of rapid or frequent water movement, the organic layer of the soil is washed away, leaving behind sand, silt and clay. The effects of anaerobic conditions include the accumulation of organic matter, the accumulation or loss of iron, manganese, sulfur, or carbon compounds. Hydric soils can be identified in both wet or dry times of the year based on the characteristic morphologies of the above processes, such as oxidized root channels. Another indicator of a hydric soil is the strong odor of hydrogen sulfide gas. However, this indicator cannot be depended upon for all areas, as it only occurs in very wet sites which contain sulfur.

Wetland Chemistry. The community composition of wetland vegetation is strongly affected by pH and associated chemical variables. Acid wetlands created by microbial processes affecting plant decomposition, are described as having a pH of less than 5.5. Circumneutral wetlands are defined as those with a pH ranging from 5.5-7.4, and alkaline sites, which are generally created by limestone or similar rock in the drainage or groundwater, have a pH of 7.4 or greater. Based on historical plant occurrence, some acidic wetlands may have occurred within Philadelphia. These may have been analogous to acidic areas near the Delaware River in Bristol, PA. For example, there are reports of historical occurrence of Atlantic white cedar (*Chamaecyperis thyoides*), a species typical of acidic wetlands, near the lower Schuylkill River (A.E. Schuyler, pers. comm.), i.e., near the current site of FDR Park. However, the wetlands now present throughout Fairmount Park are circumneutral.

Vegetation. Hydrophytic vegetation includes plants that are adapted morphologically to grow in wet conditions. They are found in areas that are, at the least, periodically deficient in oxygen as a result of excess water. These plants have adapted morphological, physiological and reproductive characteristics to the wet conditions in which they grow. Plants lacking morphological, physiological, and/or reproductive adaptations for wet conditions cannot grow, effectively compete, reproduce, and/or persist in areas that are subject to prolonged inundation or saturated soils. Morphological adaptations to vegetation in wet areas include but are not limited to the following: buttressed tree trunks, shallow root systems, floating leaves, and multiple trunks. These adaptations aid the plants in nutrient uptake, buoyancy, and support, and are indicative of a wet area. Physiological adaptations are essential for plants that are subject to the anaerobic conditions of wetlands. Adaptations such as these are not easily quantified in the field since they involve biochemical processes. Prolonged viability of seeds and flood-tolerant seedlings are several reproductive adaptations which plants in wet conditions must also possess.

Wetland Functions. The wetlands in FDR Park have become targets for destruction since they are easily drained or filled to accommodate for development. The benefits of wetlands are sometimes not obvious and these biologically diverse ecosystems can therefore be regarded as waste areas or areas that attract mosquitoes and pests. Wetland functions are defined as the biological, chemical and physical processes of the wetland, many of which provide direct benefits to human beings. Wetlands play an integral part in the purification of water. They act as a sink for nutrients and metals and can filter the water of sediments and organic matter. They may serve as sites for transformation of nutrients (e.g., from organic nitrogen to inorganic nitrogen gas which is released to the atmosphere) or storage of nutrients. These processes improve overall water quality and provide us with clean drinking water. Wetlands in FDR Park process subsurface flows as well as storm water runoff that flood the wetlands. Wetlands are also involved in the process of water storage. They store rain water either from direct precipitation or from storm water runoff which is then slowly released from the wetland. Some of the values associated with this function include flood protection and erosion control. Wetlands are areas of high biological productivity, serve as breeding grounds for many aquatic species, and provide wildlife with refugia and food sources. Many species depend on wetlands, so that regional biodiversity depends on wetlands. These areas are also significant to the commercial fisheries industry as they are critical habitat types for many fish species.

The benefits provided by wetlands will vary with type, size and other site-specific factors. Different types of wetlands will differ in the relative importance of different benefits (Table 3.B.8). For example, the ability to reduce storm peaks by water holding will depend on the storage capacity relative to the size of the storm flow. Areas that have saturated soils (including ponds, swamps and marshes with standing water) require topography or structures (berms, etc.) that allow ponding of storm water. Since some of the wetland vegetation cannot tolerate long periods of inundation, large areas of such wetland would be necessary to store significant quantities of water. Furthermore, storm flows may carry sediments which would be deposited by storms. While this can be considered as a type of filtration, it can fill in wetlands unless there is periodic maintenance to remove sediment. Similarly, the purification functions of wetlands will depend on their size relative to inputs. Wetlands along tributaries, seeps, etc., may be more effective for these functions.

Relevance to Restoration. Although wetlands were once abundant in Philadelphia, in particular in the tidal Delaware River area, these areas have since been filled and/or drained for development. To preserve and restore the natural landscape in the area, we must place special emphasis on wetlands. This includes preserving them from further destruction, implementing actions to aid them in proper functioning and working to replace lost wetlands. As part of this project, we have identified wetlands in the park boundaries and have offered recommendations for the protection and/or restoration of these lands. Recommendations are based on the size and condition of the existing wetland, the ecological benefits of enlarging or creating a wetland and the feasibility of long-term monitoring, and cost associated issues. For example, a wetland located along a large stream would need to be large and deep in order to store the overflow from the stream as well as storm water. This could prove to be an extremely expensive project, and may not prove to be as beneficial as removing exotics and trash from several existing wetlands. The actions recommended as part of the restoration plans are grouped and described according to their functions in the following text.

Development and urbanization have lead to the destruction of tidal wetlands, which were once abundant along the Delaware River and intertidal wetlands which existed in the wooded areas of Philadelphia. Protection of the few remaining wetlands in the park is critical to many species of plants and animals, including humans. For many aquatic species, these wetlands acts as refugia, without which the species would not survive in this area. The overall level of biodiversity in the Philadelphia region is dependent on the protection of natural lands in the city. Wetlands have proven to be lands of high productivity and diversity and it is essential that we understand their ecological significance.

Restoration Activities Recommended in Wetlands. Areas of FDR Park that have already been mapped and verified by ground-truthing as wetlands are sites that should be protected and monitored to ensure against future development in the area. These sites are shown on the Restoration Sites Map in Section 3.F and highlighted on park maps to raise public awareness of the existence and importance of wetlands. This action is recommended for wetlands where little disturbance is evident.

A variety of active restoration activities are recommended for wetlands. Many of these are analogous to activities in other habitats. These include activities designed to reduce damage to wetlands by controlling access or improving trails and structures associated with access, enhancing wetland vegetation, improving hydrology, and enhancing native fauna.

Access:

The following action addresses the need for increased or decreased access to an area of the park. Where restoration sites occur on or near sites that are heavily impacted by humans and or deer, structures such as boardwalks and exclosures must be installed to protect the existing vegetation and/or the new plantings from the effects of trampling and herbivory.

- *Structural Improvement*. If there is an obvious structure (e.g., a dam, parking lot, etc.) that is impeding water from reaching the wetland, and it is feasible, we are suggesting that these structures be removed to restore the natural hydrology of the area.

Replanting and Exotics Control:

Wetlands can be especially prone to invasion of exotic plants, and several actions are suggested to promote native vegetation and control exotics. Some of the more common problematic species found in FDR Park include: Japanese knotweed (*Polygonum cuspidatum*), purple loosestrife (*Lythrum salicaria*), lesser celandine (*Ranunculus ficaria*), common reed (*Phragmites australis*), Japanese stilt grass (*Microstegium vimineum*), Japanese honeysuckle (*Lonicera japonica*), purple loosestrife (*Lythrum salicaria*) and oriental bittersweet (*Celastrus orbiculatus*). When attempting to rid an area of exotics, species-specific removal methods need to be researched. Exotic species are aggressive and have demonstrated their ability to grow in a wide variety of habitats under different conditions. Care should be taken when removing these plants from a site to ensure that every part of the plant is removed and disposed of off-site. To promote native vegetation and decrease the incidence of exotics, replanting the area with appropriate native species after exotics have been removed is recommended. The general recommendations for replanting address those areas in which the native vegetation is sparse due to some factor other than exotic species, such as man-made structures and herbivory.

Invasive/Exotic Control- This action is recommended in those areas where there are minor invasive/exotic issues, the removal of which would promote native vegetation regrowth. This action does not include replanting.

Remove Exotics/Replant Natives- In areas where wetland vegetation is sparse due to the dominance by exotic species, it is recommended that exotics be removed and native wetland species be planted. Removal of exotic species from a wetland and replanting of natives that are appropriate to the region, will promote wetlands which are able to support native fauna. This may aid in increasing the level of biodiversity in the area and will promote succession.

Replant Native Herbs- This is recommended in areas where the shrub and canopy layers are well established, but the herb layer is sparse due to human disturbance or impacts from deer browsing.

Replant Native Shrubs- In wetlands where the herbaceous and canopy layers are well established, but the shrub layer is sparse due to human disturbance, replanting of native shrubs is recommended. This adds vertical diversity to the wetland and promotes understory growth.

Replant Native Trees- Recommended in areas that have large canopy gaps due to exotic vines or dead standing trees.

Storm Water/Channel Actions:

Hydrological or topographical modifications are suggested to enhance the water filtering and holding functions of the wetland and to promote high biological productivity.

Berms-Vegetated mounds that act as dikes which are placed in the path of the storm water runoff can be used to promote infiltration and decrease flow velocities. Berms promote the greater infiltration of rainwater into the ground, thereby decreasing storm water runoff and reducing erosion and the occurrence of gullies.

Regrade Banks- Streambanks which are unstable can benefit by regrading to decrease their slopes. Many of the problems which cause unstable streambanks are caused by upstream impacts and would require solutions which are not contained within the scope of this project.

Creation/Expansion:

Suggestions for increasing wetland acreage are provided such as expanding existing wetlands by changing management techniques, and creating new wetlands where they do not currently exist.

Release/Widen - A simple management technique that could enhance wetland activity is to mow less frequently in areas adjacent to wetlands. Some mowed areas may have wetland hydrology and may support wetland vegetation if frequent mowing is stopped. Mowed grass does not function as well as tall grasses and meadow forbs do in erosion protection. Where appropriate, open fields located next to wetlands should be mowed as infrequently as possible. Allowing natural vegetation to grow in a maintained area increases habitat for wetland species. Where usage is not high, these areas should be taken out of the active management regime, since they would then support diverse wetland plants and serve as refugia for animal species.

Wetland Creation/Expansion- This is recommended in areas that once existed as wetlands or appear to have the hydrology and soils that could support hydrophytic vegetation and are typical of a wetland. To ensure success, the hydrology, soil characteristics and vegetation present need to be examined carefully to determine the appropriate depth and area needed to sustain a healthy wetland. This also requires replanting of the wetland with appropriate native wetland species. Some existing wetlands may be enlarged where the surrounding area could be restored to contain appropriate hydrology and vegetation.

3.C.3.6. **Channel and Pond**

A highly manipulated channel.

FDR Park

Proposed restorations were classified as “channel” type if the activity is intended to restore a stream within its channel or along its banks. The types of “channel” restoration actions applicable to FDR Park include: trash removal, modify channel, structural improvements (trails and storm water), dredging, restoration of tidal flow, and fish reintroduction. A given restoration site may involve one or more of these actions, depending on site-specific conditions. The overriding objective for channel restoration is to improve in-stream habitat to a more natural state.

Given the highly modified (and partly artificial) nature of the ponds and lagoons in FDR Park, restoration to natural reference models is not appropriate. Instead, activities were identified to enhance specific aquatic resources (e.g., riparian vegetation, fishes and other aquatic organisms). These activities are discussed in the structural improvement section below.

Trash Removal. Trash accumulates in and at the edges of the ponds and lagoons of FDR Park, especially at the channel between Edgewood and North Meadow Lake and around Pattison Lagoon. Periodic trash removal is a general recommendation for the park riparian zones, ponds and lagoons.

Modify Channel. This is an umbrella term which includes any type of in-stream modification of channel grade or shape.

Structural Improvement to Channels and Ponds. These actions seek to address problems caused by malfunctioning or obstructive structures in or near streams. The main structural issues in FDR Park are the tide gate which controls water flow in and out of the park, and the concrete linings of the ponds. These are discussed in the writeups of the individual restoration sites.

Dredging. Dredging sediments in ponds of FDR Park can have several benefits, such as increasing volume for aquatic organisms, providing cooler bottom water during summer, and removing nutrients. Typically, nutrients (especially phosphorus) build up in pond sediments, derived from decaying algae and vegetation and inputs from the watershed. If the sediments become anoxic (lack dissolved oxygen), they can release nutrients back into the water column, which can encourage algal blooms. At high nutrient concentrations, algae (e.g., blue-green algae) of lower food value to aquatic animals can become dominant. The high algae concentrations can lead to fluctuations in dissolved oxygen, with reduced values at night when algae are respiring and not photosynthesizing. Thus, sediments can help perpetuate a cycle of high nutrients, algal blooms, reduced dissolved oxygen, nutrient regeneration, and deposition of algae to the sediment; this cycle is often referred to as eutrophication. Removal of nutrient-rich sediments can reduce eutrophication in two ways: by directly removing some sediment; and, increasing depth and creating stratification, which can reduce nutrient flux from sediments into surface water.

Dredging can have potential risks that need to be considered. Shallow water habitats can be important for submerged and aquatic plants and as refuge for small fish and other organisms, so that large reductions in shallow waters can have negative impacts. Turtles hibernate in shallow sediments, so large reductions in area of shallows or dredging during the winter could have adverse impacts. If sediments are contaminated with high levels of nutrients or organic pollutants (PCBs, pesticides, etc.), disposal of dredge spoil may be a problem and dredging could expose buried contaminants. Depending on how dredging is done (draw-down of lake, pumping, etc), there may be direct mortality of benthic organisms or effects on shoreline plants.

Fish Habitat Enhancement Techniques. A number of devices have been developed to improve habitat for certain fish. Cover for fish may be provided in pond and lake habitats (D'Itri 1985). Such installations can be as simple as addition of trees, or may involve more complicated artificial structures. These structures can provide attachment sites for algae and invertebrates, spawning sites for organisms (species which attach eggs to hard surfaces or which guard nests in crevices), and cover for both forage fish and predators. These projects may be implemented by volunteers, and organizations and agencies (e.g., Pennsylvania Fish and Boat Commission) may assist in planning and installation.

3.C.3.7. **Faunal Monitoring**

Most of the restoration activities are expected to affect park fauna by improving habitat for terrestrial and aquatic animals. Some activities directly involve fauna. These include some types of monitoring and introductions. While the faunal inventory for this study and other monitoring programs provided a great deal of information on faunal occurrence and abundance, sampling was limited in time and space. Additional monitoring can be valuable in determining occurrence of uncommon species, determining trends in species, and determining response to restoration. The assessment for this study demonstrated decreases in the native fauna in many groups and increases in exotic species in some groups. Sampling of other taxonomic groups would provide additional information on the park fauna. Monitoring programs can be linked to environmental center activities, to park special events and to more thorough scientific collection.

Faunal monitoring would be particularly valuable as part of some restoration activities. Where feasible, baseline and post-restoration monitoring should be defined as part of restoration planning, although in some cases, funding constraints may preclude monitoring. Monitoring of virtually any taxonomic group would be valuable, but certain groups would be particularly informative for different types of restoration, such as butterflies for meadow and edge management; aquatic macroinvertebrates for wetland creation and restoration, and stream channel restoration; reptiles and amphibians for wetland creation and restoration; fishes for restoration in larger wetlands and streams; birds for woodland restorations, meadow restoration, and exotic control; and terrestrial invertebrates such as land snails and slugs, ants and earthworms for woodland restoration.

Faunal Introductions. Re-introduction of animal species can restore the natural biodiversity of an area. However, there are some ecological risks to re-introductions which need to be considered. These risks are outlined in the project goals (Section 1.C). Where major restoration of vegetation is done, faunal re-introductions should typically be undertaken after successful establishment of the vegetation. Many organisms which are mobile or have mobile dispersal stages will colonize restored sites. However, introduction may be necessary for less mobile and habitat-restricted species or for species locally extirpated from an area. For example, reintroduction may be especially appropriate for some species of fish, amphibians (e.g., frogs or salamanders which reproduce in small ponds), or butterflies (see Volume I, Section 4.E.5).

Fish:

Natural colonization of fish to a site is expected where there is an aquatic connection to a source fauna. Introduction is appropriate to stock new, isolated ponds, to restore species extirpated from the colonizing source, and to develop migratory stocks on the site.

Introduction should be made from local sources, so that issues concerning disease and genetic differentiation are insignificant. Also, a nearby source material makes introduction logistically easy. Introduction would need approval by the Pennsylvania Fish and Boat Commission. In addition, collection of fish would be best done under a scientific collecting permit in order to use efficient collecting techniques and to collect enough fish. Introduction could probably be done successfully at various times during the year, but would probably be easiest and most successful in early to mid-spring. At this time, holding and transport of fish would be safer, since lower water temperatures reduces risks of handling mortality. The source and receiving water would be at similar temperatures, easing acclimation. Introduction at this time would also allow spawning during the first year. The specifics of stocking (methods of capture, holding, number, size and stage to stock, etc.) will depend on the species involved.

Wetland creation may be feasible in the southwestern part of FDR Park. Larger restorations (e.g., about one or more acres) with permanent water of a foot or more in depth would be able to support fish. These would provide an opportunity for introduction of fishes which were historically found in regional wetlands and are still present in some sites. The Eastern mudminnow and bluespotted sunfish are candidates for such programs. However, these species may be affected by predation and/or competition with other species (e.g., largemouth bass, bluegill, carp). It is likely that fishermen would stock some of these species in new ponds, especially since there is a nearby source in the existing FDR ponds, probably reducing the chance of successful reintroduction of native species. Stocking of smaller wetlands is not recommended, since these would support fewer fish individuals, would have a smaller likelihood of long-term success, and would be more valuable as breeding sites for amphibians which can be adversely affected by fish predation in breeding ponds.

The three-spined stickleback (*Gasterosteus aculeatus*) is a small, partly anadromous species which has become rare in Pennsylvania. It is known to inhabit some small tidal ponds (e.g., in Delaware County). Reintroduction of this species into existing ponds or new ponds, if these have a tidal connection, may be feasible.

Re-establishment of migratory stocks could be an important benefit of water quality improvements and increased water exchange through the FDR tide gate. Some migratory species return to their natal waterbody to spawn (they become “imprinted” on the their natal waterbody during early life stages by chemical or other cues). As a result, re-establishment of a stock may be prevented by lack of imprinted fish, and stocking of eggs or larvae may be necessary to produce fish that will return to the site. This strategy has been successful for American shad, which are closely imprinted on their natal river, and is being used on the Schuylkill River. However, it is likely that such stocking would not be necessary for species likely to benefit from the restoration and habitat improvements on streams and ponds outside the Schuylkill River. Anadromous or migratory species likely to use streams and ponds in FDR Park include alewife and blueback herring, gizzard shad, white perch, striped bass, and white catfish. These species are not as closely tied to their natal site as

American shad and may be expected to establish themselves through Schuylkill and Delaware River populations, if suitable habitats and connections are present.

Amphibians:

A number of frogs and salamanders are resident in ponds and wetlands and may be unable to recolonize new or enhanced sites because of the isolation of these sites. Several species (e.g., Fowler's toad, *Bufo woodhousi*, and spring peeper, *Hyla crucifer*) reproduce in ponds and use adjacent habitats (marshes, woods, etc.). The spring peper is present, but local in the Fairmount Park system (e.g., in the Pennypack and Wissahickon), and these species would be good candidates for introduction. Reproduction of these species is most successful in temporary ponds (e.g., vernal ponds) and other fishless sites. Another candidate for reintroduction to FDR Park is the Southern leopard frog (*Rana utricularia*). In Pennsylvania, this species has been much reduced in abundance because of development of the Coastal Plain. However, it does occur in the area at the Tinicum marsh. The leopard frog is resident in ponds and marshes, and it could be introduced to appropriate wetlands at FDR Park.

3.C.3.8. **Golf Courses**

The FDR golf course presents a special opportunity for protection, restoration and management of natural lands. The golf course contains much of the natural areas remaining in the park, including several lagoons. General recommendations for golf course management and recommendations specific to the FDR course were developed and presented to the managers of the courses. Relevant parts of these recommendations are presented in Appendix C-3 in Volume III.

3.D. RECOMMENDED RESTORATION ACTIVITIES

3.D.1. **Restoration Site Overview**

Thirty-one potential restoration sites were identified in FDR Park; for many of these, there were multiple or alternative restoration options. Of these, 28 have been identified as high priority restoration areas (Table 3.D.1). Some of the high priority restoration sites are categorized as high priority volunteer (HV), which is defined as sites where restoration is particularly suitable for school groups, friends groups and other volunteers. Typically, HV projects involve activities such as the removal of invasive and exotic vegetation and trash removal. These projects allow the community to become involved in the restoration and long-term monitoring of their park. Some sites are categorized as high priority sites which require coordination with other groups (HC sites). These are sites where restoration would need to be coordinated with other agencies or organizations in order to succeed, either because of the size of the project, joint control over different aspects of restoration, or possible regulatory issues concerning restoration. General recommendations for improving the quality of habitat in FDR Park include the removal of trash from the land and the lakes, removing exotic and invasive species, replanting riparian zones along the ponds and lagoons to create a buffered edge and mowing less frequently, where feasible.

Two large projects were identified: dredging parts of Edgewood Lake and Pattison Lagoon, and removing the swimming pool and restoring the southern part of South Meadow Lake. It is recommended that these projects be coordinated with other groups, because of their size and complexity.

While restoring tidal flow to the park is infeasible, changes in the tide gate to allow more tidal exchange could benefit the ponds in the park. Since the tide gate is located outside the park (in the Philadelphia Naval Yard), any change in structure or operation would require coordination with other groups.

Table 3.D.1. List of sites in FDR Park recommended by ANSP for restoration by NLREEP. Priority codes are: H=high; M=medium; L=low; HC=high, requires coordination; HD=high, after deer; HP=high protection; HPD=high, protection and restoration after deer are controlled; HT=high trail; HVD=high, volunteer action, other actions after deer are controlled; HV=high volunteer; MC=medium, requires coordination.

Site ID	Restoration Type	Site Name	Location	Priority	Acreage
V1.01	Forested Upland	Hill between Hollander Creek limbs	West of Algonquin Drive	H	6.79
		Action	**Priority**		
		Release/Widen	H		
V1.03	Wetland	Shedbrook Creek Wetland	East of Shedbrook Creek west of Edgewood Lake	H	0.88
		Action	**Priority**		
		Replant Native Herbs	H		
V1.05	Riparian Zone	Margins lower Shedbrook Creek	Shedbrook Creek	H	2.20
		Action	**Priority**		
		Release/Widen	H		
V1.06	Wetland	Recycling Center Wetland	N. of tennis courts	H	0.21
		Action	**Priority**		
		Remove Exotics/Replant Native Wetland Species	H		
V1.07	Riparian Zone	West margin of west limb Hollander Creek	West side Hollander Creek (n of Tennis Courts)	H	3.19
		Action	**Priority**		
		Remove Exotics/Replant Native Forest Species	H		
V1.08	Riparian Zone	East margin of West limb Hollander Creek	E side of Hollander Creek west of Algonquin Drive	H	1.16
		Action	**Priority**		
		Release/Widen	H		
		Remove Exotics/Replant Native Forest Species	H		
V1.09	Non-Forested Upland	Golf Course Meadows/Hills	Southern part of golf course	H	5.58
		Action	**Priority**		
		Protect/Monitor	H		
		Invasive-Exotic Control	H		
		Replant Native Herbs	L		
V2.01	Riparian Zone	South shore of Pattison Lagoon	Lagoon between Pattison Ave. and Pocono Trail	H	0.61
		Action	**Priority**		
		Release/Widen	H		
		Trash Removal	H		
V2.02	Riparian Zone	North shore of Pattison lagoon	Between Pattison Ave. and Pocono Trail	H	1.79
		Action	**Priority**		
		Release/Widen	H		
		Remove Exotics/Replant Native Forest Species	H		
		Invasive-Exotic Control	L		

Table 3.D.1. List of sites in FDR Park recommended by ANSP for restoration by NLREEP. Priority codes are: H=high; M=medium; L=low; HC=high, requires coordination; HD=high, after deer; HP=high protection; HPD=high, protection and restoration after deer are controlled; HT=high trail; HVD=high, volunteer action, other actions after deer are controlled; HV=high volunteer; MC=medium, requires coordination.

Site ID	Restoration Type	Site Name	Location	Priority	Acreage
V2.03	Non-Forested Upland	Park west of Swedish Museum	Between Pattison Ave., Pocono Trail, Swedish Mus.	M	2.62
		Action	**Priority**		
		Replant Native Shrubs	M		
		Release/Mow Infrequently	L		
		Meadow Management	L		
V2.04	Channel	Pattison Lagoon (no mapped polygon)	South of Pattison	H	
		Action	**Priority**		
		Dredge	HC		
V3.01	Forested Upland	Broad Street Buffer	Along Broad Street	H	5.43
		Action	**Priority**		
		Replant Native Trees	H		
V3.02	Non-Forested Upland	I-95 field (east)	Between I-95 and Navy Yard	HV	2.40
		Action	**Priority**		
		Invasive-Exotic Control	HV		
		Remove Exotics/Replant Native Meadow Species	L		
V3.04	Non-Forested Upland	Park northeast of Meadow Lake	Between north Meadow Lake and Pocono Trail loop	L	2.85
		Action	**Priority**		
		Meadow Management	L		
		Replant Native Shrubs	L		
V3.05	Forested Upland	Maintenance Center Woodlot	Bend of Algonquin Trail west of Broad St.	H	2.24
		Action	**Priority**		
		Replant Native Trees	H		
V3.06	Riparian Zone	Meadow Lake (southern part)	Meadow Lake	H	2.01
		Action	**Priority**		
		Structural Improvement	H		
		Replant Native Shrubs	H		
V3.07	Wetland	North Meadow Lake	Northern end	H	0.23
		Action	**Priority**		
		Invasive-Exotic Control	H		
		Trash Removal	HV		

Table 3.D.1. List of sites in FDR Park recommended by ANSP for restoration by NLREEP. Priority codes are: H=high; M=medium; L=low; HC=high, requires coordination; HD=high, after deer; HP=high protection; HPD=high, protection and restoration after deer are controlled; HT=high trail; HVD=high, volunteer action, other actions after deer are controlled; HV=high volunteer; MC=medium, requires coordination.

Site ID	Restoration Type	Site Name	Location	Priority	Acreage
V3.08	Riparian Zone	Hollander Creek (south part of east branch)	Across road from tennis courts	H	0.90
		Action	**Priority**		
		Protect/Monitor	HP		
		Meadow Management	H		
V3.10	Non-Forested Upland	I-95 field (west)	West part of park area south of I-95	HV	8.20
		Action	**Priority**		
		Invasive-Exotic Control	HV		
		Remove Exotics/Replant Native Meadow Species	M		
V3.11	Wetland	Margin of Meadow Lake (southern pond)	Southern part of Meadow Lake	H	0.95
		Action	**Priority**		
		Invasive-Exotic Control	H		
		Structural Improvement	L		
V3.12	Channel	Edgewood Lake	Edgewood Lake	H	3.88
		Action	**Priority**		
		Structural Improvement (SW)	H		
		Structural Improvement (SW)	H		
		Dredge	HC		
V3.13	Riparian Zone	Edgewood Lake	South edge of the Lake	H	0.68
		Action	**Priority**		
		Release/Widen	H		
		Meadow Management	H		
		Protect/Monitor	HP		
		Trash Removal	H		
V3.14	Wetland	Edgewood Lake	West edge of the Lake	H	1.55
		Action	**Priority**		
		Release/Widen	H		
		Invasive-Exotic Control	HV		
V5.01	Wetland	Log dump/field/woods	West of the W. Br. Of Hollander Creek	HC	3.74
		Action	**Priority**		
		Invasive-Exotic Control	HV		
		Remove Exotics/Replant Native Wetland Species	M		
		Wetland Creation	HC		

Table 3.D.1. List of sites in FDR Park recommended by ANSP for restoration by NLREEP. Priority codes are: H=high; M=medium; L=low; HC=high, requires coordination; HD=high, after deer; HP=high protection; HPD=high, protection and restoration after deer are controlled; HT=high trail; HVD=high, volunteer action, other actions after deer are controlled; HV=high volunteer; MC=medium, requires coordination.

Site ID	Restoration Type	Site Name	Location	Priority	Acreage
V5.02	Riparian Zone	Field, woods near log dump	West and north of tennis courts	H	4.31
		Action	**Priority**		
		Remove Exotics/Replant Native Forest Species	H		
V5.03	Forested Upland	West end golf course woods	south of golf course, north and west of dump	HV	8.57
		Action	**Priority**		
		Invasive-Exotic Control	HV		
		Remove Exotics/Replant Native Forest Species	M		
V5.04	Non-Forested Upland	Phragmites stand	Slope south of golf course	H	7.81
		Action	**Priority**		
		Meadow Management	H		
		Remove Exotics/Replant Native Meadow Species	H		
		Invasive-Exotic Control	L		
V7.01	Forested Upland	West edge of park	Between golf course and railroad	HV	5.27
		Action	**Priority**		
		Invasive-Exotic Control	HV		
		Remove Exotics/Replant Native Forest Species	L		
V8.0	Riparian Zone	Northern Shedbrook Creek	Branches of Shedbrook Creek just south of Pattison	H	3.24
		Action	**Priority**		
		Remove Exotics/Replant Native Forest Species	H		
V9.0	Park Wide	Parkwide (no mapped polygon)	FDR Park	MC	
		Action	**Priority**		
		Control Canada Geese	MC		
V9.01	Park Wide	Ponds and lagoons (no mapped polygon)	Ponds and lagoons	H	
		Action	**Priority**		
		Floral Reintroduction	H		
W1	Channel	FDR Tide Gate (no mapped polygon)	South end of E. Br. Hollander Ck./Reserve Basin	HC	
		Action	**Priority**		
		Restore Tidal Flow	HC		

Other recommended restoration activities focus on the ponds in FDR Park proper. These include invasive control (especially in North Meadow Lake), trash removal and riparian management. These activities would enhance aquatic vegetation (including several plant species which are rare in the state) and increase the amount of wooded riparian zones, while maintaining vistas and lake access. Increasing the amount of tree and shrub vegetation in other parts of the park (particularly along the east edge) is also recommended.

The southwestern part of the park provides a major opportunity for natural land restoration. While this area has some wetland patches and supports a variety of native species, much of the area is dominated by exotic species. Dumping of trash and logs also reduces the natural value of this area. Recommended activities in this area include control of exotic and invasive plants, trash removal, and replanting of native species. Part of the area could be an appropriate site for creation of a wetland. Because of the potential expense of that project, it is likely that wetland creation would depend on obtaining additional funding.

Several projects would enhance natural values of the golf course proper. These include creating riparian buffers along Shedbrook Creek where these would not interfere with golf course operation, and enhancement of wetland areas within the course. Part of the golf course is currently maintained as old fields and small patches of woods. These areas support wildlife and it is recommended that these areas be maintained.

Despite its relatively small size and the large amount of maintained land, natural resources are important within FDR Park. These resources are particularly important because of the scarcity of natural lands in South Philadelphia, the link between the park and the Delaware Estuary, and the location of the park in the Coastal Plain. The proposed restoration activities can enhance these resources and add to the variety of uses and benefits which the park provides its users.

3.D.2. **General Recommendations for Future Activities**

The prior section described specific activities that are recommended for implementation in FDR Park. In addition to these, a number of other related activities are also recommended. These relate to overall operations in the park, particularly those involving management of the borders between the designed and natural lands. Some of these are outside the direct purview of NLREEP and should be implemented in cooperation with other groups.

- Damage done to the natural lands by trash dumping is a major problem. Exercising control, through methods such as passive blocking of access points as well as patrolling and/or enforcement of regulations is necessary to minimize or eliminate the damage. Accumulation of litter (bottles, styrofoam, plastic bags, etc.) is pervasive, especially in the ponds and lagoons of the park. The direct ecological impacts of litter may be small (there are potential risks of ingestion by wildlife, trapping wildlife, or chemical contamination), but litter may reinforce a perception of natural lands as waste lands. Installation of trash receptacles, filters on storm sewer inlets, staffing to remove litter, and periodic cleanups by volunteers may be used to control litter.
- Non-native plantings in landscaped areas are often a source of invasion by these plants. An increased use of native plants in landscape settings and avoidance of particularly invasive species, such as Norway maple, is recommended in order to avoid this infiltration of non-native plants.
- Decreasing the frequency of mowing can result in taller grass and other vegetation which increases water retention and provides better habitat. Implementation of a decreased mowing schedule in places where this does not interfere with other uses is recommended.

However, monitoring of the areas of less frequent mowing should be done to ensure that they are not colonized by exotic plants.

- Exotic species occur in both landscaped areas and natural lands. However, exotic species are often patchy in occurrence and may be controlled if addressed early. Occurrence of the species should be monitored throughout the parks.
- Dumping of large quantities of logs, leaves and other horticultural waste is damaging and should be controlled. However, logs can be used in woods to increase soil fungus, decrease surface runoff, provide animal habitat and restrict access. Logs can also be used in wetlands as cover for amphibians and aquatic insects, basking sites for reptiles, and perching sites for birds. Mulch can be used in restoration plantings to improve soil and decrease unwanted plants. Methods of making these materials available for restoration can improve the success of restoration initiatives, while reducing the storage needs for these materials.

3.D.3. **Suggested Implementation Schedule**

Costs per acre for implementation of the various restoration activities were calculated and used to estimate costs for the restoration activities at the recommended sites. These estimates indicate that most or all of the high priority options would be achievable under NLREEP funding and other grants which were submitted for dredging of the lakes, removal of the pool and restoration of the lake, and creation of new wetlands. As a result, no attempt was made to further develop an implementation schedule, i.e., to prioritize sites among the high priority sites. Scheduling would depend on optimal times for performing various restoration activities and logistics involved in scheduling volunteers, contracting for commercial work, and making links with other agencies. Some particular considerations for implementation are:

- Some types of restoration, particularly control of invasives, will often require several treatments. Scheduling should allow for multiple treatments at optimal times.
- Scheduling should be done to optimize effectiveness. For example, control of exotics which spread by seed (e.g., garlic-mustard, mile-a-minute, and possibly Japanese knotweed) should be done before seed set. Planting of most species is best done in spring or fall to minimize stress on newly planted material. Some species will have particular requirements, necessitating a more specific planting season.
- Scheduling should be done to minimize impacts of implementation. For example, stream bank stabilization in the spring may increase chances of washout by storms and effects on spawning fishes.
- The recommended stream restoration projects include wetland creation, which is relatively expensive and need a longer lead time for planning and review. These should be implemented early to allow implementation and modification of other schedules if changes in these projects significantly change costs.
- Since many restoration projects are clustered, scheduling is important to avoid impacts on already completed projects and to increase efficiency of implementation.
- A maintenance schedule should be developed for different types of restorations. For replanting activities, several maintenance visits should be made during the first planting season to water new stock, control any invading unwanted plants, and, if necessary, plant additional material. For projects done early in the NLREEP funding period, additional visits will be possible in one or more seasons after planting, when control of invasives and other corrective activities can be done. These maintenance activities are expected to be

inexpensive relative to the initial investment in restoration and can greatly increase probability of success and provide information to improve subsequent restoration work.

- Scheduling should allow for implementation of baseline and post-restoration monitoring programs. If such monitoring is not done by NLREEP or FPC staff, scheduling and notification should be done to give outside groups an opportunity to develop monitoring programs.

3.E. RESTORATION SITE ASSESSMENTS

The individual restoration site assessments for FDR Park are presented on pages II-249 through II-280. The high priority sites are also shown on the Restoration Sites maps in Volume II, Section 3.F.6. The key to codes used in the restoration site assessments is given below.

Option priorities:

HP High priority to protect/monitor

HV High priority, can be immediately implemented by volunteers

HC High priority; coordination with other agencies should be sought to deal with large complex projects, joint responsibilities or regulatory issues.

H High priority, single action for site or multiple, equivalent actions for site

M Medium priority

MC Medium priority; coordination with other agencies should be sought to deal with large complex projects, joint responsibilities or regulatory issues.

L Low priority

N Not recommended

Site Use constraints:

P Near playground, main paths, etc., where safety a potential issue

OM Ongoing mowing

D Likely ongoing disturbance

Fairmount Park Restoration Sites

FDR Park

Park: FDR **Restoration Site ID:** V1.01 **Site Name:** Hill between Hollander Creek limbs

Location: West of Algonquin Drive

General Location: FDR Golf Course and west of drive

Disturbance/Condition:

Restoration Category Vegetation

Restoration Type: Forested Upland **Constraints:** P

Acreage: 6.79

Site Priority: H **Location Criteria:** Affects ecolog. Significant site

Description:

This area contains large specimen plantings in the mowed area and small thickets. Some of these thickets and the edges along Hollander Creek contain native species. The mowed area is not heavily used by picnickers, etc, therefore, infrequent mowing would increase habitat without impacting park use.

Restoration Options:

ID	Action	Priority	Proportion
A	Release/Widen	H	40%

Park: FDR **Restoration Site ID:** V1.03 **Site Name:** Shedbrook Creek Wetland

Location: East of Shedbrook Creek west of Edgewood Lake

General Location: FDR Golf Course and west of drive

Disturbance/Condition:

Restoration Category Stream

Restoration Type: Wetland **Constraints:** D

Acreage: 0.88

Site Priority: H **Location Criteria:** Near other restorations

Description:

This small area adjacent to Shedbrook Creek could benefit from planting of native herbs.

Restoration Options:

ID	Action	Priority	Proportion
A	Replant Native Herbs	H	80%

Park: FDR **Restoration Site ID:** V1.05 **Site Name:** Margins lower Shedbrook Creek

Location: Shedbrook Creek

General Location: FDR Golf Course and west of drive

Disturbance/Condition:

Restoration Category Vegetation

Restoration Type: Riparian Zone **Constraints:** OM

Acreage: 2.20

Site Priority: H **Location Criteria:** Affects ecolog. Significant site

Description:

Where it does not interfere with golf course operations, the margins of the creek should be released from frequent mowing, so that native plants can regenerate. Fencing to reduce grazing by geese would be beneficial. Monitoring of regeneration should be done to determine what plant species colonize the site; depending on these findings, control of exotics and planting of natives may be necessary.

Restoration Options:

ID	Action	Priority	Proportion
A	Release/Widen	H	30%

Park: FDR **Restoration Site ID:** V1.06 **Site Name:** Recycling Center Wetland

Location: N. of tennis courts

General Location: FDR Golf Course and west of drive

Disturbance/Condition: Invasive/Exotic Vegetation

Restoration Category Vegetation

Restoration Type: Wetland **Constraints:** D

Acreage: 0.21

Site Priority: H **Location Criteria:** Near other restorations

Description:

The exotic species (Phragmites, purple loosestrife, etc.) should be controlled and the area should be replanted with appropriate native wetland species.

Restoration Options:

ID	Action	Priority	Proportion
B	Remove Exotics/Replant Native Wetland Species	H	100%

Park: FDR **Restoration Site ID:** V1.07 **Site Name:** West margin of west limb Hollander Creek

Location: West side Hollander Creek (n of Tennis Courts)

General Location: FDR Golf Course and west of drive

Disturbance/Condition:

Restoration Category Vegetation

Restoration Type: Riparian Zone **Constraints:** D

Acreage: 3.19

Site Priority: H **Location Criteria:** Near other restorations

Description:

The exotic species (Ailanthus, multiflora rose, Japanese honeysuckle, purple loosestrife, etc.) in the riparian zone should be removed and the area should be replanted with native streambank species of trees, shrubs and herbs.

Restoration Options:

ID	Action	Priority	Proportion
B	Remove Exotics/Replant Native Forest Species	H	40%

Park: FDR **Restoration Site ID:** V1.08 **Site Name:** East margin of West limb Hollander Creek

Location: E side of Hollander Creek west of Algonquin Drive

General Location: FDR Golf Course and west of drive

Disturbance/Condition:

Restoration Category Vegetation

Restoration Type: Riparian Zone **Constraints:** OM

Acreage: 1.16

Site Priority: H **Location Criteria:** Near other restorations

Description:

This area should be released from frequent mowing. The edge of the pond has native species, but exotics are found at the site as well (e.g., multiflora rose). Exotic plants should be controlled and the riparian zone should be planted with native riparian species.

Restoration Options:

ID	Action	Priority	Proportion
A	Release/Widen	H	50%
B	Remove Exotics/Replant Native Forest Species	H	50%

Park: FDR **Restoration Site ID:** V1.09 **Site Name:** Golf Course Meadows/Hills

Location: Southern part of golf course

General Location: FDR Golf Course and west of drive

Disturbance/Condition:

Restoration Category Vegetation

Restoration Type: Non-Forested Upland **Constraints:** D

Acreage: 5.58

Site Priority: H **Location Criteria:** Near other restorations

Description:

This site contains a mix of old fields, thickets, copses and small wetland areas. These areas are not within fairways and are currently not mowed or infrequently mowed. They have value for wildlife and should be maintained. Maintenance of fields would require periodic mowing. Control of invasives (purple loosestrife, etc.) could aid regeneration of native species. The extent of this area depends on golf course management. Therefore, the mapped polygon shows the general location, but not necessarily the precise boundaries of this site.

Restoration Options:

ID	Action	Priority	Proportion
B	Invasive-Exotic Control	H	20%
A	Protect/Monitor	H	100%
C	Replant Native Herbs	L	20%

Park: FDR **Restoration Site ID:** V2.01 **Site Name:** South shore of Pattison Lagoon

Location: Lagoon between Pattison Ave. and Pocono Trail

General Location: FDR Park

Disturbance/Condition: Mowed/No Riparian Zone

Restoration Category Vegetation

Restoration Type: Riparian Zone **Constraints:** OM

Acreage: 0.61

Site Priority: H **Location Criteria:** Near environmental Center

Description:

The southern riparian buffer is thin and disturbed. The lake can be better protected by expanding the edge into the mowed lawn area. Intermittently small wet areas also circle the perimeter of the southern side of the lake and would benefit from trash removal and replanting with appropriate vegetation. There is a considerable amount of trash along the lake shore which needs to be removed. Care must be taken not to plant in front of the stage. The intertidal flora seen in Edgewood Lake was not observed here, but patches may be present. The shore flora should be surveyed prior to replanting to allow management for the intertidal species if present.

Restoration Options:

ID	Action	Priority	Proportion
A	Release/Widen	H	100%
B	Trash Removal	H	100%

Park: FDR **Restoration Site ID:** V2.02 **Site Name:** North shore of Pattison lagoon

Location: Between Pattison Ave. and Pocono Trail

General Location: FDR Park

Disturbance/Condition:

Restoration Category Vegetation

Restoration Type: Riparian Zone **Constraints:** OM

Acreage: 1.79

Site Priority: H **Location Criteria:** Near environmental Center

Description:

The area should be released from active management, exotics should be controlled, and natives should be replanted once the exotics are removed. The rare plants (Heteranthera multiflora, Echinochloa walteri, Cyperus oderatus) which were found in Edgewood Lake and Hollander Creek were not found in Pattison Lagoon. However, the shores of Pattison Lagoon should be checked to determine whether any of these are present.

Restoration Options:

ID	Action	Priority	Proportion
B	Release/Widen	H	80%
C	Remove Exotics/Replant Native Forest Species	H	80%
A	Invasive-Exotic Control	L	80%

Park: FDR **Restoration Site ID:** V2.04 **Site Name:** Pattison Lagoon (no mapped polygon)

Location: South of Pattison

General Location: FDR Park

Disturbance/Condition: Filled/Drained Pond or Wetland

Restoration Category Stream

Restoration Type: Channel **Constraints:**

Acreage:

Site Priority: H **Location Criteria:** Affects ecolog. Significant site

Description:

There is no mapped polygon for this site. Pattison Lagoon is very shallow due to an accumulation of sediment. Dredging of the sediment could improve aquatic water quality by reducing the sediment nutrient pool and increasing aquatic volume. However, turtles (including the state threatened red-bellied turtle) use the lagoon, and impacts of dredging on hibernation sites would need to be considered. Dredging only a portion of the lagoon (e.g., the lower part) would probably be desirable to maintain hibernating habitat. Dredging in the lagoon should be coordinated with dredging in Edgewood Lake. Because of the magnitude of these activities (expense, planning, etc.), these should be coordinated with other groups for permitting, planning and funding.

Restoration Options:

ID	Action	Priority	Proportion
B	Dredge	HC	10%

Park: FDR **Restoration Site ID:** V3.01 **Site Name:** Broad Street Buffer

Location: Along Broad Street

General Location: FDR Park

Disturbance/Condition:

Restoration Category Vegetation

Restoration Type: Forested Upland **Constraints:** OM

Acreage: 5.43

Site Priority: H **Location Criteria:** No distinctive

Description:

Planting trees along the edge of the park would provide some additional habitat (e.g., for migrating birds) and would provide a buffer between Broad Street and the park.

Restoration Options:

ID	Action	Priority	Proportion
A	Replant Native Trees	H	40%

Park: FDR **Restoration Site ID:** V3.02 **Site Name:** I-95 field (east)

Location: Between I-95 and Navy Yard

General Location: FDR Park

Disturbance/Condition: Invasive/Exotic Vegetation

Restoration Category Vegetation

Restoration Type: Non-Forested Upland **Constraints:** D

Acreage: 2.40

Site Priority: HV **Location Criteria:** Isolated

Description:

This area is affected by runoff from the I-95 bridge. The site contains some native trees (e.g. box elder and red oak), but has many exotics (Japanese honeysuckle, etc.) as well. Invasives should be controlled in this area. This area is heavily impacted and planting would require very stress-tolerant species. Because of ongoing disturbance and the long, narrow shape of the site, planting success may be low and it may be difficult to sustain high natural biodiversity here. However, control of invasives can improve the condition of this area.

Restoration Options:

ID	Action	Priority	Proportion
B	Invasive-Exotic Control	HV	100%
A	Remove Exotics/Replant Native Meadow Species	L	100%

Park: FDR **Restoration Site ID:** V3.05 **Site Name:** Maintenance Center Woodlot

Location: Bend of Algonquin Trail west of Broad St.

General Location: FDR Park

Disturbance/Condition:

Restoration Category Vegetation

Restoration Type: Forested Upland **Constraints:** OM

Acreage: 2.24

Site Priority: H **Location Criteria:** Isolated

Description:

This area is currently maintained mainly as lawn. Planting trees could create a woodlot, increasing natural vegetation and value for wildlife (e.g., breeding and migrating birds). It would also enhance the aesthetic value of this part of the park. The area does not appear to be heavily used for picnicking, etc., so the planting wouldn't conflict with other uses.

Restoration Options:

ID	Action	Priority	Proportion
A	Replant Native Trees	H	70%

Park: FDR **Restoration Site ID:** V3.06 **Site Name:** Meadow Lake (southern part)

Location: Meadow Lake

General Location: FDR Park

Disturbance/Condition:

Restoration Category Pond

Restoration Type: Riparian Zone **Constraints:** OM

Acreage: 2.01

Site Priority: H **Location Criteria:** Affects ecolog. Significant site

Description:

This area now has the swimming pool, which is closed because of persistent structural problems leading to leakage. Removal of the pool would allow restoration of the original Olmstead lake, which would increase aquatic habitat, e.g., for aquatic, wetland and riparian plants, fish and waterfowl. Removal should be coordinated with other agencies and additional funding sources should be sought to remove the swimming pool, to restore the pool area to its original conformation as part of Meadow Lake, and to grade the banks. NLREEP contributions would be primarily for replanting. The proportion of the site to be restored by NLREEP reflects the assumption that planting will be in the bank area and shallow water near shore. The perimeter of the pool now has various exotics (e.g., cut-leaved raspberry); it is assumed that these would be removed as part of the overall structural removal activities.

Restoration Options:

ID	Action	Priority	Proportion
B	Replant Native Shrubs	H	20%
A	Structural Improvement	H	100%

Park: FDR **Restoration Site ID:** V3.07 **Site Name:** North Meadow Lake

Location: Northern end

General Location: FDR Park

Disturbance/Condition: Invasive/Exotic Vegetation

Restoration Category Vegetation

Restoration Type: Wetland **Constraints:**

Acreage: 0.23

Site Priority: H **Location Criteria:** Affects ecolog. Significant site

Description:

North Meadow Lake is maintained as a marsh which filters water between Edgewood and South Meadow Lakes. It contains native marsh plants (e.g., cattail) and trees (e.g., willow and box elder). However, it also contains exotics, including Phragmites, purple loosestrife and oriental bittersweet. The marsh provides habitat for wetland wildlife and would be enhanced by control of the exotics. Because of the existing native species in the marsh, native regeneration is likely. The area also accumulates trash, particularly near the bridge, which should be removed.

Restoration Options:

ID	Action	Priority	Proportion
A	Invasive-Exotic Control	H	100%
B	Trash Removal	HV	100%

Park: FDR **Restoration Site ID:** V3.08 **Site Name:** Hollander Creek (south part of east branch)

Location: Across road from tennis courts

General Location: FDR Park

Disturbance/Condition: Maintained Lawn/Mowed Field

Restoration Category Stream

Restoration Type: Riparian Zone **Constraints:** OM

Acreage: 0.90

Site Priority: H **Location Criteria:** Affects ecolog. Significant site

Description:

The borders of the lagoon support several rare plants. Heteranthera multiflora (PA-endangered) grows in the water, along with Ludwigia peploides. The grass Echinochloa walteri (PA-endangered) grows along the narrow band of unmowed vegetation along the shore. Other wetland and field plants (e.g., swamp milkweed), grasses and asters grow in the unmowed strip. Increase in the width of the buffer would provide additional habitat for these plants. Infrequent mowing would be desired to prevent tree and shrub growth. Cutting of some shrubs along the shore could be done to encourage herbaceous growth. The HP priority is warranted because of the presence of the PA state-endangered plants.

Restoration Options:

ID	Action	Priority	Proportion
A	Meadow Management	H	70%
B	Protect/Monitor	HP	70%

Park: FDR **Restoration Site ID:** V3.10 **Site Name:** I-95 field (west)

Location: West part of park area south of I-95

General Location: FDR Golf Course and west of drive

Disturbance/Condition:

Restoration Category Vegetation

Restoration Type: Non-Forested Upland **Constraints:** D

Acreage: 8.20

Site Priority: HV **Location Criteria:** Near other restorations

Description:

This strip lies between I-95 and the Naval Yard. It receives road runoff from the bridge and contains stands of Phragmites. Control of exotics would increase the value of this site. Since the area to the north of this site is recommended for major restoration, restoration at this site will protect the nearby restorations and reduce the area which provides a source of exotic plants. Replanting with native plants would further improve this site. Because of ongoing disturbance and the long, narrow shape, survival of the planted material may be low. Therefore, invasive control is recommended in conjunction with nearby restoration activities.

Restoration Options:

ID	Action	Priority	Proportion
B	Invasive-Exotic Control	HV	100%
A	Remove Exotics/Replant Native Meadow Species	M	80%

Park: FDR **Restoration Site ID:** V3.11 **Site Name:** Margin of Meadow Lake (southern pond)

Location: Southern part of Meadow Lake

General Location: FDR Park

Disturbance/Condition:

Restoration Category Vegetation

Restoration Type: Wetland **Constraints:**

Acreage: 0.95

Site Priority: H **Location Criteria:** Near other restorations

Description:

The pond has a concrete border, which could be removed to provide better habitat for aquatic and shoreline plants. However, plants grow on top of or through the concrete, so removal may not create great additional benefits. Control of exotic plants (e.g., purple loosestrife) is recommended

Restoration Options:

ID	Action	Priority	Proportion
B	Invasive-Exotic Control	H	100%
A	Structural Improvement	L	20%

Park: FDR **Restoration Site ID:** V3.12 **Site Name:** Edgewood Lake

Location: Edgewood Lake

General Location: FDR Park

Disturbance/Condition: Filled/Drained Pond or Wetland

Restoration Category Stream

Restoration Type: Channel **Constraints:** May affect plant or animal life in the pon

Acreage: 3.88

Site Priority: H **Location Criteria:** Affects ecolog. Significant site

Description:

Dredging could increase and improve fish habitat and reduce nutrient loading to pond water associated with pond sediments. More information on the extent of sediment in the pond is needed. A reconnaissance in 1999 indicated that there is about 4-6 ft of sediment toward the middle of the pond, with a maximum water depth of about 4 ft. Sediments were deepest in the northwest-central part of the lake, i.e., south of the boathouse. Gross examination of sediments indicated that there was more sand toward the bottom of sediment deposits, so that dredging of surficial sediments could remove much of the organic material. More information on sediments is presented in the text of the master plan. The size and depth of sediment to be removed cannot be determined at this time, so that the boundaries of the restoration polygon are approximate (the estimate of 100% of the area to be dredged refers to the acreage of the polygon and not the total acreage of the lake).

Sediments in the ponds in the park are probably used as hibernation sites for turtles, including the red-bellied turtle (PA-threatened). The extent of dredging would need to consider impacts on hibernation sites. Heteranthera multiflora, a state-endangered wetland plant, occurs on the margins of the pond. As a result, dredging would have to be done "wet", since the pond could not be drained.

Placement of cover (Option C, e.g., snags, dead trees) could provide habitat for fish and perching sites for birds. Construction of an island (Option B) could provide additional habitat and conform to original plan. Dredged material could be used to create the island (reducing cost for spoil disposal), but there would be additional costs for containment structures and planting. Fencing or other structures to discourage nesting by Canada geese would be valuable.

Costs for these plans are highly uncertain.

Dredging would be beneficial, but should be coordinated with other agencies, given the cost of dredging and various planning issues (protection of turtles, disposal of sediment). If dredging were done using existing funds, the costs of dredging the lagoon and Edgewood Lake would severely limit the amount of other work which could be done, so that dredging should be done if additional funds are available.

Restoration Options:

ID	Action	Priority	Proportion
B	Structural Improvement (SW)	H	5%
C	Structural Improvement (SW)	H	1%
A	Dredge	HC	100%

Park: FDR **Restoration Site ID:** V3.13 **Site Name:** Edgewood Lake

Location: South edge of the Lake

General Location: FDR Park

Disturbance/Condition: Filled/Drained Pond or Wetland

Restoration Category Vegetation

Restoration Type: Riparian Zone **Constraints:** Could impact PA endangered plant

Acreage: 0.68

Site Priority: H **Location Criteria:** Affects ecolog. Significant site

Description:

This area supports a PA-endangered plant (Heteranthera multiflora) and other wetland plants. Habitat for these could be improved by removal of concrete rubble, widening the pond buffer, and infrequent mowing to control growth of trees and shrubs. The HP priority is warranted because of the presence of the rare plants.

Restoration Options:

ID	Action	Priority	Proportion
C	Meadow Management	H	100%
D	Protect/Monitor	HP	100%
B	Release/Widen	H	100%
A	Trash Removal	H	10%

Park: FDR **Restoration Site ID:** V3.14 **Site Name:** Edgewood Lake

Location: West edge of the Lake

General Location: FDR Park

Disturbance/Condition:

Restoration Category Vegetation

Restoration Type: Wetland **Constraints:** OM

Acreage: 1.55

Site Priority: H **Location Criteria:** Affects ecolog. Significant site

Description:

The area should be released from active management and native wetland, and riparian species plantings are recommended. The edge currently has a narrow riparian zone containing a mix of native and exotic trees, shrubs and forbs. Maintenance of gaps for access and to preserve park vistas would be valuable.

Restoration Options:

ID	Action	Priority	Proportion
B	Release/Widen	H	50%
A	Invasive-Exotic Control	HV	50%

Park: FDR **Restoration Site ID:** V5.01 **Site Name:** Log dump/field/woods

Location: West of the W. Br. Of Hollander Creek

General Location: FDR Golf Course and west of drive

Disturbance/Condition:

Restoration Category Vegetation

Restoration Type: Wetland **Constraints:** D

Acreage: 3.74

Site Priority: HC **Location Criteria:** Near other restorations

Description:

The area west of Hollander Creek (west and north of the tennis courts) contains a mix of exotic and native vegetation, small wetlands, and a log-dumping site. A wetland on this site could increase aquatic habitat. Because of the saturated soils in the area, site hydrology could sustain a wetland (low areas in the site frequently hold standing water). Fill is generally deeper on the northwest part of the site, with more exotic plants present. Wetland creation in these parts would require more excavation and disposal of fill, but would have greater ecological benefit.

There are a number of options for the size and design of a wetland in this area. Depending on the amount of excavation, the wetland (or different parts of it) could range from being seasonally damp to having permanent standing water. The wetland could be planted and managed to maintain open marsh or marsh/standing water conditions; alternately, it could be designed to support swamp forest vegetation (red maple, sweet gum, etc.). There is little woodland in the park and Coastal Plain woodland is poorly represented in Southeastern Pennsylvania, so that development of swamp forest may be most desirable. Because of the various options for design, the polygon on the restoration map only shows one potential conformation for the wetland area.

The site could be an appropriate site for reintroduction of certain wetland plants, e.g., American lotus (Nelumbo lutea), which formerly grew in the general area. The wetland would also be appropriate for introduction of aquatic or wetland animals (e.g., the Coastal Plain leopard frog). The reintroduced taxa would depend on the final design of the wetland.

Wetland creation should be coordinated with other groups, because of its relatively high cost and the need to coordinate land management with park staff (with respect to the log dump) and possibly golf course management.

Restoration Options:

ID	Action	Priority	Proportion
B	Invasive-Exotic Control	HV	100%
C	Remove Exotics/Replant Native Wetland Species	M	100%
A	Wetland Creation	HC	100%

Park: FDR **Restoration Site ID:** V5.02 **Site Name:** Field, woods near log dump

Location: West and north of tennis courts

General Location: FDR Golf Course and west of drive

Disturbance/Condition: Invasive/Exotic Vegetation

Restoration Category Vegetation

Restoration Type: Riparian Zone **Constraints:** Use as log dump

Acreage: 4.31

Site Priority: H **Location Criteria:** Near other restorations

Description:

The area around the log dump has a mix of small woods and fields, with extensive exotics. Control of exotics and replanting with native shrubs, trees and herbs would improve habitat. This site could be adjacent to a new wetland (V5.1) or an alternative to wetland creation.

Restoration Options:

ID	Action	Priority	Proportion
A	Remove Exotics/Replant Native Forest Species	H	80%

Park: FDR **Restoration Site ID:** V5.03 **Site Name:** West end golf course woods

Location: south of golf course, north and west of dump

General Location: FDR Golf Course and west of drive

Disturbance/Condition: Invasive/Exotic Vegetation

Restoration Category Vegetation

Restoration Type: Forested Upland **Constraints:**

Acreage: 8.57

Site Priority: HV **Location Criteria:** Near other restorations

Description:

The site contains a mix of low woods and shrubby thickets, containing many exotics. Control of the exotics would enhance the area. If the exotics are successfully controlled, replanting of native species would be desirable.

Restoration Options:

ID	Action	Priority	Proportion
A	Invasive-Exotic Control	HV	100%
B	Remove Exotics/Replant Native Forest Species	M	80%

Park: FDR **Restoration Site ID:** V5.04 **Site Name:** Phragmites stand

Location: Slope south of golf course

General Location: FDR Golf Course and west of drive

Disturbance/Condition: Invasive/Exotic Vegetation

Restoration Category Vegetation

Restoration Type: Non-Forested Upland **Constraints:**

Acreage: 7.81

Site Priority: H **Location Criteria:** Near other restorations

Description:

The site contains a dense stand of Phragmites, which should be removed. Native species should be planted in this area, once the Phragmites is controlled. The site occurs on a hill which is presumably fill. The fill may affect planting success.

Restoration Options:

ID	Action	Priority	Proportion
A	Meadow Management	H	100%
C	Remove Exotics/Replant Native Meadow Species	H	100%
B	Invasive-Exotic Control	L	100%

Park: FDR **Restoration Site ID:** V7.01 **Site Name:** West edge of park

Location: Between golf course and railroad

General Location: FDR Golf Course and west of drive

Disturbance/Condition:

Restoration Category Vegetation

Restoration Type: Forested Upland **Constraints:** D

Acreage: 5.27

Site Priority: HV **Location Criteria:** Isolated

Description:

This site is currently an old field with a thin margin of trees. The site could be replanted once the exotic species are removed. It is likely that the site is on fill, an old building site or other disturbed soil. It is small, narrow and isolated from other natural areas. These factors would reduce the likelihood of survival of plantings and benefits of the restoration, so this activity is not considered a high priority.

Restoration Options:

ID	Action	Priority	Proportion
B	Invasive-Exotic Control	HV	100%
A	Remove Exotics/Replant Native Forest Species	L	100%

Park: FDR **Restoration Site ID:** V8.0 **Site Name:** Northern Shedbrook Creek

Location: Branches of Shedbrook Creek just south of Pattison

General Location: FDR Golf Course and west of drive

Disturbance/Condition:

Restoration Category Vegetation

Restoration Type: Riparian Zone **Constraints:** Golf course

Acreage: 3.24

Site Priority: H **Location Criteria:** Near other restorations

Description:

The margins of Shedbrook Creek support exotic species (e.g., Phragmites), particularly along the northern edge. Control of exotics and replanting native riparian species would improve habitat. Planting would have to be coordinated with golf course management so that vegetation doesn't interfere with the course. Fencing to reduce grazing by Canada geese may be necessary to protect some plantings.

Restoration Options:

ID	Action	Priority	Proportion
A	Remove Exotics/Replant Native Forest Species	H	60%

Park: FDR **Restoration Site ID:** V9.01 **Site Name:** Ponds and lagoons (no mapped polygon)

Location: Ponds and lagoons

General Location:

Disturbance/Condition:

Restoration Category

Restoration Type: Park Wide **Constraints:**

Acreage:

Site Priority: H **Location Criteria:** Affects ecolog. Significant site

Description:

This is a general recommendation, and therefore there is no mapped polygon. Several wetland plants which were once recorded from the park and nearby areas no longer occur in the park. Reintroduction of these as part of wetland and riparian planting activities at the various sites is recommended. Candidate species for reintroduction include American lotus (Nelumbo lutea), white water-buttercup (Ranunculus longirostris); the flora of the park is discussed in more detail in the master plan.

Restoration Options:

ID	Action	Priority	Proportion
A	Floral Reintroduction	H	100%

Park: FDR **Restoration Site ID:** W1 **Site Name:** FDR Tide Gate (no mapped polygon)

Location: South end of E. Br. Hollander Ck./Reserve Basin

General Location: FDR Park

Disturbance/Condition: SW Structure Malfunction/Problem

Restoration Category Stream

Restoration Type: Channel **Constraints:** Coordination, ecological risks

Acreage:

Site Priority: HC **Location Criteria:** Affects ecolog. Significant site

Description:

There is no mapped polygon for this site. Restoration of the full tidal range would result in flooding of large parts of the FDR Park and the golf course and is therefore infeasible. A partial increase in tidal flow would increase habitat for intertidal flora, could improve aquatic habitat, and increase exchange of anadromous and other migratory fauna (especially fish) between the ponds and the estuary. Relative water quality in the ponds and Reserve Basin would need to be considered, so that inflow doesn't degrade water quality in the park. Coordination with the Philadelphia Naval Yard to modify the tide gate would need to be done. To date, it has been difficult to establish contacts to discuss options concerning tide gate structure, maintenance and operation. Attempts to establish these contacts should be continued.

Restoration Options:

ID	Action	Priority	Proportion
A	Restore Tidal Flow	HC	100%

3.F. MASTER PLAN MAPS

The Master Plan Maps for FDR Park follow.

FDR PARK

Natural Lands Restoration Master Plan

PARK BASE MAP

N

500 0 500 Feet

1 inch = 500 feet

Prepared for: Fairmount Park Commission
Natural Lands Restoration and
Environmental Education Program

Prepared by: THE ACADEMY OF NATURAL SCIENCES
Patrick Center for Environmental Research

Date: May 2000

Base Map Data: Roads from Phila. Water Department
Digitial Data Set
Park Boundaries from the Phila. Planning
Commission with updates by PCER
Hydrology from the Phila. Water Department
Digital Data Set with updates from PCER

FDR PARK

Natural Lands Restoration Master Plan

VEGETATION CLASSIFICATION

FAIRMOUNT PARK COMMISSION

N

500 0 500 Feet

1 inch = 500 feet

Prepared for: Fairmount Park Commission Natural Lands Restoration and Environmental Education Program

Prepared by: THE ACADEMY OF NATURAL SCIENCES
Patrick Center for Environmental Research

Date: May 2000

Base Map Data: Roads from Phila. Water Department Digitial Data Set
Park Boundaries from the Phila. Planning Commission with updates by PCER
Hydrology from the Phila. Water Department Digital Data Set with updates from PCER.

FDR PARK
Natural Lands Restoration Master Plan
HABITAT QUALITY

N

500 0 500 Feet

1 inch = 500 feet

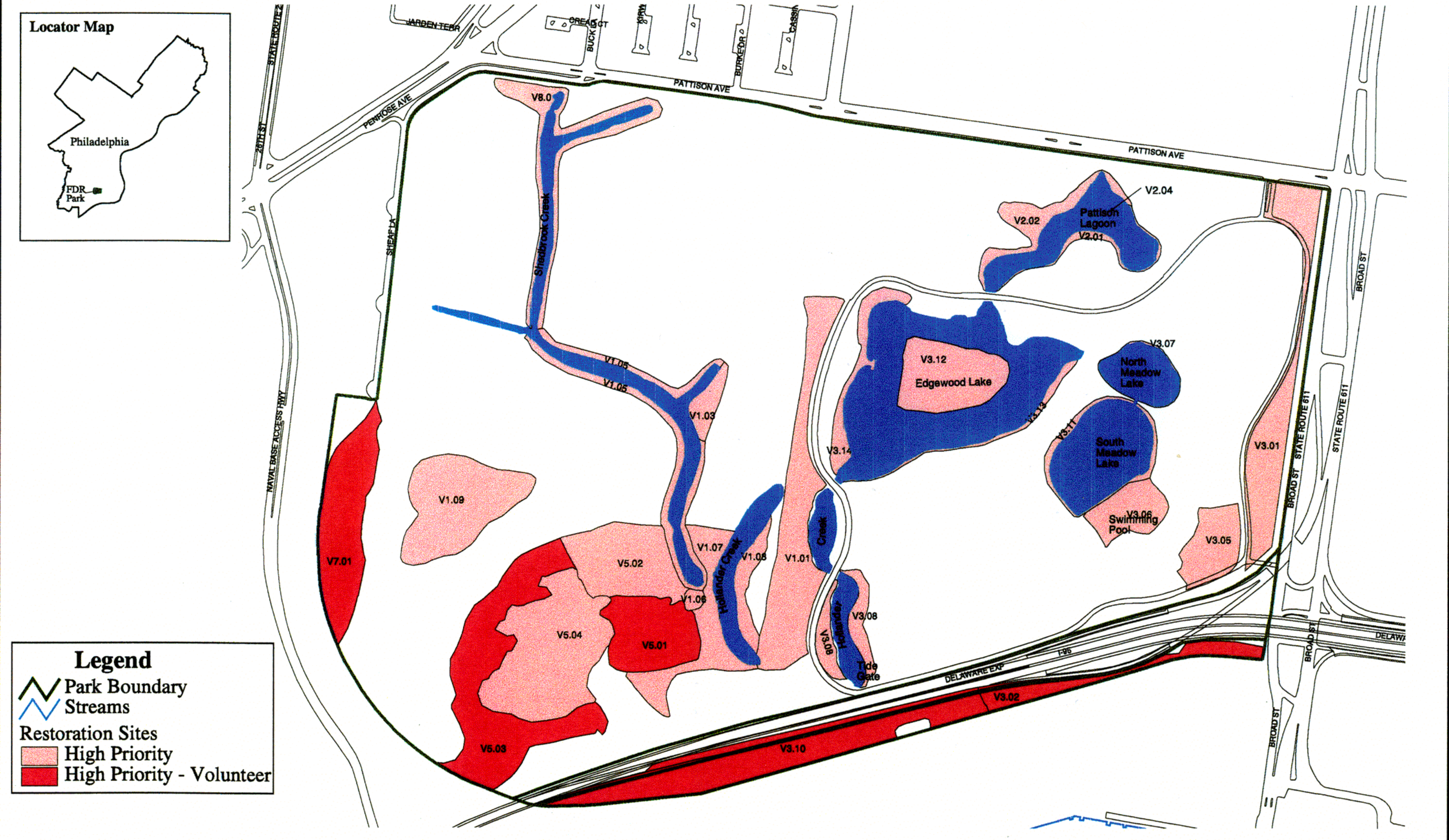
FAIRMOUNT PARK COMMISSION

Prepared for: Fairmount Park Commission
Natural Lands Restoration and
Environmental Education Program

Prepared by: THE ACADEMY OF NATURAL SCIENCES
Patrick Center for Environmental Research

Date: June 2000

Base Map Data: Roads from Phila. Water Department
Digitial Data Set
Park Boundaries from the Phila. Planning
Commission with updates by PCER
Hydrology from the Phila. Water Department
Digital Data Set with updates from PCER.



FDR PARK

Natural Lands Restoration Master Plan

RESTORATION SITES

N

500 0 500 Feet

1 inch = 500 feet

Prepared for: Fairmount Park Commission
Natural Lands Restoration and
Environmental Education Program

Prepared by: THE ACADEMY OF NATURAL SCIENCES
Patrick Center for Environmental Research

Date: May 2000

Base Map Data: Roads from Phila. Water Department
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