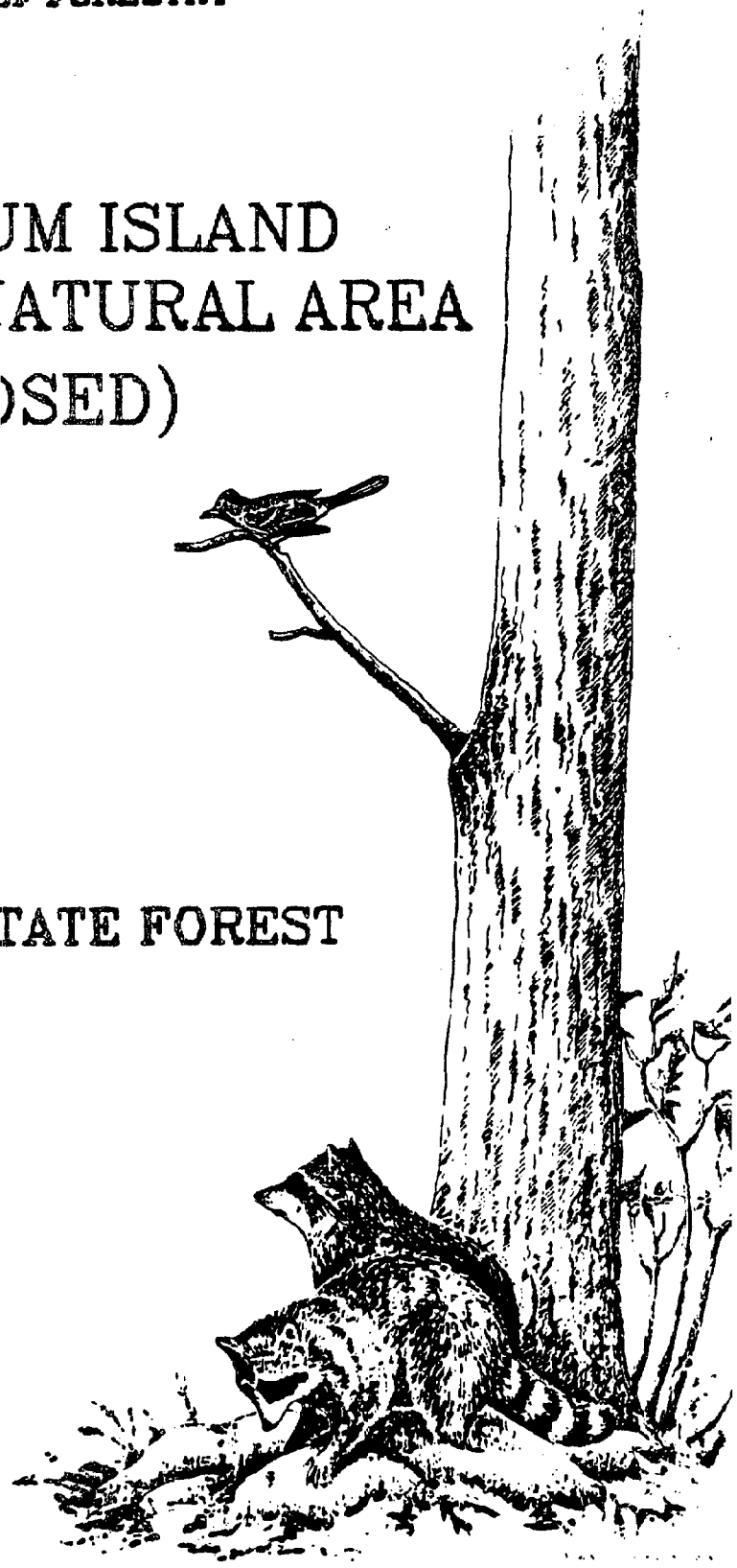
DEPARTMENT OF ENVIRONMENTAL RESOURCES
OFFICE OF RESOURCES MANAGEMENT
BUREAU OF FORESTRY

LITTLE TINICUM ISLAND STATE FOREST NATURAL AREA (PROPOSED)



VALLEY FORGE STATE FOREST

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Coastal Zone
Funded and Coordinated through
Dept. of Environmental Resources
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LITTLE TINICUM ISLAND
Proposed State Forest Natural Area

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LITTLE TINICUM ISLAND MANAGEMENT PLAN

Location and Administration

Little Tinicum Island in the Delaware River estuary, Delaware County, Pennsylvania, represents a unique ecosystem in the Commonwealth. It is administered by the Department of Environmental Resources, Office of Resources Management, Bureau of Forestry, Valley Forge State Forest. It is located in a heavily industrialized section of the state south of Philadelphia. The long axis of the Island runs east to west. It is about two miles long and varies from 200 to 900 feet wide. It is bounded on the north by a shallow channel, or back channel, that accesses a number of small marinas in Essington and Darby Creek and the south by a dredged forty-foot deep channel that accommodates international freighters and tankers. Philadelphia International Airport is immediately northeast of the Island. The western section of the Island is directly beneath the glide path for landings.

Management Designation

An estuary is a body of water where fresh river waters meet and mix with saline seawaters. This results in diluted seawater or brackish water. Because of the unique nature of this area, compared to other State Forest lands, the Bureau will recommend to the Environmental Quality Board in 1986 that it be designated as a Natural Area. Management will be predicated on protection of this ecosystem and its unique animal and plant inhabitants and will follow the standard administrative and operating guidelines for Natural Areas.

STATE FOREST NATURAL AREAS

Definition

Recognizing that there is a basic need for the preservation of certain areas of forest land with either limited or no human disturbance, the following definition has been adopted for Natural Areas that are or will be established on State Forest land:

> A Natural Area is an area of unique scenic, historic, geologic or ecological value which will be maintained in a natural condition by allowing physical and biological processes to operate, usually without direct human

intervention. These areas are set aside to provide locations for scientific observation of natural systems, to protect examples of typical and unique plant and animal communities, and to protect outstanding examples of natural interest and beauty.

Administrative Guidelines

The guidelines governing the administration of Natural Areas are as follows:

1. No human habitation is permitted, except that primitive type backpack camping may be permitted in designated areas only.

2. Access for all but essential administrative activities is restricted to foot travel and non-motorized watercraft, except in designated areas.

3. Buildings and other improvements are restricted to the minimum required for public health, safety and interpretive aids.

4. Timber harvesting is not permitted except as may be required for maintenance of the public safety.

5. Leases and mineral development are prohibited; however, subsurface oil and gas rights may be leased where no surface use or disturbance of any kind will take place on the Natural Area. New rights-of-way are prohibited except for designated utility corridors in the Bucktail Natural Area.

Operating Guidelines

The following operating guidelines have been developed to further refine the administrative guidelines:

Natural Area Location Factors

Any unique or unusual biologic, geologic or historic areas can be considered for designation as Natural Areas. The size of these areas will generally be small but may be as large as several thousand acres. They should be created whenever other resource development would have an adverse effect on their future utility and value. Areas recommended for Natural Area designation should be submitted to the State Forester by the District Forester along with a map and a complete documentation describing the character of the area. Final approval and official designation as a Natural Area will be by action of the Environmental Quality Board under authority granted in Section 1920-A of the

Administrative Code of 1929 as amended by Act 275, December 3, 1970.

Natural Area Management

Natural Areas will be left undisturbed with natural succession allowed to occur. Intervention will only be permitted when man-caused activities or events threaten its natural value.

A 660 foot wide uneven-age management buffer will be maintained around Natural Areas except when a road, pipeline or powerline serves as a boundary in which case a 330 foot wide buffer will apply.

Existing right-of-way expansion will be considered on an individual case basis. Expansion approval will be considered when the project will not harm the feature for which the area was designated and is justified as the alternative that will result in the least overall ecological damage to State Forest lands. Proposed right-of-way expansion will undergo a Project Review as detailed in the Report Section of the Forest Resource Plan.

Aerial spraying of herbicides to maintain rights-of-way within and bordering Natural Areas will be prohibited. Vegetation on these rights-of-way may be cut and controlled by direct spray application to cut stems.

Insect and disease control will be considered on an individual case basis. Control measures will be considered if the feature for which the area was designated is in jeopardy. All proposed insect and disease control activities will undergo a Project Review as detailed in the Report Section of the Forest Resource Plan.

Fire control is permitted as per normal operating procedures of the Bureau of Forestry.

Horse-back riding and handicapped apparatus equipped with electric motors may be permitted on designated, maintained trails.

No artificial regeneration will be permitted in Natural Areas.

Hunting and fishing will be permitted in Natural Areas unless otherwise posted.

Any management or requested activity on Natural Areas that will result in some form of disturbance must be approved by the State Forester.

Signs will be erected at access points and where needed along roads bordering Natural Areas. Signs will indicate the name of the Natural Area, why the area was set aside and any special restrictions which might apply.

Certain Natural Areas have been designated by the Bureau and the Pennsylvania Fish Commission as protection areas for reptiles and amphibians. Signs will be maintained stating that the taking, catching, killing or possession of any reptile or amphibian within the area is prohibited.

Little Tinicum Island Natural Area Guidelines

Because of the diversity of the nature, type, and size of Natural Areas, specific guidelines are needed to fit each area. The following guidelines for Little Tinicum Island clarify the State Forest Natural Areas administrative and operating guidelines.

1. Primitive type backpack camping is permitted.

2. Access to the Island by motorized watercraft is permitted. No motorized vehicles are permitted on the Island.

3. Trails or other physical improvements will not be made on the Island.

4. On official designation of Little Tinicum Island as a Natural Area by the Environmental Quality Board, the Bureau and the Pennsylvania Fish Commission will designate it as a Reptile and Amphibian Protection Area.

Inter-Agency Cooperation

The Bureau of Forestry is committed to sound multiple resource management. The management of many of the fauna resources on State Forest lands is under the jurisdiction of the Pennsylvania Game and Fish Commissions (PGC-mammals and birds: PFC-fish, reptiles, amphibians and aquatic invertebrates). The Bureau has management responsibility for the habitat on which these animals depend. It is therefore desirable for all parties to cooperate in their resource management endeavors to attain the goals and objectives of the respective agencies.

To promote cooperation in resource management endeavors, separate cooperative agreements have been developed with the Pennsylvania Game Commission and the Pennsylvania Fish Commission. This cooperation will encompass the Little Tinicum Island. In addition, cooperation has been solicited and received for some time with the U.S. Fish and Wildlife Service. The Bureau will pursue formalizing this cooperation.

Public Participation

In February, 1986, the Bureau of Forestry held two public meetings to receive public comments on the management of the Valley Forge State Forest. Little Tinicum Island is part of that administrative unit and was a subject open for public input. Written public comments were also solicited with a March 31, 1986, deadline. No comments were received at the meetings or in written form.

For additional information on the character and use of the Island and Delaware River and natural resource inventories of the Island, see Appendix A, Little Tinicum Island: An Environmental Analysis and Evaluation of Alternative Utilization Plans, Tredinnick/Waetzman Associates, November 1985.

PROJECT CONSIDERATIONS

On initiation of any project on State Forest lands that may or will disrupt, alter, or otherwise change the environment, review the following items to ensure that each concern has been adequately considered and addressed. Detailed information about each concern can be obtained from the sources in parentheses.

1. Erosion and Sedimentation: Soil losses and resultant water degradation can be greatly reduced or prevented for most activities (operating/Management Manuals or County Conservation District).

2. Water Quality: Potential sedimentary, thermal, and chemical pollution can be avoided for most activities. Existing pollution can be reduced or eliminated by certain practices or procedures (Operating/Management Manuals or the Bureau of Water Quality Management or Pennsylvania Fish Commission).

3. Air Quality: Potential dust, smoke, chemical, and other particulate pollution can be avoided for most activities. Certain practices, such as timing of the activity, can alleviate potential problems when the pollutant cannot be reduced or prevented (Bureau of Air Quality Control).

4. Water Quantity: Certain practices in or adjacent to wetlands can affect the water level. Streams and bodies of water are also subject to manipulation of water levels. Practices should have an overall beneficial effect and not adversely affect the water level (Bureau of Water Resources Management or Pennsylvania Fish Commission).

5. Groundwater: Potential pollution of groundwater can be avoided for most activities (Operating/Management Manuals or the Bureau of Water Quality Management).

6. Soils: Potential problems, i.e., erosion, stability, overcompaction, saturation, etc., should be anticipated and avoided (SCS County Soil Survey, County Conservation District, or Bureau of Soil and Water Conservation).

7. Unique/Unusual Geologic Features: Potential damage to or destruction of these features should be anticipated and avoided (Forest Resource Plan and Pennsylvania Natural Diversity Inventory for details of locations. Minerals Section, Division of State Forest Management or the Bureau of Topographic and Geologic Survey for details of possible project effect on feature and preventive measures).

8. Aesthetic (Visual) Values: Often projects can be blended into their surroundings, or the adverse impact of their appearance lessened, by certain practices or procedures (Operating/Management Manuals).

9. Noise Levels: Potential problems for the public, contractors, and employees should be anticipated and avoided. Certain practices or procedures, i.e., timing of the activity, use of buffer zones, etc., can alleviate potential problems.

10. Archeological Sites/Historic Sites: Potential damage to or destruction of these features should be anticipated and avoided. Discovery of new sites should be reported to the Division of Forest Advisory Services (Forest Resource Plan and Division of Forest Advisory Services for details of locations. FAS will refer Projects to the Historical and Museum Commission for details of possible project effect on feature and preventive measures).

11. Recreation Sites/Opportunities: Potential damage to or degradation of existing or potential sites should be anticipated and avoided. Certain practices, i.e., timing of the activity, use of buffer zones, etc., can alleviate potential problems (Division of State Forest Management).

12. Public Health and Safety: Project design and administration must ensure that the public is protected at the project site from all potential hazards that could be associated with the project activities or result from the completed project (Division of State Forest Management).

13. Transportation: Project design must ensure adequate ingress to and egress from the site and minimize disruption of public rights-of-way (Division of State Forest Management).

14. Energy Needs/Use: Energy resources fill domestic and commercial needs. Projects should ensure their conservation. Projects should also be designed to use energy wisely (Division of State Forest Management).

15. Existing/Potential Land Use: Project design should be compatible with current zoning for the site and planned future uses if any (District Forest Resource maps and the Division of State Forest Management).

16. Protected Animals/Plants: Certain animal and plant species have been listed and given protected status by the U.S. Fish and Wildlife Service, the Pennsylvania Game and Fish Commissions and the Pennsylvania Department of Environmental Resources. Projects that will have a potential adverse effect on any of these species, or habitats critical to their survival, should be avoided. (For a listing of these species and guidelines for their protection, refer to the Forest Resource Plan, Fauna and Flora Operating Manuals, Pennsylvania Natural Diversity Inventory, Pennsylvania Game Commission, or Pennsylvania Fish Commission).

17. Habitat Diversity and Interspersion: Habitats are classified as either terrestrial, wetland, aquatic or riparian. Management strategies, in most cases, should strive to maximize diversity within and between these habitats primarily by promoting various habitat components. When protecting, creating or developing habitat components, consideration should be given to the arrangement or interspersion of these components within an area. (For definitions of diversity and interspersion and guidelines to promote them, refer to the Fauna Operating Plan and the Forest Resource Plan, Fauna and Flora Management Section).

18. Biological Productivity: While it is the goal of the Bureau to provide for and maintain a diversity of species, we are also striving to promote conditions favorable for the highest possible numbers of certain species while still maintaining diversity. Management for productivity may be aimed at a particular species or group of species while not jeopardizing the area's overall species diversity (Fauna and Flora Operating Manuals).

19. Other: Consider other unique features which may be affected by the proposed project, i.e., scenic rivers, National Natural Landmarks, etc.

20. Permits: Projects affecting or encroaching on wetlands require encroachment permits. New entrances to public roads, other than State Forest roads, require occupancy permits. Certain other activities must be permitted (Division of State Forest Management).

PROJECT REVIEW

On initiation of <u>any</u> project in the following categories, a Project Review must be completed by the District Forester and approved by the State Forester:

1. Wetlands encroachment.

2. Insect and disease control activities in a Natural Area.

3. Right-of-way expansion in a Natural Area or Wild Area.

4. Surface mining.

5. Addition of Class 1 or 2 roads to the State Forest road system.

6. Other projects as determined by the State Forester.

The Project Review will include a description of the project, justification for the project's need, a description of the project site, and a narrative consideration of each of the 20 Project Considerations items. The narrative must include an assessment of the project's probable impact on each factor and whether it is a beneficial or adverse impact. For factors where an adverse impact is predicted, explain the corrective measures to be taken or justification why "none" are planned.

The District Forester will submit the original copy of each Project Review to the State Forester and a copy to each Division within the Bureau for review and comment. Final project approval will be made by the State Forester. The Project Review will be made a permanent part of the project file.

LITTLE TINICUM ISLAND :

An Environmental Analysis and Evaluation of Alternative Utilization Plans

TREDINNICK / WAETZMAN ASSOCIATES

AN ENVIRONMENTAL ANALYSIS AND ALTERNATIVE UTILIZATION PLANS FOR LITTLE TINICUM ISLAND, DELAWARE COUNTY, PENNSYLVANIA

NOVEMBER, 1985

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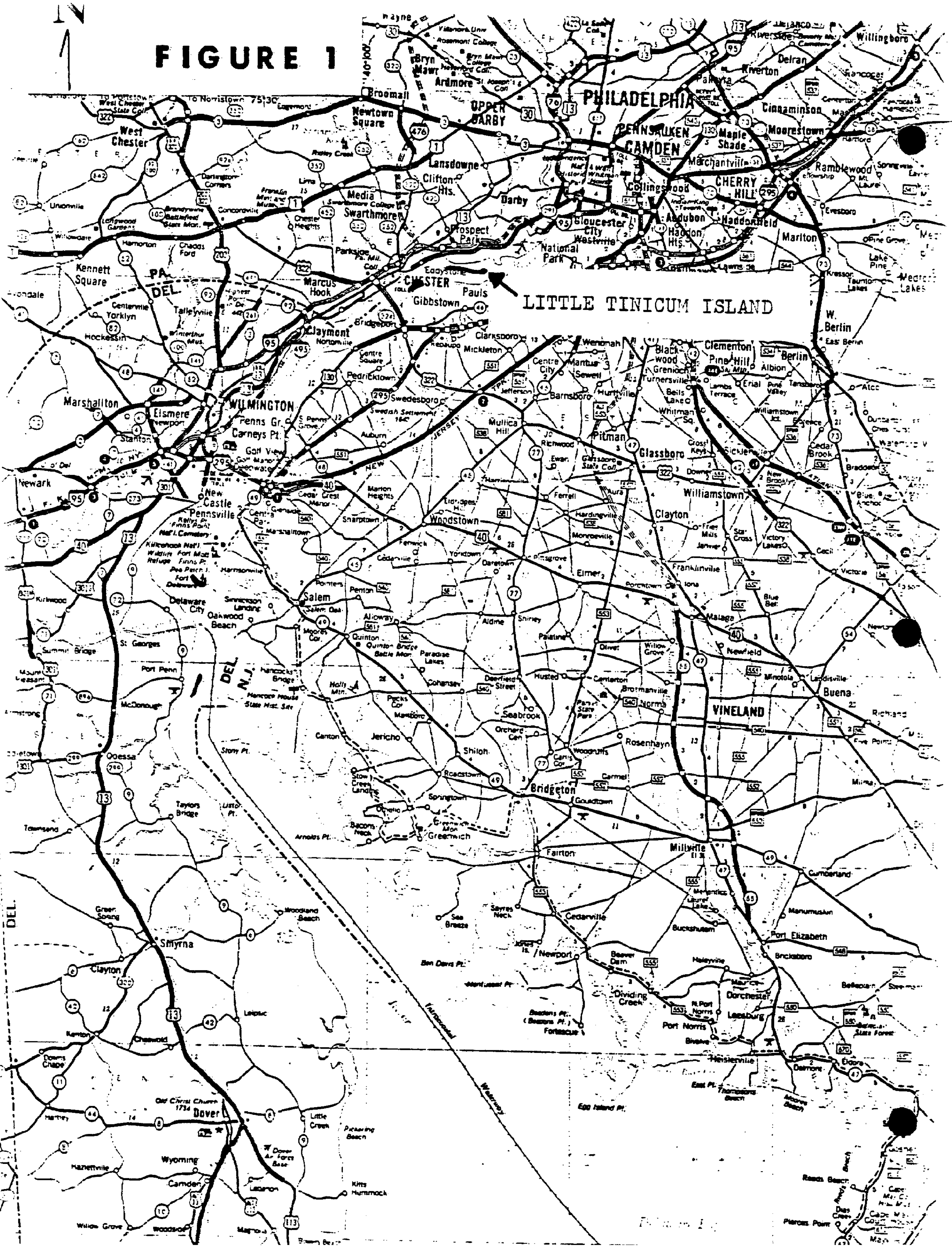
Location of Little Tinicum Island

Little Tinicum Island is an island in the Delaware River estuary. An estuary is a body of water in which the fresh waters of a river mix with the saline waters of the sea to create a brackish water or diluted seawater. The tidal section of the river extends north of Phialdelphia. The area of brackish water moves with the seasons, but usually occurs south of Little Tinicum Island during most of the year. The Delaware River Estuary contains few islands: Pea Patch and Reedy Islands, which are south of Wilmington Delaware, Chester Island, Little Tinicum Island, and Petty Island, see Figure One [1].

Little Tinicum Island is located in a heavily industrialized section of the Delaware River Estuary, see Figure Two [2]. An oil refinery is located on the New Jersey shore opposite the eastern end of the island. The landing glide path of large commercial jets destined for the Philadelphia International Airport crosses the western end of the island. The altitude of jets crossing the Island is a few hundred feet. The landing runway is less than one half a mile from the eastern tip of the island.

Little Tinicum Island is about twelve miles downstream of Philadelphia. It is bounded on its north by a shallow channel that permits entrance to numerous small marinas in Essington and Darby Creek, see Figure Three[3]. A dredged forty foot deep shipping channel which accomodates large international tankers and freighters headed for Philadelphia and Camden lies five to eight hundred (500 - 800) feet south of the Island.

FIGURE 1


LITTLE TINICUM ISLAND
N
PHILADELPHIA
CAMDEN
PENNSAUKEN
CHESTER
WILMINGTON
VINELAND
Bridgeton
Millville
Salem
Dover
Smyrna
Glassboro
Woodstown
Pennsville
New Castle
Newark
Elsmere
West Chester
Kennett Square
Marcus Hook
Claymont
Gibbstown
Paulsboro
Bridgeport
Swedesboro
Pitman
Clayton
Williamstown
Berlin
Marlton
Haddonfield
Cherry Hill
Collingswood
Gloucester City
Westville
National Park
Eddystone
Prospect Park
Darby
Lansdowne
Upper Darby
Media
Swarthmore
Broomall
Newtown Square
Bryn Mawr
Ardmore
Moorestown
Maple Shade
Merchantville
Cinnaminson
Riverton
Delran
Willingboro
Ramblewood
Buena
Newfield
Elmer
Malaga
Franklinville
Mullica Hill
Pedricktown
Penns Gr.
Carneys Pt.
Delaware City
Oakwood Beach
Quinton
Alloway
Shiloh
Jericho
Greenwich
Fairton
Cedarville
Newport
Dividing Creek
Port Norris
Port Elizabeth
Dorchester
Leesburg
Heislerville
Odessa
Marshallton
Stanton
Hockessin
Yorklyn
PA.
DEL.
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NEW JERSEY

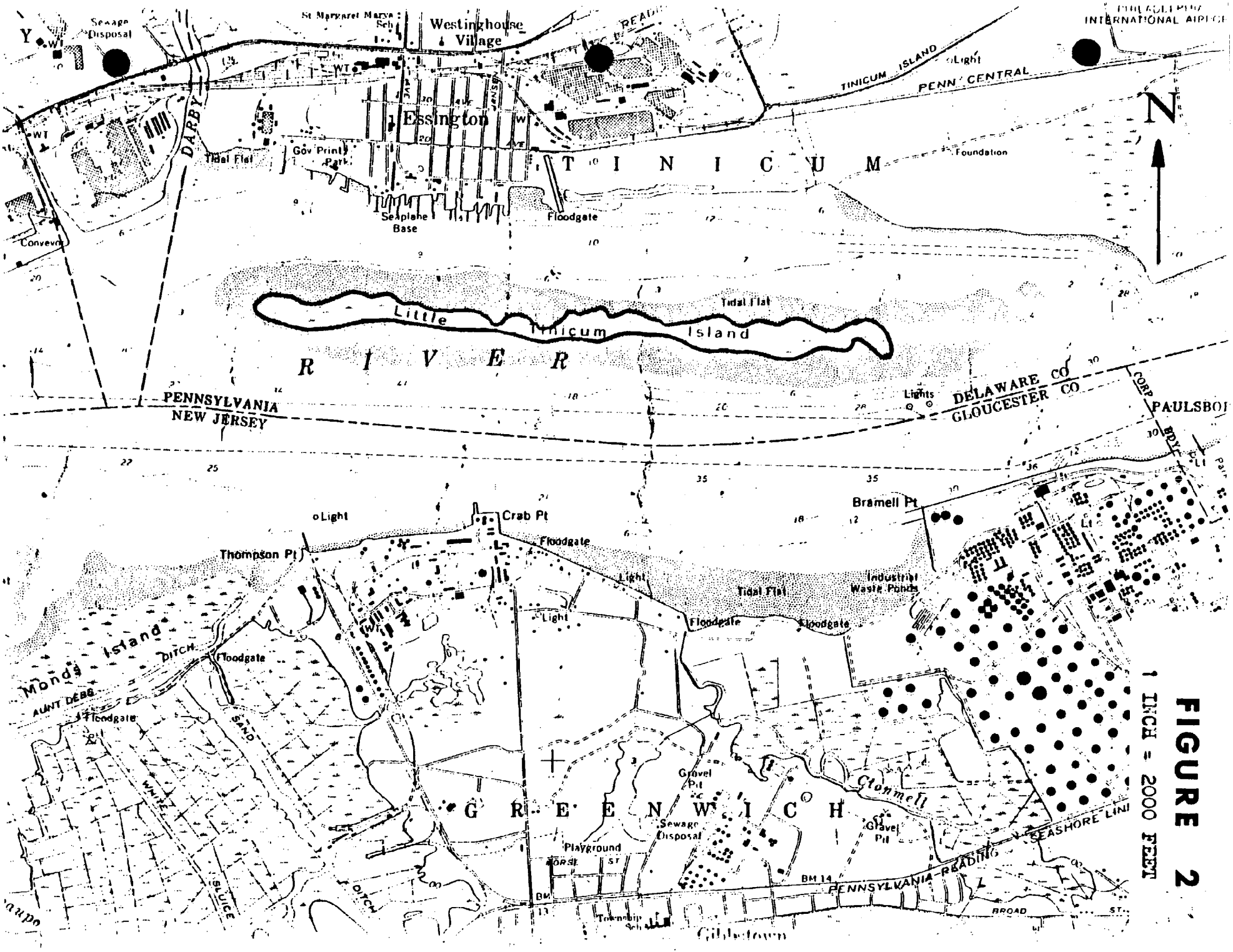
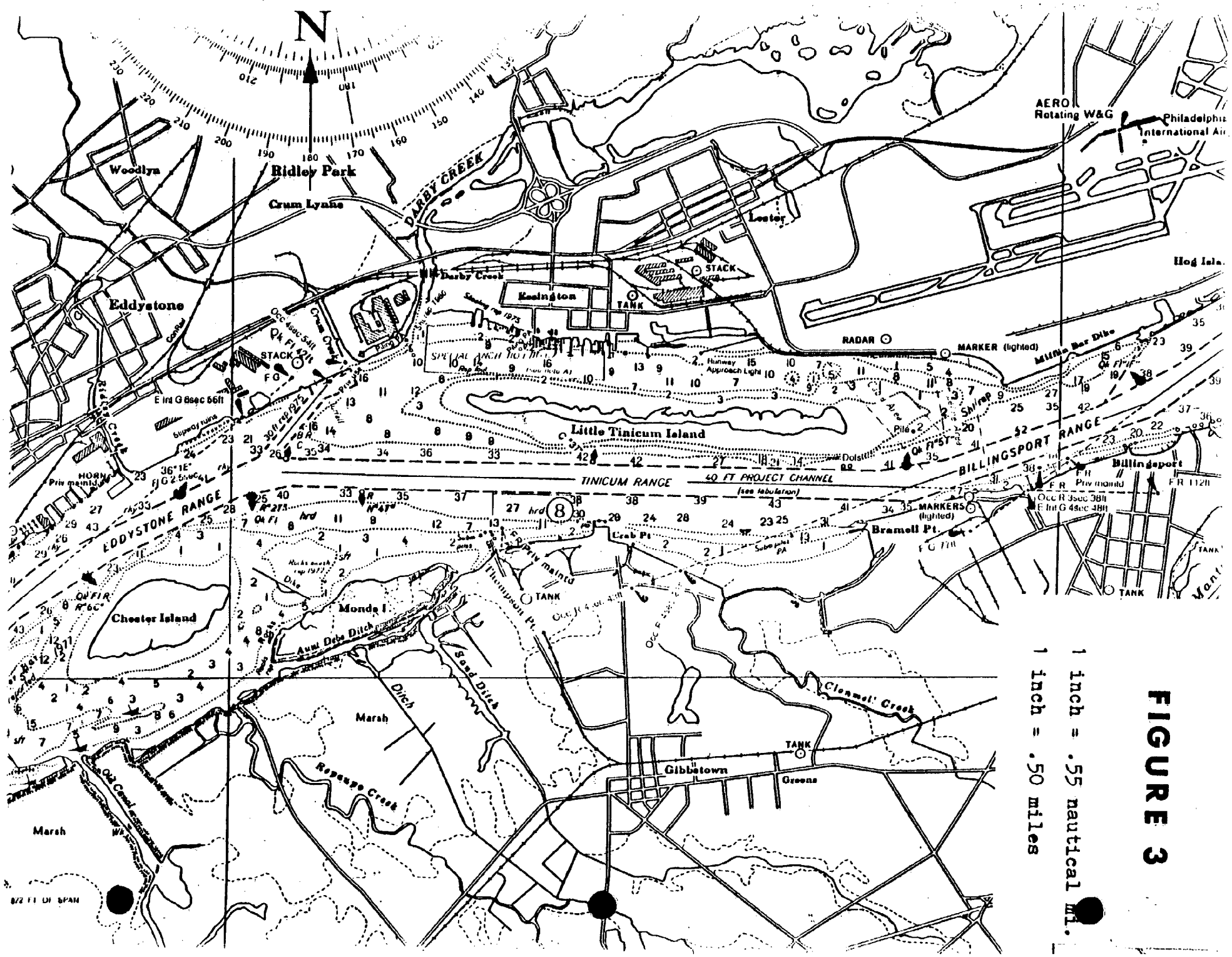


FIGURE 2

1 INCH = 2000 FEET



1 inch = .55 nautical mi.

1 inch = .50 miles

FIGURE 3

The History of Little Tinicum Island and Vicinity

The area of Essington was settled in 1640 by the New Swedish Company. The first Royal Governor, Johan Printz, arrived in 1643 and constructed the Printzhoff- his home and office. The ruins of this building are located in Governor Printz State Park in Essington. The Swedish colony was seized by the Dutch and the British before becoming part of the United States.

In 1799 a new location for the Philadelphia immigration quarantine station was sought. A new facility named the Lazaretto was built on a ten acre tract in Essington. During the yellow fever epidemic in 1870 a request to move the quarantine station to Little Tinicum Island was rejected by the state legislature. The facility was moved to Marcus Hook. The Lazaretto has been used subsequently as a resort, yacht club, and as headquarters for the Seaplane Base and the United States Army Signal Corps.

The first Swedish settlers built dikes for pastureland and cultivation. These dikes were breached in 1777 during the American revolution, but it is not clear if the British occupants or the American revolutionaries breached the dikes.[4] The presently existing dikes on the island were built by the United States Army Corp of Engineers to hold sediments that were hydraulically removed from the river bottom to deepen the shipping channel. Three holding sections exist. The easternmost area was never filled and the dikes have breached creating an inlet.

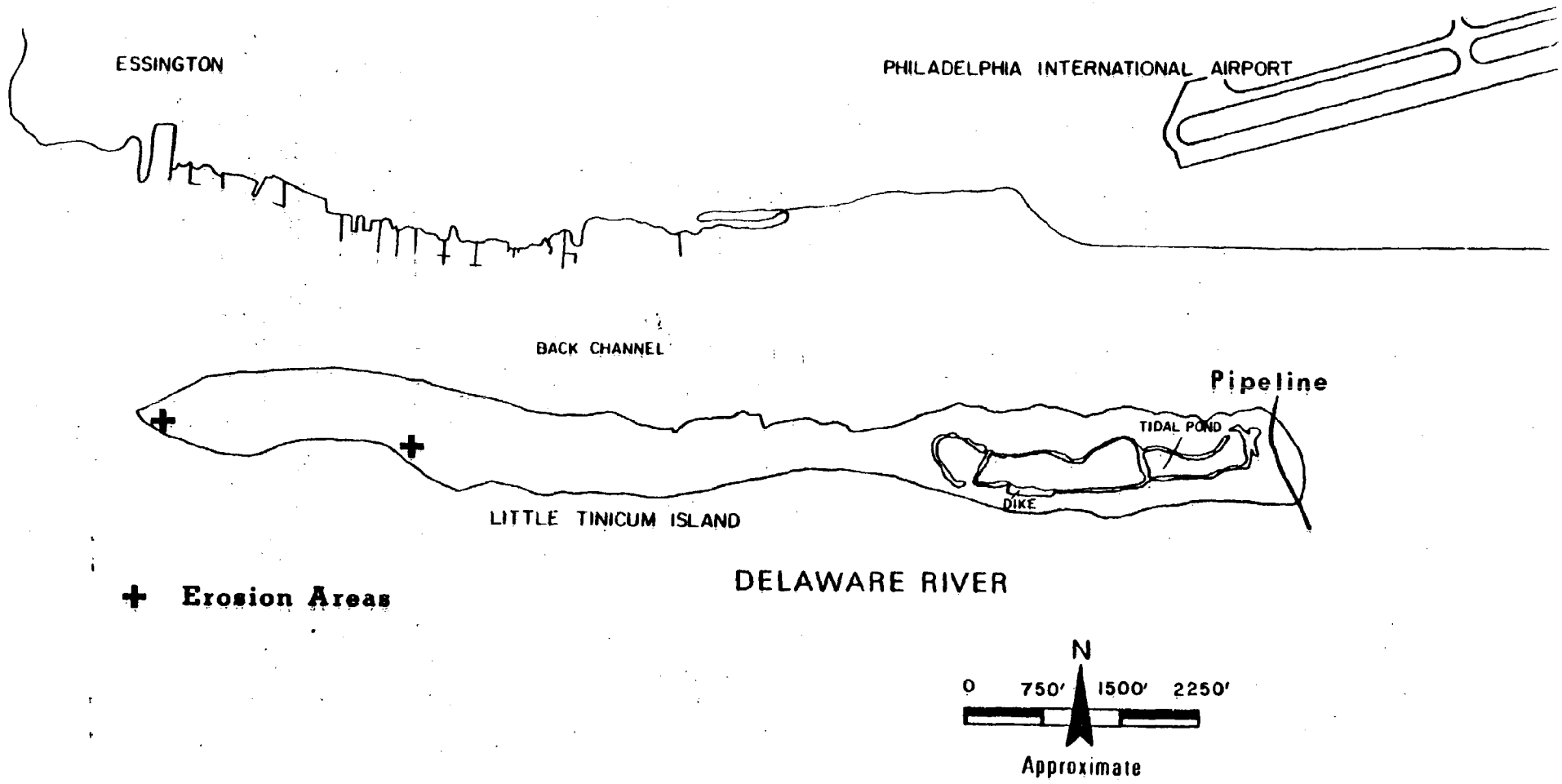
Mr. Robert Mills, owner of the Lazaretto found ruins of a foundations on the west end of the island. Little Tinicum Island is not listed on the National Register of Historic Places or the Pennsylvania Inventory of the Pennsylvania Historical and Museum Commission. This site is not listed for future excavation for ruins or preservation.[5]

A right-of-way was granted to the Southern Pipe Line Company to "lay, maintain and operate two pipe lines for the transportation of oil and construct, maintain and operate telegraph-telephone lines,... over and across Tinicum Island". "The telegraph-telephone lines shall be ... of cable in the River and upon the Island".[6] The location of these rights-of-way was not given in

greater detail. Figure Three shows the location of a cable area and pipeline area near the eastern end of the island. These do not coincide with the existing pipeline on the extreme eastern end of the island, see Figure Four [7].

An easement for a proposed two hundred foot wide channel through Little Tinicum Island is mentioned in the Title Report.[8] This land may be subject to " any outstanding unrecorded agreements with the United States Army Corp of Engineers relative to depositing material dredged from the Delaware River".[9]

FIGURE 4
LITTLE TINICUM ISLAND AND VICINITY



Physical Characteristics of the Island

The recent geologic history of the Delaware River explains the formation of Little Tinicum Island. The course of the Delaware River allowed silt to accumulate on the river shorelines between the mouths of Darby Creek and the Schuylkill River. Little Tinicum Island may have originally been part of this deltaic marshland. A now extinct creek may have separated the island from the mainland before the Delaware River overflowed the creek. These marsh shorelines and the island north of Little Tinicum Island- Hog Island, were diked and filled to create land. Little Tinicum Island is on an inside curve of the river bend. The water flow is slower here and sediments accumulate, especially in the back channel or north side of the island.[10]

The shape of the island is slowly changing. The southwestern end of the island and its accompanying small tidal flats are eroding away while the extensive tidal flats and shoals offshore of the eastern end remains stable. The western end of the island previously extended beyond the mouth of Darby Creek in 1890.[11] The waves created by passing freighters erode the shorelines that are not protected by the buffering action of Three-Square Bulrush of the tidal flats, see Figure Four. The western end has two areas that are eroding for these reasons and also because these areas lie perpendicular to the unobstructed westerly winds and subsequent building waves. These waves hit the eroding clifflike shoreline which is stabilized by strongly rooted Phragmites plants.

Sandy beaches are formed in a few areas of the southern shore that are not protected by emergent vegetation. Large amounts of debris and driftwood lie at the high storm tide elevations of the island, see Figure Four. The driftwood consists mostly of large tree trunks that were uprooted upstream during large storms and floods. These trunks protect the island against erosion by waves during large storms by holding and trapping sand and silt.

The soils on Little Tinicum Island are classified as Tidal Marsh- a mixture of silty clay and coarse textured sediments washed down from the coastal plain by Darby Creek.[12]

Tides and Navigation near Little Tinicum Island

The Delaware River has a semidiurnal 5.7 foot tide near Little Tinicum Island. There are two approximately equal high and low tides each day. There are no navigational aids for boaters near Little Tinicum Island marked on the chart, see Figure Three. The Pennsylvania Fish Commission does maintain their private markers near their boat basin. The western area of the back channel is designated by the United States Coast Guard as a special anchorage for pleasure craft. Navigation in the back channel is very difficult at low tide, especially for sail boats and deep draft vessels. The mud flats surrounding the island extend out an average of three hundred feet. The mud flats extend for twelve hundred feet east of the island, see Figure Five [13]. The entire island is in the floodplain of the river. Large storm tides cause the river to wash across low lying areas.

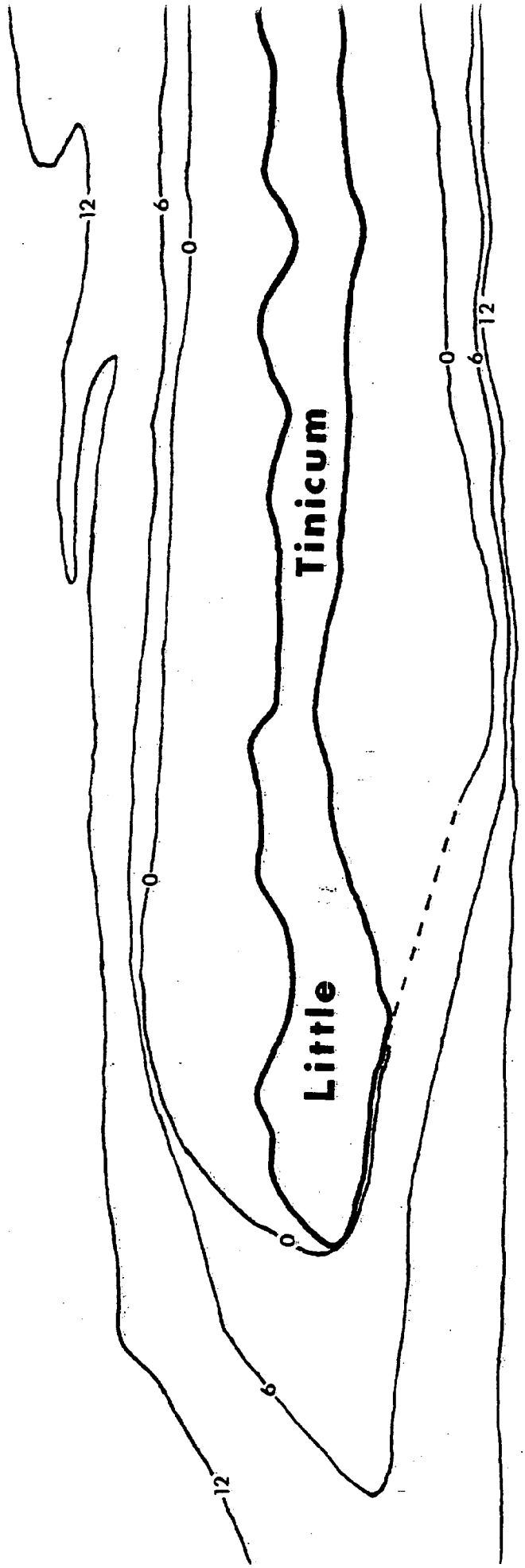
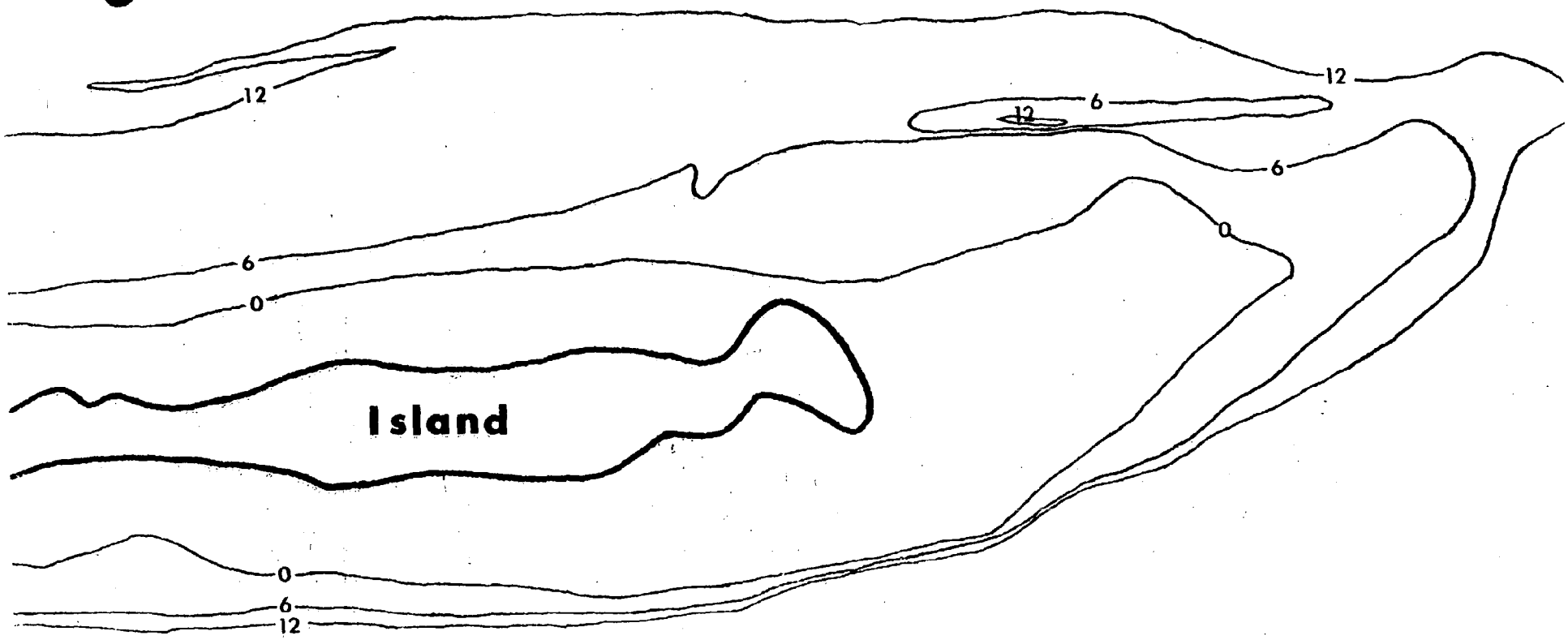


FIGURE 5

The Mud Flats

SOUNDINGS IN FEET
MEAN LOW WATER + 0.7 ft.
MEAN HIGH WATER + 6.1 ft.
ONE INCH = 400 FEET


12
12
6
12
6
0
6
0
Island
0
6
12

The Quality of Delaware River Estuary Waters near Tinicum Island

The water quality of the river water is improving along most of its length. The quality of the river near Little Tinicum Island is very poor. The two recently improved sewage treatment plants in Philadelphia are discharging secondarily treated sewage effluent into the river. This treatment is not complete and the effluent puts a burden on the river to complete the degradation of wastes and consequently lowers the amount of dissolved oxygen in the water.

Water quality data of a section of the Delaware River near the Island is collected at Paulsboro, New Jersey. The quality of water can vary greatly along short distances upstream or downstream or from shore to shore. Consequently, data collected at Paulsboro may not accurately reflect the water quality in the back channel but probably is accurate for the south shore of the island. Satisfactory levels are indicated for pH, temperature, hardness, alkalinity, chloride, phenol, iron and lead.[14, 15]

Dissolved oxygen is an important indicator of water quality. Dissolved oxygen concentrations above 5 mg/l are required for a complete life cycle of the most sensitive fish- ex. American Shad. Dissolved oxygen at two to three milligrams per liter (2 - 3 mg/l) is required for a minimally diverse estuarine fishery.[16] The State of Pennsylvania standard states that dissolved oxygen concentrations should be greater than 3.5 mg/l on a single day and greater than 6.5 mg/l as a spring and fall seasonal average. Figure Six [17] shows that oxygen levels were usually substandard.

Sewer lines that combine flood waters and sewage during rainstorms discharge raw sewage into the river during heavy storms. The Delaware River Basin Commission estimates that this is a large source of river pollution (bacterial contamination) near Little Tinicum Island. Fecal coliform is a measure of the amount of water contamination by human sewage. Fecal coliform levels are indicators of the potential of human pathogenic bacteria and other organisms existing in the water. These bacterial, virus and

protozoan pathogens cause hepatitis, salmonella, shigella, encephalitus and other infections.[18]

The Pennsylvania standard for fecal coliform concentrations for waters used for boating and other secondary contact recreation (not swimming) is 770 counts/ml. Swimming waters should have counts less than 200 counts/ml. The Delaware River near Paulsboro never met the swimming standard during the seventeen sampling days in 1984 to the present. The boating standard was met during two sample days during this period, see Figure Six.

The Pennsylvania Department of Health was contacted to determine if any instances of illness related to river contact was reported. Health Records are not kept in a format that could be readily investigated to answer this question. No outbreaks of illness due to river contact have been noted by the Chester, PA. office of the Pennsylvania Department of Health.[19]

Chloride is an element found in greater concentrations in saltwater than in freshwater. It is used as an indicator of saltwater in an estuary. Freshwater has chloride concentrations of ten to twenty milligrams per liter; the saltwater front is defined at 250 mg chloride/l. Diluted saltwater enters the Essington area usually in late summer and retreats in the fall. The average location of the saltwater front during the year is Marcus Hook.[20]

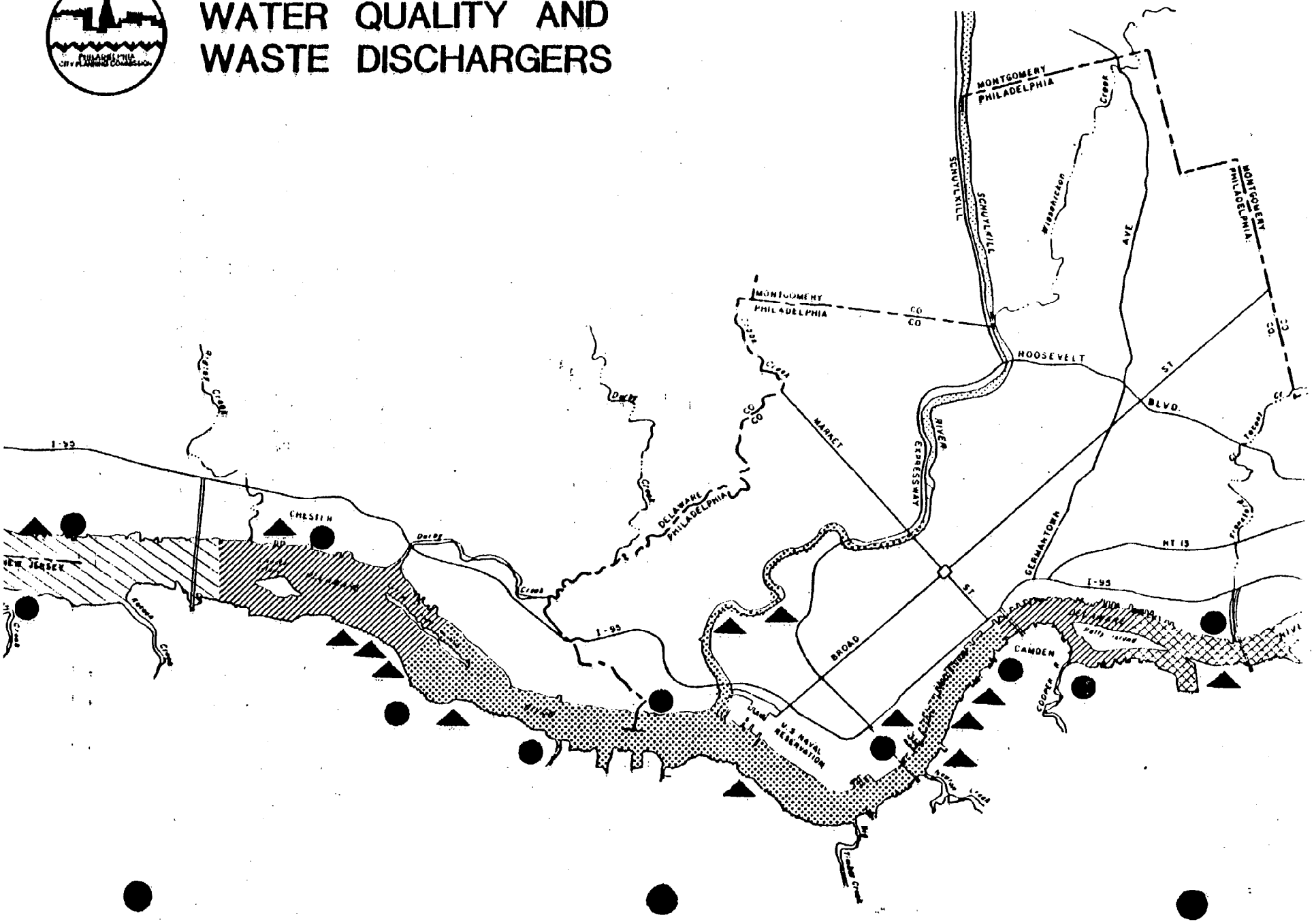
FIGURE SIX

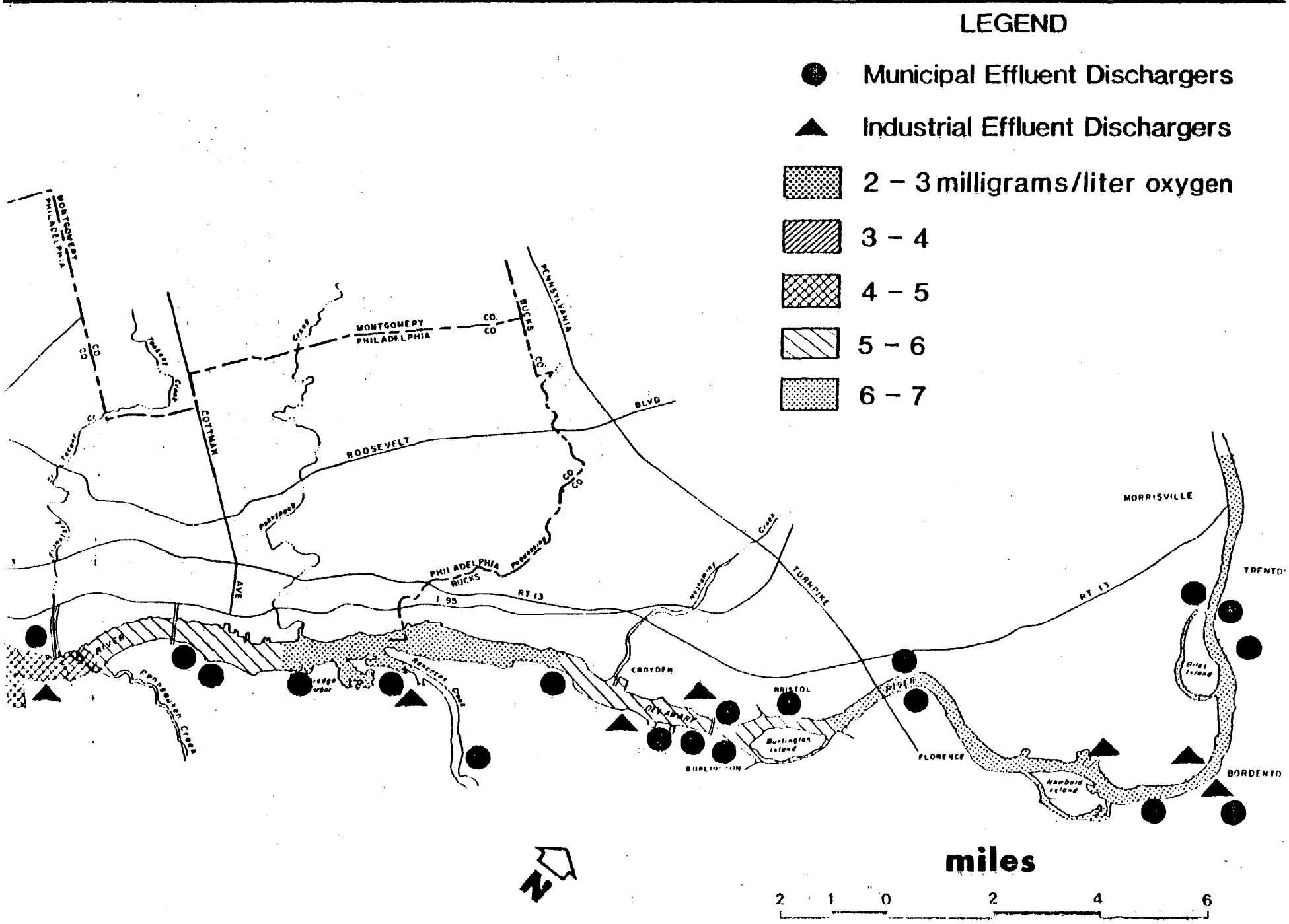
	spring 84	summer 84	fall 84	spring 85
temperature °F	56	76	64	62
Fecal coliform counts/ 100 ml	3240	2380	4000	-
Dissolved Oxygen mg O_2/l	7.15	2.46	3.98	5.63
Chloride mg Cl/l	14.3	24.6	72	25.5

The water quality of the Delaware River was summarized in a map prepared by the Philadelphia City Planning Commission, see Figure Seven.[21]

FIGURE 7

WATER QUALITY AND WASTE DISCHARGERS




LEGEND
Municipal Effluent Dischargers
Industrial Effluent Dischargers
2 – 3 milligrams/liter oxygen
3 – 4
4 – 5
5 – 6
6 – 7
MONTGOMERY
PHILADELPHIA
CO.
CO
BUCKS
PENNSYLVANIA
COTTMAN
AVE
ROOSEVELT
BLVD
PHILADELPHIA
BUCKS
I-95
RT 13
TURNPIKE
MORRISVILLE
TRENTO
RT 13
CROYDEN
BRISTOL
DELAWARE
RIVER
Burlington Island
FLORENCE
Newbold Island
BORDENTO
Biles Island
Pennsauken Creek
Rancocas Creek
miles
2 1 0 2 4 6
N

The Vegetation and Geomorphology of Little Tinicum Island

Little Tinicum Island is circled by tidal freshwater wetlands. The interior of the island consists of scrub forests and disturbed areas of fill with a variety of types of vegetation. Figure Eight is a vegetation map of the island. The vegetation types are described below. Scientific names are listed in Figure Nine.

Three-square Bulrush Marsh

This emergent plant grows in silty soils in the lower tidal areas and forms the outermost fringe of vegetation on most of the island. The large tidal change and waves on the south shore prevent other plants from growing in these areas habitated by the three-square bulrush. The few species that are found in this area are found more inland and are very sparse. They are pickerelweed, spatterdock, nutsedge, wild rice, cattails, great bulrush, and iris species. On the north shore the three-square bulrush fringes the Lower and Upper Tidal Marshes and mixes with these marshes.

Lower Tidal Marsh

This marsh is the outermost vegetation on certain more protected areas of the north shore. The soils of these areas are totally exposed at low tide and are flooded with two to three feet of water at high tide. This marsh contain areas where a single species, such as spatterdock or pickerelweed dominates. This area also contains arrowheads, arrow arum and mud plantain.

Upper Tidal Marsh

This marsh is found between the lower tidal marsh and phragmites stands or scrub/forest. These mud flats are flooded shallowly during high tide. This marsh is very narrow and is a transition zone between tidal areas and uplands. It contains a mixture of numerous species, with no species predominating except for the two eastermost areas on the north shore where water smartweed is plentiful. Components of this marsh are narrow-leaved and common cattail, wild rice, nutsedge, common reed (Phragmites), spikerush, water smartweeds, speedwell, water purslane, false pimpernel, monkeyflower, waterdock and beggarticks.

The Upper and Lower Marshes have been mapped together for practical

reasons.

Common Reed

Homogenous stands of the common Phragmites are spreading on the island. These reeds have replaced a narrowleaved cattail marsh near the western end of the island that was mapped in 1971.[22] These reeds are ten to fourteen feet tall and grow in thick impassible stands just inland of the high tide mark.

Mixed Shrubs

The shrubs are found above the high tide mark and as a transition zone between the common reed and the scrub/forest. Areas of shrubs grow among the common reed on the western tip of the island. Staghorn sumac is the predominant shrub in these areas.

Scrub/Forest

Scrub/forest occupies the interior uplands. The composition varies from scrub areas with bare sands and few trees to forest areas with thirty to fifty feet tall trees. The common trees are black willow, crack willow, cottonwood, white ash, red ash and sycamore. Locally common tree species are silver maple, boxelder, red maple, wild cherry, river birch, catalpa and sweetgum. Non-native and pollution tolerant trees growing on open areas and beaches are the tree-of-heaven, princess-tree, Norway maple and white mulberry.

Shrubs, tree saplings, herbs, grasses and vines comprise the understory. Purple loosestrife and Japanesse knotweed are non-native 'weed' species that dominate a few small shoreline areas above the high water mark on the south shore. Thick growths of herbs and vine understory were present in richer soils in the central part of the island. The sand and gravel fill soils on the eastern end supported less of an understory.

The construction of dikes and filling of these areas has altered the natural soils and hydrology of the eastern third of the island. The easternmost dike has been breached creating an inlet. The steeply sloped tidal reas of this inlet are not habitated by aquatic vegetation. Shrubs and grasses grow on the steep banks- ticklegrass, horsenettle, blackberry.

The grasses present in the scrub/forest are ticklegrass, switchgrass and witchgrass. The vines noted were poison ivy, virginia creeper and japanesse honeysuckle. The herbs present are spotted jewelweed, morning glory, pokeweed, dodder, mints, lambsquarters, american germander and mullein. The shrubs are elderberry, silky dogwood, staghorn sumac, buttonbush, common alder, blackberry, false indigo and hibiscus.

Compositae stand

The central basin has very course soils which drain quickly. This area has a history of fires. In 1971 it was noted that a fire had destroyed most of the trees leaving a thick stand of soapwort and sunflower with cottonwood and black willow sprouts. The eastern section of this central basin is now composed of a thick stand of an unidentified genus of the family Compositae.

Cottonwood Grove

A stand of cottonwood trees occupies the center of the central dike. This twenty to thirty-five foot stand has grown since the fire in 1971.

Grasslands

One small area is composed of grasses and a few shrubs that are common in the scrub/forest.

Sand Beaches

These clean, unvegetated sandy beaches exist on the south shore.

Driftwood and Debris areas

This area occurs from the high water mark and extend inland for more than a few yards. In low lying areas driftwood is found in the interior of the island. Most of the area is driftwood but some trash debris is present. Few plants grow among the driftwood.

A map of the wetlands delineated by the United States Department of the Interior in the National Wetlands Inventory is Appendix Two.

FIGURE NINE

Grasses, sedges and rushes:	
Three-square bulrush	Scirpus americanus
Great bulrush	Scirpus validus
Nutsedge	Cyperus spp.
Common reed	Phragmites communis
Wild rice	Zizania aquatica
Spikerush	Eleocharis diandra
Ticklegrass	Agrostis hyemalis
Switchgrass	Panicum virgatum
Witchgrass	Panicum capillare
Fern and Monocots:	
Arrow arum	Peltandra virginica
Arrowheads	Sagittaria latifolia
Common cattail	Typha latifolia
Narrow-leaved Cattail	Typha angustifolia
Sensitive fern	Onoclea sensibilis
Pickerelweed	Pontederia cordata
Mud plantain	Heteranthera reniformis
Marsh Herbs:	
Beggar-ticks	Bidens spp.
Water dock	Rumex altissima
Water hemp	Acnida cannabina
Annual hedge hyssop	Gratiola neglecta
False pimpernel	Lindernia dubia
Water purslane	Ludwigia palustris
Water smartweed	Polygonum punctatum
Spatterdock	Nuphar advena
Speedwell	Veronica arvensis
American germander	Teucrium canadense
Monkeyflower	Mimulus spp.
Blue Vervain	Verbena hastata

Upland Herbs:

Lambsquarters	Chenopodium album
Mullein	Verbascum thapus
Cocklebur	Xanthium sp.
Marsh hoarhound	Lycopus europaeus
Horsenettle	Solanum carolinense
Spotted jewelweed	Impatiens capensis
Milkweed	Asclepias sp.
Mustard	Roripba spp.
Pokeweed	Phytolacca americana
Sunflower	Helianthus sp.
Soapwort	Saponaria officinalis

Trees:

Red Maple	Acer rubrum
Red Ash	Fraxinus p. pennsylvanicum
White Ash	F. americana
River birch	Betula nigra
Boxelder	Acer negundo
Catalpa	Catalpa speciosa
Wild cherry	Prunus serotina
Cottonwood	Populus deltoides
Norway Maple	Acer platanoides
Silver maple	Acer saccharinum
White mulberry	Morus alba
Osage orange	Maclura pomifera
Princess Tree	Paulownia tomentosa
Sweetgum	Liquidambar styraciflua
Sycamore	Platanus occidentalis
Tree-of-heaven	Ailanthus altissima
Black Willow	Salix nigra
Crack Willow	Salix fragilis

Shrubs:

Black alder	Alnus glutinosa
Common alder	Alnus serrulata
Blackberry	Rubus spp.
Buttonbush	Cephalanthus occidentalis

Silky dogwood	*Cornus amomum*
Elderberry	*Sambucus canadensis*
False indigo	*Amorpha fruticosa*
Staghorn sumac	*Rhus typhina*
Dwarf sumac	*Rhus copalina*
Shrubform Herbs:	
Japanese knotweed	*Polygonum cuspidatum*
Purple loosestrife	*Lythrum salicaria*
Marsh mallow	*Hibiscus palustris*
Vines:	
Japanese honeysuckle	*Lonicera Japonica*
Poison ivy	*Rhus radicans*
Virginia creeper	*Parthenocissus quinquefolia*
Dodder	*Cuscuta* spp.
Morning glory	*Iponoea purpurea*
Bittersweet nightshade	*Solanum dulcamara*

Plant Species of Special Concern

The following species of special concern are listed in the Pennsylvania Natural Diversity Inventory.[23] Wild rice was observed during this study. A complete survey of the north shore by rowboat or canoe to areas that were inaccessible by foot or motorboat may yield reports of waterhemp ragweed and Walter's barnyard grass.

Zizania aquatica (wild rice) status rare. Reported in 1983, 100 - 1000 plants on the mud flats of the north shore. During this study, three groups of a few plants each were observed, two groups on the mud flats of the north shore and one group at the high water mark in driftwood on the south shore.

Amaranthus cannabinus (water hemp ragweed) status rare. Reported in 1983 as 1000 - 10,000 plants growing on silt, muck and sand substrate near the upper zone of the high water mark in shallow water.

Echinochloa walteri (Walter's barnyard grass) status rare. Reported in 1983 as 10,000 flowering and fruiting plants nearly all mature growing in the upper limit of high tide mark to adjacent shore on sand and gravel, and silt and muck.

Hypericum gymnanthum (Clasping-leaved St. John's-Wort) status rare. Reported in 1866.

Scirpus fluviatilis (River bulrush) status rare. Reported in 1865.

Lobilia nuttallii (Nuttall's lobelia) status rare. Reported in 1864.

Elatine americana (Long-stemmed water-wort) status extirpated. Reported in 1868.

Fires on Little Tinicum Island

Fires are an annual occurence in the summer on the island. These fires occur on the east end of the island and burn a small area up to an acre. In 1985 there were two very small fires in the driftwood debris and nearby herbs and shrubs. Evidence of small fires in previous years was noted. A few stone fire circles have been built on the southeast beach.

The Food Value of Vegetation to Wildlife

The value of the aquatic plants is listed in Figure Ten.[24] The many varieties of plants that grow on the island can feed a variety of reptiles, amphibians, birds and mammals. The seeds of bulrush, smartweed, waterhemp, wild rice and nutsedge are eaten by waterfowl. Common reeds are not utilized by birds for food. The spread of common reeds into valuable food habitats has a negative effect on the wildlife.

Shrubs and trees provide food for wildlife. The fruit of blackberry shrubs, wild cherry, elderberry and white mulberry trees are eaten by birds and mammals. Buttonbush seeds are eaten by aquatic birds. The fruit of the dwarf sumac is eaten by wildlife.[25]

FIGURE TEN

THE FOOD VALUE OF AQUATIC PLANTS

	muskrat	upland game birds	water fowl	marsh birds	shore birds	song birds
Agrostis spp.						
Alnus spp.		x	x			x
Bidens			x			x
Cyperus spp.		x	x	x	x	x
Echinochloa spp.		x	x			x
E. walteri	x		x			
Fraxinus spp.			x			x
Heteranthera			x			
Hibiscus pal.			x			
Hypericum gym.			x			
Ludwigia pal.	x					
Nuphar advena	x		x	x	x	x
Peltandra virg.	x		x			
Phragmites	x					
Polygonum spp.	x	x	x	x	x	
Pontederia cord.	x		x			
Rumex spp.	x	x	x			x
Sagittaria spp.	x		x			
Salix spp.	x	x	x	x		x
Scirpus amer.	x		x			
S. validus			x			
S. fluviatilis			x			
Typha angustifolia	x		x	x		x
T. latifolia	x		x	x		x
Zizania aquatica	x	x	x	x		x

LITTLE TINICUM ISLAND, DELAWARE RIVER:

Herpetological Comments

by

John D. Groves
Curator of Amphibians & Reptiles
Philadelphia Zoological Garden

On 31 October 1985, I visited Little Tinicum Island in the Delaware River to give advice on the possible herpetological fauna that may be present on the island. Since this visit occurred on a cool cloudy day at the end of October no amphibians or reptiles were observed. Despite the lack of direct observations and the unavailability of documented herpetological records from the island, it is possible from knowledge of the island's history, habitats and food resources, as well as a knowledge of herpetofaunal colonizations of other similar islands in other areas of the Atlantic region, to formulate a working list of probable or possible amphibians and reptiles on Little Tinicum Island. The following comments and table are intended to provide a preliminary list of this herpetofauna and are not to be considered a definitive account for this island.

Habitat Comments

Nine habitat types were noted on the island (Fig. 1; Table 1). These varied from mud flats (extending from the shore line to deeper water of the river) to upland areas of scrub, successional woods and old fields in the interior of the island. A long, but narrow flood plain encircles most if not the entire island and a fair size (2 acre) lagoon, devoid of aquatic and emergent plants, which is connected to the west channel are also present on the island. A series of three dikes of sandy soil comprise three small, but distinct habitat types (old field, scrub and barrens) on the north side of the island's interior. These dikes originated as a result of the dredging of the channel in the Delaware River on the east side of the island which accounts for the sandy soil. Apparently a variety of environmental factors are actively at work on the island that have created such a diversity of habitats for such a small island.

Species Comments

From an evaluation of the islands available habitats and the known distribution of amphibians and reptiles on both the Pennsylvania and New Jersey sides of the Delaware River, the possible herpetofauna of Little Tinicum Island may contain at least three species of amphibians and 11 or 12 species of reptiles. However, because of the size of the island and its available resources it is doubtful that all of these species have resident reproducing populations on the island. It is more probable that most of these species are only present on the island as occasional waifs or only to use the resources of the island for specific purposes. Table 1 lists all of the possible amphibians and reptiles that may occur on the island and the habitats where they can be expected to be found.

Two endangered species of Pennsylvania and one status undetermiend species may occur on or in the waters surrounding the island. At least one of the endangered species (red-bellied turtle, *Pseudemys rubriventris*) has been sited by Pennsylvania Fish Commission biologists in the Delaware River near this island in the Federal Channel in October 1985. This site record indicates that this species may use

the island for feeding and nesting.

The following comments are included to give justification for the species listed on Table 1.

Amphibians

Three species of anurans may occur on the isalnd. These include the following:

Spring Peeper (Hyla c. crucifer) - This small treefrog has been reported to reproduce on the island (Cathy Leonard, per. comm.). Available habitat is found on many parts of the island for adults. The lagoon area is probably used for breeding since the salinity levels are low or absent in the river during their breeding season. Dean Florence (PA Fish Commission) reports that the salt line in the Delaware River recedes down river between October and December and returns in June of the following year. This period is adequate for both the breeding season and the tadpoles to develop to the adult stage.

American Toad (Bufo a. americanus) - This toad is common throughout Delaware County with several large populations in the Essington and Tinicum areas. The adult American toad appears to withstand brackish environments and has been found on many islands along river courses in Maryland (per. observations) and even on Barrier islands off the Atlantic coast (per. observations).

Fowler's Toad (Bufo woodhousei fowleri) - This toad, like the American toad, is another island colonizer (Gibbons and Coker, 1978). Museum records from the Pennsylvania and New Jersey mainland are available for this species in the the vicinity of the island. An early breeder with a short tadpole developmental rate makes this species a probably resident species.

Reptiles

Twelve species of reptiles are listed on Table 1 as possibly occurring on the island. Although habitat is available for each of these species, it is unlikely if all species have resident populations on the island.

Snapping Turtle (Chelydra s. serpentina) - This large aquatic turtle is probably the most common reptile in southeastern Pennsylvania. It occurs in large numbers in a variety of aquatic habitats. It is known to occur in many areas of the Delaware River and most likely occurs on and around the island.

Musk Turtle (Sternotherus odoratus) - This little turtle is similar in habits to the snapping turtle and is known to occur in many areas of the Delaware River.

Eastern Mud Turtle (Kinosternon s. subrubrum) - This turtle is endangered in Pennsylvania. Only three locations are presently known for the mud turtle along the coastal plain section of the Commonwealth. Groves (1985) reviewed its distribution and ecological requirements. The available habitat and food resources on and around the island make this a possible species in the herpetofauna.

Painted Turtle (Chrysemys p. picta) - A common turtle around the Delaware River. This species may use the islands resources for feeding and nesting. The warm waters in the lagoon and mud flats provide adequate hibernating areas.

Red-bellied Turtle (Pseudemys r. rubriventris) - This large aquatic turtle is endangered in the Commonwealth. Ernst (1985) reviewed its distribution and ecological requirements. Michael Kauffman and Chuck Emory (PA Fish Commission) sited a large adult swimming in the Delaware River near the island. Adequate feeding, nesting and hibernation areas are available on and around the island. Populations are probably small, however, in the area.

Box Turtle (Terrapene c. carolina) - The box turtle is frequently found on off-shore islands. This species probably makes use of most of the terrestrial habitats on the island. This species is frequently kept as pets and may disappear from over-collecting if present.

Water Snake (Nerodia s. sipedon) - A common aquatic species along the Delaware River. It is considered poisonous wherever found, but is harmless to man. Many people confuse this snake with the cottonmouth of the south. A resident population most likely exists on the island.

Northern Brown Snake (Storeria d. dekayi) - This small snake is one of the most common snakes on the adjacent mainlands of Pennsylvania and New Jersey. It is highly adaptable to urban and other disturbed areas. It probably occurs in all terrestrial habitats that have sufficient moisture to support slugs, worms and pill bugs. The flood plain or the eastern shore of the island has more than adequate habitat with an abundance of shelter (drift wood and other debris) and probably supports a large population.

Eastern Garter Snake (Thamnophis s. sirtalis) - Another extremely common snake on the mainland of Pennsylvania and New Jersey. Commonly found in association with the northern brown snake, sometimes under the same shelter site. Habitat and food resources of the island probably supports a substantial population.

Eastern Hognosed Snake (Heterodon platyrhinos) - This medium sized snake is historically known from the area, but is extremely uncommon. The sandy soil of the uplands and the possible presence of toads on the island may provide adequate suitable conditions for this species. In other areas (Maryland to Florida) this species is commonly found on river and coastal islands. The size of Little Tinicum Island would, however, support only a small population. McCoy (1985) discussed this species in Pennsylvania.

Black Racer (Coluber c. constrictor) - A large snake that is found in fields and open areas near this island. Adequate food and habitat is available on the island.

Black Rat Snake (Elaphe o. obsoleta) - Historically known from the area. May occur in the marsh and upland areas. The black racer may compete with this species keeping populations low if it indeed occurs on the island.

Conclusions

The list and table provided here on the possible amphibians and reptiles that may occur on Little Tinicum Island is intended to be a brief account of these animals for planning purposes only. It is not the result of extensive surveys and needs to be confirmed. I have examined the available habitats and considered the potential food resources and potential reproductive parameters for each included species. Most likely the actual list of species occurring on the island will be reduced and not expanded upon due to human activities on the mainland shores and possibly on the island itself.

Although three species of concern in Pennsylvania are listed, I do not feel that special protective methods need to be formulated for populations on the island. Current protective measures regulated by the Pennsylvania Fish Commission are adequate. Field surveys of these three species should, however, be undertaken on the island by Bureau of Forestry personnel.

Literature Cited

Ernst, C.H. 1985. Endangered: Red-bellied Turtle, Pseudemys rubriventris. IN Genoways, H.H. and F.J. Brenner (Eds.) Species of Special Concern in Pennsylvania. Carnegie Mus. Nat. Hist., Special Publ., No. 11, pp. 267-270.

Gibbons, J.W. and J.W. Coker. 1978. Herpetofaunal Colonization Patters on Atlantic Coast Barrier Islands. Am. Midl. Nat. 99: 213-233.

Groves, J.D. 1985. Endangered: Eastern Mud Turtle, Kinosternon subrubrum. IN Genoways, H.H. and F.J. Brenner (Eds.) Species of Special Concern in Pennsylvania. Carnegie Mus. Nat. Hist., Special Publ., No. 11, pp. 265-267.

McCoy, C.J. 1985. Status Undetermined: Eastern Hognose Snake, Heterodon platyrhinos. IN Genoways, H.H. and F.J. Brenner (Eds.) Species of Special Concern in Pennsylvania. Carnegie Mus. Nat. Hist., Special Publ., No. 11, pp. 289-291.

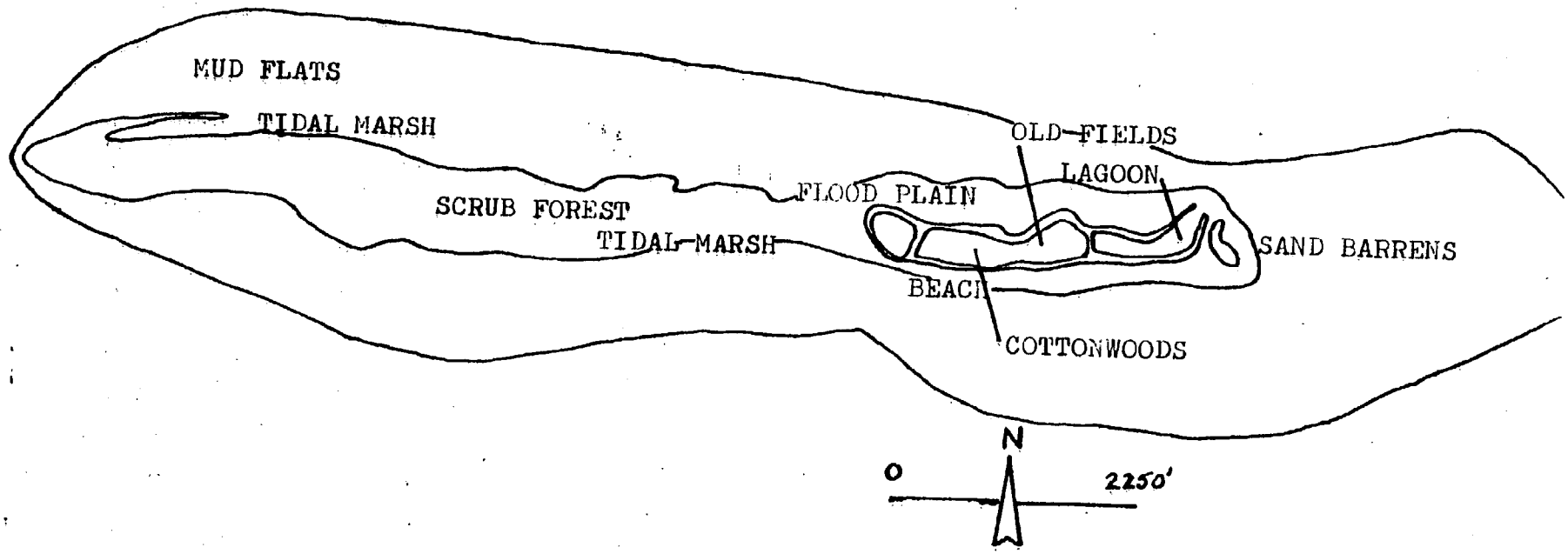
FIGURE 11 Possible Amphibians and Reptiles of Little Tinicum Island, Delaware River

Species	Mud Flats	Tidal Marsh	Beach	Lagoon	Flood Plain	Scrub Forest	Cotton-woods	Old Field	Sand Barrens	(See Figure 12)	
Amphibians											
Spring Peeper		X		X	X	X	X			known*	
American Toad		X	X	X	X	X	X	X	X	probable*	
Fowlers Toad		X	X	X	X	X	X	X	X	probable	
Reptiles											
Snapping Turtle	X	X		X	X					probable*	
Musk Turtle	X	X		X						probable	
Mud Turtle	X	X		X	X					possible	Endangered-PA
Painted Turtle	X	X		X						probable*	
Red-bellied Turtle	X	X		X						probable*	Endangered-PA
Box Turtle		X	X		X	X	X	X	X	probable	
Water Snake	X	X	X	X	X					likely*	
N. Brown Snake			X		X	X	X	?		probable	
E. Garter Snake		X	X	X	X	X	X	X		probable*	
Hog-nosed Snake								X	X	possible	Undetermined
Black Racer		X	X	X	X	X	X	X	X	probable	
Black Rat Snake		?	?		?	?	?	?	?	unknown	

* Observed on Little Tinicum Island by John Miller, Pennsylvania Game Commission

FIGURE 12

AMPHIBIAN AND REPTILE HABITATS
ON LITTLE TINICUM ISLAND



The Fish of the Delaware River near Little Tinicum Island

The waters surrounding the island are important spawning and nursery grounds for anadromous fish. These marine fish come into freshwater river to spawn. Few shallow protected waters and wetlands remain for these fish. The back channel of Little Tinicum Island is an important area for the following species: Bay Anchovies, Blue-back herring, American Shad and Striped Bass. Striped Bass populations have decreased along the Atlantic coast. Measures to protect the striped bass are in effect.

Resident fish of the Delaware River near Little Tinicum Island are channel catfish, brown bullhead, american eel, white perch (a marine fish occassionally found in fresh water), silvery minnows, mummichogs (a brackish water fish), and banded killifish. Salt-water crabs have been present near the island during the summer and fall for the past several years. Flounder were observed near the island this year.

Pennsylvania Fish Commission Area Fisheries Biologist, Mr. Mike Kaufman considers the waters near Little Tinicum Island as a remnant habitat along the tidal area of the Delaware River and very strongly feels the island should be a protected natural area. Any disruption of the shoreline or channel through dredging would have a significant negative impact on these fisheries. A previous study of the island in 1971 expressed a similiar appraisal of these waters- " the Back Channel is the most valuable fisheries habitat within 10 or 12 miles upstream or downstream." [27]

Tiger muskelunge have been stocked in the river near the Island by the PA. Fish Commission in 1984 and 1985. Six thousand 7 - 12 inch fingerlings were stocked each year. Confirmed sitings of the 1984 fingerlings indicates that the fish have survived the first year. These fish grow to the legal size in three years.

There is a possibility that some fish species may have PCBs in their flesh. This group of chemicals- polychlorinated biphenyls causes cancer in laboratory animals. They are extraordinarily resistant to degradation and their contamination is widespread.

The United States Fish and Wildlife Service has sampled fish

and snapping turtles found in Darby Creek and ponds in the Tinicum National Environmental Center. The results indicated Levels of PCBs in fish slightly over the recommended level of the Food and Drug Administration's Action Level for human consumption. The level of PCB in snapping turtles was very high. These results may or may not apply to the fish and turtles in the Delaware River near Little Tinicum Island. The contamination of fish and turtles in the Environmental Center may be a local and restricted phenomena. The Pennsylvania Fish Commission is analyzing two fish species collected from the back channel of the island for the presence of PCBs. Results should be available from Mr. Mike Kaufman in January 1986.

Appendix One is the results of the U. S. Fish and Wildlife sampling of fish and turtles for PCB contamination.

Birds of Little Tinicum Island

This island is an extremely important bird habitat. The very large number of bird species that frequent the island represent almost all the families of birds, except tropical, open-ocean and upland bird families. The many diverse habitats supply food and shelter for a diverse bird population. The island is an important stopover area for migratory birds in the Atlantic flyway. The amount of suitable habitat is very sparse along the Delaware River and nearby counties.

Mr. John Miller, Pennsylvania Game Commission, keeps a daily checklist of birds seen near Little Tinicum Island and nearby areas. He has been watching the birds and maintaining records of their occurences since the early 1950's. The following list of birds seen near or on Little Tinicum Island was prepared by Mr. Miller. The Federal status and the proposed Pennsylvania status is listed. A summary of Species of Special Concern follows:

State status- none.

Cattle Egret, Snowy Egret, Black-crowned Night Heron, Glossy Ibis, Hooded Merganser, Virginia Rail, Cliff Swallow.

State status- undetermined.

Sharp-shinned Hawk, Yellow-bellied Sapsucker, Bobolink.

State status - special concern.

Great Blue Heron, Cooper's Hawk, Red-shouldered Hawk, Marsh Hawk, Snowy Owl, Purple Martin, Long-billed Wren.

State status- threatened.

American Bittern, Black Tern.

State status- endangered.

Bald Eagle, Osprey, Short-eared Owl.

State Status- extirpated.

Peregrine Falcon, Common Tern.

Federal Status- endangered.

Bald Eagle, Peregrine Falcon.

The following complete list includes the level of occurence of birds. It is important to note the occurence of species of special concern. Some of these are common on Little Tinicum Island. The Long-billed Marsh Wren is nesting on the island.

	Occurence	Federal Status	Proposed State Status
Common Loon	common		
Red-throated Loon	uncommon		
Red-necked Grebe	uncommon		
Horned Grebe	uncommon		
Pied Billed Grebe	uncommon		
Audobon's Shearwater	very rare		
Great Cormorant	rare		
Double breasted Cormorant	common		
Great Blue Heron	common	none	sp. con.
Green Heron	common-nesting		
Little Blue Heron	common		
Cattle Egret	uncommon	none	none
Common Egret	common		
Snowy Egret	common	none	none
Black crowned night Heron	common	none	none
American Bittern	uncommon	none	threatened
Glossy Ibis	uncommon	none	none
Mute Swan	rare		
Whistling Swan	common		
Canada Goose	common		
Snow Goose	uncommon		
Brant	rare		
Mallard	common-nesing		
Black Duck	common-nesting		
Gadwall	uncommon		
Pintail	common		
Green-winged Teal	common		
Blue-winged Teal	common		
American Widgeon	uncommon		
Shoveler	uncommon		
Wood Duck	uncommon		
Redhead	uncommon		
Ring-necked Duck	uncommon		
Canvasback	uncommon		
Greater Scaup	common		

	Occurence	Federal Status	Proposed State Status
Lesser Scaup	common		
Common Goldeneye	common		
Bufflehead	common		
Oldsquaw	uncommon		
White-winged Scoter	rare		
Surf Scoter	rare		
Ruddy Duck	common		
Hooded Merganser	uncommon	none	none
Common Merganser	common		
Red-breasted Merganser	uncommon		
Turkey Vulture	common		
Sharp-shinned Hawk	common	none	undeter.
Cooper's Hawk	common	none	sp. Conc.
Red-tailed Hawk	common		
Red-shouldered Hawk	uncommon	none	sp. conc.
Broad-winged Hawk	common		
Rough-legged Hawk	uncommon		
Bald Eagle	uncommon	endangered	endangered
Marsh Hawk (Circus Cyaneus)	common	none	sp. conc.
Osprey	common	none	endangered
Peregrine Falcon	uncommon	endangered	extirpated
Pidgeon Hawk	uncommon		
Sparrow Hawk	common		
Ring-necked Pheasant	common		
Virginia Rail	uncommon	none	none
Sora	common		
Common Gallinule	common		
American Coot	uncommon		
Semipalmated Plover	common		
Killdeer	common-nesting		
Golden Plover	common		
Black-bellied Plover	common		
Ruddy Turnstone	uncommon		
American Woodcock	common		

	Occurence	Federal Status	Proposed State Status
Common Snipe	common		
Whimbrel	very rare		
Upland Plover	uncommon		
Spotted Sandpiper	common-nesting		
Solitary Sandpiper	common		
Willet	very rare		
Greater Yellow-legs	common		
Lesser Yellow-legs	common		
Pectoral Sandpiper	common		
White-rumped Sandpiper	common		
Least Sandpiper	common		
Dunlin	common		
Short-Biller Dowitcher	common		
Long-billed Dowitcher	common		
Stilt Sandpiper	uncommon		
Semipalmated	common		
Western Sandpiper	common		
Hudsonian Godwit	uncommon		
Sanderling	uncommon		
Glaucous Gull	uncommon		
Iceland Gull	uncommon		
Great Black-backed Gull	common		
Herring Gull	common		
Ring-billed Gull	common		
Laughing Gull	common		
Bonaparte's Gull	common		
Little Gull	very rare		
Forster's Tern	common		
Common Tern	rare	none	extirpated
Least Tern	uncommon		
Caspian Tern	common		
Black Tern	common	none	threatened
Rock Dove	common		
Mourning Dove	common-nesting		
Yellow-billed Cuckoo	common		

	Occurence	Federal Status	State Status
Black-billed Cuckoo	common		
Barn Owl	common	none	sp. conc.
Snowy Owl	rare		
Short-eared Owl	common	none	endangered
Common Nighthawk	common		
Chimney Swift	common		
Ruby-throated Hummingbird	common		
Belted Kingfisher	common		
Flicker	common-nesting		
Yellow-bellied Sapsucker	uncommon	none	undeter.
Hairy Woodpecker	uncommon		
Downy Woodpecker	common-nesting		
Eastern Kingbird	common-nesting		
Gr. Creasted Flycatcher	common		
Eastern Phoebe	common		
Willow Flycatcher	uncommon-nesting		
Traill's Flycatcher	uncommon		
Eastern Wood Pewee	common		
Horned Lark	common		
Tree Swallow	common-nesting		
Bank Swallow	common		
Rough-winged Swallow	common		
Barn Swallow	common		
Cliff Swallow	common	none	none
Purple Martin	common	none	sp. conc.
Blue Jay	common		
Common Crow	common-nesting		
Fish Crow	common-nesting		
Black-capped Chickadee	uncommon		
Carolina Chickadee	uncommon		
Tufted Titmouse	uncommon		
Red-breasted Nuthatch	uncommon		
Brown Creeper	common		
House Wren	common-nesting		
Winter Wren	common		
Carolina Wren	uncommon		

	Occurence	Federal Status	Proposed State Status
Long-billed Marsh Wren	common-nesting	none	sp. conc.
Mockingbird	uncommon-nesting		
Catbird	common-nesting		
Brown Thrasher	uncommon-nesting		
Robin	common-nesting		
Wood Thrush	uncommon		
Hermit Thrush	common		
Swainson's Thrush	common		
Grey-cheeked Thrush	common		
Veery	common		
Blue-grey Gnatcatcher	uncommon		
Golden-crowned Kinglet	common		
Ruby-crowned Kinglet	common		
Water Pipit	common		
Cedar Waxwing	uncommon		
Solitary Vireo	uncommon		
Red-eyed Vireo	common		
Black & White Warbler	common		
Tennessee Warbler	uncommon		
Nashville Warbler	uncommon		
Parula Warbler	common		
Yellow Warbler	common-nesting		
Magnolia Warbler	common		
Cape May Warbler	common		
Black-throated Blue Warbler	common		
Myrtle Warbler	common		
Black-throated Warbler	common		
Chestnut -sided Warbler	uncommon		
Bay-Breasted Warbler	uncommon		
Black-poll Warbler	common		
Prairie Warbler	uncommon		
Palm Warbler	common		
Ovenbird	common		
Northern Water Thrush	common		
Yellow Throat	common nesting		
Wilson's Warbler	common		

	Occurence	Federal Status	Proposed State Status
Canada Warbler	uncommon		
American Redstart	common		
House Sparrow	uncommon		
Bobolink	common	none	undetermin
Eastern Meadowlark	uncommon		
Red-winged Blackbird	common-nesting		
Orchard Oriole	uncommon		
Baltimore Oriole	common		
Rusty Blackbird	common		
Common Grackle	common		
Brown-headed Cowbird	common		
Scarlet Tanager	uncommon		
Cardinal	uncommon-nesting		
Rose-breasted Grosbeak	common		
Blue Grosbeak	uncommon		
Indigo Bunting	common-nesting		
Purple Finch	uncommon		
House Finch	uncommon		
Common Redpoll	common		
Pine Siskin	common		
American Goldfinch	common-nesting		
Rufous-sided Towhee	uncommon		
Savannah Sparrow	common		
Slate Colored Junco	common		
Chipping Sparrow	uncommon		
Field Sparrow	uncommon		
White-crowned Sparrow	uncommon		
White-throated Sparrow	common		
Fox Sparrow	common		
Swamp Sparrow	common-nesting		
Song Sparrow	common-nesting		
Lapland Longspur	uncommon		
Snow Bunting	common		

	Occurence	Federal Status	Proposed State Status
Canada Warbler	uncommon		
American Redstart	common		
House Sparrow	uncommon		
Bobolink	common	none	undetermin
Eastern Meadowlark	uncommon		
Red-winged Blackbird	common-nesting		
Orchard Oriole	uncommon		
Baltimore Oriole	common		
Rusty Blackbird	common		
Common Grackle	common		
Brown-headed Cowbird	common		
Scarlet Tanager	uncommon		
Cardinal	uncommon-nesting		
Rose-breasted Grosbeak	common		
Blue Grosbeak	uncommon		
Indigo Bunting	common-nesting		
Purple Finch	uncommon		
House Finch	uncommon		
Common Redpoll	common		
Pine Siskin	common		
American Goldfinch	common-nesting		
Rufous-sided Towhee	uncommon		
Savannah Sparrow	common		
Slate Colored Junco	common		
Chipping Sparrow	uncommon		
Field Sparrow	uncommon		
White-crowned Sparrow	uncommon		
White-throated Sparrow	common		
Fox Sparrow	common		
Swamp Sparrow	common-nesting		
Song Sparrow	common-nesting		
Lapland Longspur	uncommon		
Snow Bunting	common		

Mammals on Little Tinicum Island

Few mammals exist on the island. Mr. John Miller has provided a list and their level of occurence.

Eastern Cottontail	common	Sylvilagus floridanus
Muskrat	common	Ondatra zibethicus
Norway Rat	common	Rattus norvegicus
Meadow Vole	common	Microtus pennsylvanicus
House Mouse	common	Mus musculus
Short-tailed weasel	uncommon	Mustela erminea
Red Bat	common	Lasiurus borealis
White-tailed deer	rare	Odocoileus virginianus

Tracks of raccoon and opossum are visible on the mud flats.

The island has many diverse habitats capable of supporting mammals. The driftwood serves as shelter and nesting sites for mammals, especially the weasel, raccoon and opossum. The availability of aquatic and terrestrial prey is beneficial to the weasil, raccoon, opossum and muskrat.

Little Tinicum Island contains large stands of common reeds- which is reported to be a favorite food of muskrat. The island is excellent habitat for muskrat and also for the marsh rice rat. This species of special concern, status undetermined, occassionally nests in the walls of muskrat houses. The marsh rice rat has not been observed on the island, but the habitat is suitable for it.

The Pennsylvania Game Commission does not have any studies or estimates of mammal populations on Little Tinicum Island. They report the cottontail population does not contain any disease which could render the flesh inedible.

Recreational Use of Little Tinicum Island and the Delaware River

Little Tinicum Island is accessible only by boat. The island is used by recreational boaters and hunters. A survey was distributed to boaters that were on the island or boats that were nearby. Surveys were also distributed to nearby boating ramps and clubs. The survey had a very good return rate of 35 returned from 75 distributed.

Figure Thirteen is the survey questionaire (page 42) with the average (mean) response following the questions. The reverse side of the survey was a map for reference and to answer question ten. An explanation of the response follows.

Question 1 and 2

Most boats traveling to the island are motorboats. Rowboats and canoes have trouble traveling upstream and downstream in the current and waves of the river. The average length of boats is 21.6 feet. These boats fall into three categories:

a) canoes and rowboats 12 - 14 feet- 4 boats.
b) 'run-about' motorboats 15 - 24 feet- 19 boats.
c) cruising motor and sail boats 25 - 36 feet, 10 boats.

The draft of these boats (depth of boat below the waterline) are:

a) 12 - 14 foot boats- less than 12 inches. Only 1 reply out of 4 in this category (25%) - 18".
b) 15 - 24 foot boats- average draft = 28.5 inches (9 reples, 47%)
c) 25 - 36 foot boats- average draft = 43 inches (7 reples, 70%)

The number of respondents who did not indicate the draft of their boat (16 out of 35) may indicate that the draft of their boat is shallow and does not pose a problem to island access. This assumption is supported by the fact that larger boats (with larger drafts) has a much higher response rate (70%) compared to smaller boats (25% and 47%).

Access to the island is gained by wading from an anchored boat to the shore. Canoes and rowboats pull up onto the shore. The draft of most boats (excepting 25 - 36 foot) allows anchoring in water shallow enough for wading. The 5.7 foot tidal difference creates a problem for anchored boats. The tidal extremes occur six hours apart hence the tide must be considered when anchoring for more than an hour or so. Seven respondents indicated that this

FIGURE 13

Dear boater,

Your help in completing this survey is very important. The information you provide is necessary for the Pennsylvania Department of Environmental Resources to determine the most popular use or facilities for Little Tinicum Island in the Delaware River. A stamped envelope is enclosed for your reply. Thank you for your valuable help.

1. What type of boat do you use on the Delaware River? circle one
   motorboat 24 rowboat 2 canoe 1 sailboat 1 other 0
2. Length of boat? 21.6'. Draft of boat? 2.9'.
3. How many people usually occupy the boat? 4.4 .
4. How many times a year do you visit or boat near (within one mile of) Little Tinicum Island? 42 .
5. How many times a year do children under twelve years old accompany you on the boat? 9.3 .
6. What months do you visit Little Tinicum Island?
   From May to September .
7. What town or marina do you dock your boat at? _____
   _____.
8. If you trailer your boat, what ramp or marina do you launch it from? _____.
9. Please indicate the number of times per year that you participate in the following activities on or near Little Tinicum Island (within about one mile of the island):

fishing	23.3	swimming	24.4	picnicing on beach	16.0
hunting:		water skiing	15.1	picnicing on boat	17.0
waterfowl	12.3	anchoring	31.2	nature observation	24.7
game	30.0	boat races	4.4	sightseeing	16.4
trapping	-	relax on beach	21.3	walking on beach	19.6

10. On the map of Little Tinicum Island on the reverse side of this page mark your favorite spot to land or anchor by the Island.
11. Facilities you would use if built on Little Tinicum Island:

docks	27	picnic tables	26
moorings	15	barbecue grills	25
toilets	25	trash cans	28
duck blinds	11	nature trails	18

12. Hunters- Do you usually hunt from your boat or go ashore when you hunt near Little Tinicum Island? _____.
13. Do you have any suggestions that would make the Island more accessible, useful or enjoyable?

was a problem. Three of these respondents indicated that a dock would solve this problem. Five other persons indicated they would use a dock but did not state their purpose, except for the reply : " a small unloading dock."

Question 3

The mean number of person per boat is 4.4. Values range from 2 to 8 persons per boat. This is an estimated total of 144 people represented by this survey.

Question 4

The average number of visits to or near Little Tinicum Island per year is 42. The total number of visits per person per year represented by this survey is 6048. This is an approximate and not actual number.

Question 5

During twenty-one percent of visits to the island children under twelve years old accompany adults.

Question 6

The average span of months that persons visit the island is 6.2 months. Most respondents start boating in May and stop in September. Two respondents boat all year. Figure Fourteen is a graph of the number of boats visiting the island during the year.

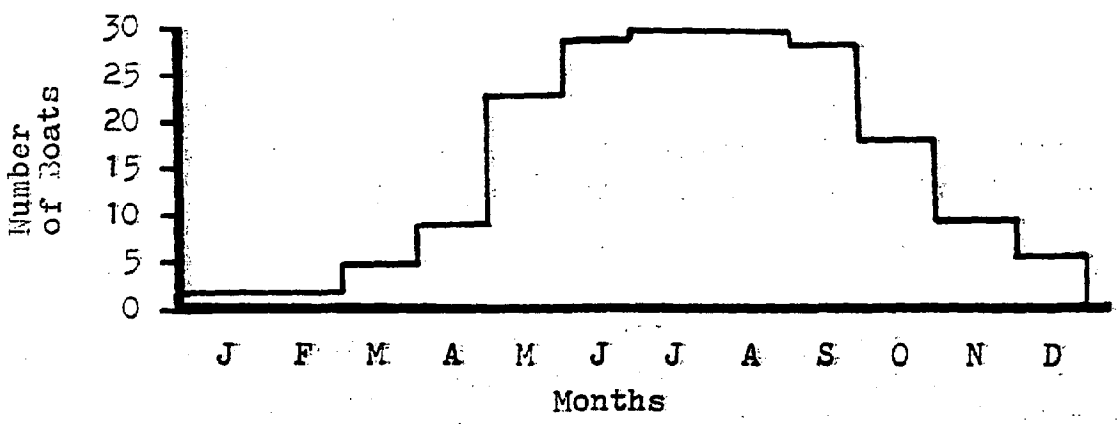


FIGURE 14

Question 7

The marina or town the respondents boats are docked at are listed below:

Morrow's Marina, Darby Creek, Ridley Twsp., PA	9
Westville Power Boat Association, Big Timber Creek, NJ	4
Seaplane Base, Delaware River, Essington, PA	2
Fox Grove Marina, Delaware River, Essington, PA	2
Riverside Yacht Club, Delaware River, Essington, PA	2
Anchorage Marina, Delaware River, Essington, PA	1
Tinicum Boat Yard, Delaware River, Essington, PA	1
Triton Marina, Chesapeake Bay, Elkton, MD	1
Darby Creek, PA	1
Essington, PA	1

Most of these boats are within a mile or two of Little Tinicum Island. The Westville Power Boat Association is 9.5 river miles upstream.

Question 8

The ramps used by respondents with trailed boats are:

Morrow's Marina, Darby Creek, Ridley Twsp., PA	6
Chester ramp, Delaware River, Chester, PA	4
Juvesh Center, Timber Creek, NJ	1
Darby Creek, PA	1
Fox's Marina, Delaware River, Essington, PA	1
Seaplane Base, Delaware River, Essington, PA	1

The Chester Ramp is about 4 miles downstream of Little Tinicum Island.

Question 9

The average number of times per year each activity is engaged in by respondents is listed below in Column A. The number of boats with respondents who participate in activites is listed in Column B. The total instances of participation for each activity by total persons represented by this survey per year is listed in Column C.

	A	B	C
Swimming	24.4	25	2684
Relax on beach	21.3	24	2249
Picnic on beach	16.0	28	1971
Nature observation	24.7	18	1956
Walk on beach	19.6	22	1897
Fishing	23.3	16	1640
Picnic on boat	17.0	21	1571
Waterskiing	15.1	19	1262
Sightseeing	16.4	17	1227
Anchoring	31.2	24	749
Game hunting	30.0	5	660
Waterfowl hunting	12.3	9	487
Boat races	4.4	7	136
Trapping	-	3	>13.2

The number of hunters is greatly underestimated by this survey. The survey was distributed in early September. Only a few boaters indicated hunting as an activity they participated in. Interviews with Conservation Officers, Pennsylvania Fish Commission, Essington, PA indicate that hunters use the island only during hunting and are underestimated in this survey. The Conservation Officers report as many as thirty persons hunt from small boats in the evening on weekdays. Two duck blinds exist on the north shore and two new blinds were built this season on the south shore.

Three activites in which boaters participate, but were not questioned regarding are crabbing, overnight camping, and building fires. It is estimated that as many as six boats with an average of four persons per boat camp overnight during summer weekends.[28]

Question 10

Figure Fifteen shows the favorite visiting location of boaters.

Question 11

The number of respondents that indicated they would use the following facilities is reported below.

docks	27	picnic tables	26
moorings	15	barbecue grills	25
toilets	25	trash cans	28
duck blind	11	nature trails	18

Question 12

Hunters indicate that they go ashore (6), hunt from boat (5), and use duck blinds (1).

Question 13

This question asked for suggestions to make the island more accessible, useful or enjoyable. The response have been categorized below.

Build docks 8
Do nothing- we like it the way it is 7 *
Clean up beach, tires, and trash 5
Depth markers along shore 4
Clean up the Delaware River 3
Make the island a wildlife refuge 2
Keep it simple and inexpensive 2
Dredge channel 2
Build breakwater for large boats 1
Build state marina on island 1
Picnic tables and grills 1
No hunting near island 1
No glass 1
No fee for use 1
Few rules 1
Refreshment stand 1
Sandy beaches 1

* Three respondents with this comment did not respond to any other question on the survey form.

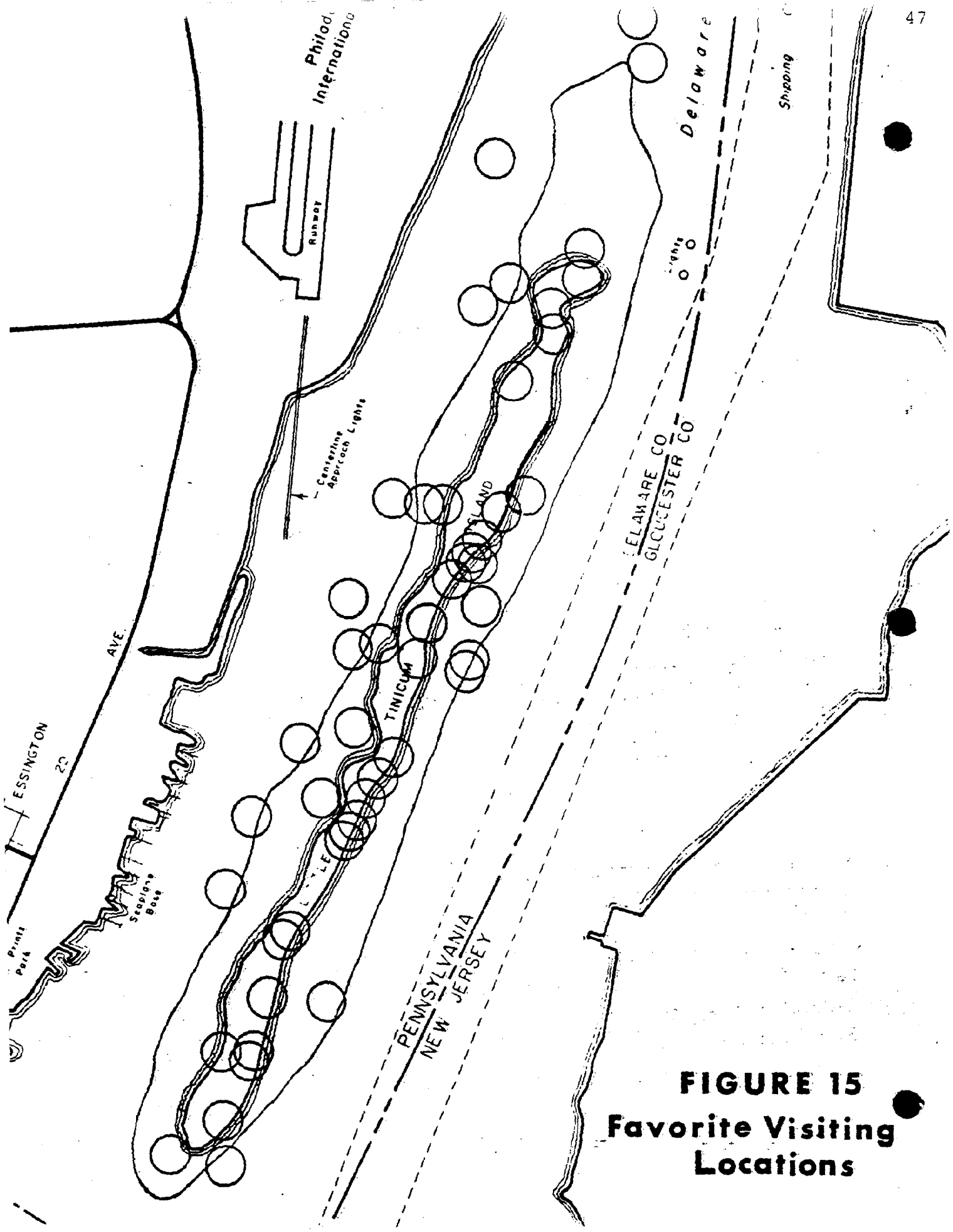


FIGURE 15
Favorite Visiting Locations

Figure Sixteen is a map from the report "Philadelphia's Plan for River Recreation" prepared by the City Planning Commission. This figure, Recreational and Cultural Sites shows areas of interest to boaters along the Delaware River. Not all of these sites are accessible by boat. Little Tinicum Island stands as out as one of the best recreational sites on the Delaware River.[29]

Figure Seventeen displays the boat ramps, marinas and yacht clubs along the Delaware River. Several marinas are clustered in Essington because Little Tinicum Island provides a sheltered harbor. In recent years the use of these marinas has declined because sediment has accumulated in the back channel and filled in docking areas.[30]

Safety and Law Enforcement at Little Tinicum Island

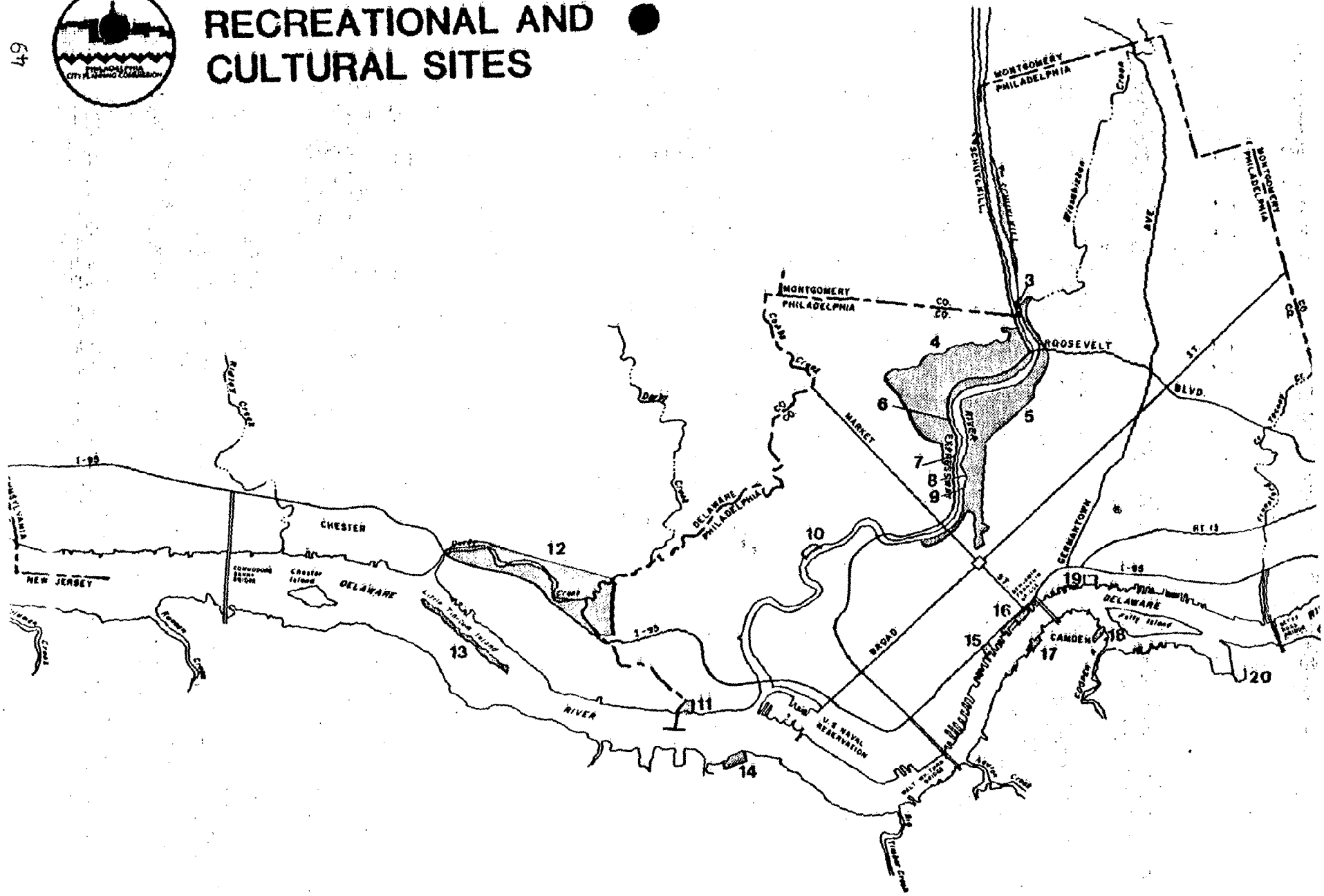
The Pennsylvania Fish Commission is stationed at Essington. These Conservation Officers are empowered to enforce state laws, fine and arrest persons. A person violating the law may sign a field acknowledgement of guilt and pay the fine immediately or within five days. Persons from other states must pay the fine immediately. If the fine is not paid, a citation is mailed. If there is no response to the citation (by appearing in court or paying the fine and costs) a warrant is issued for arrest. The Conservation Officer takes the arrested person to the District Magistrate in Essington or Lima, PA.

Little Tinicum Island is well patroled because the Fish Commission docks overlook the island. Common violations, listed in order of frequency are: disorderly conduct, illegally discharging firearms, intoxication and boating violations. It is suspected that arson may be responsible for some fires.

The Fish Commission Officers have a varied and busy schedule of activities to perform including enforcement of fishing regulations, endangered species laws and assisting the Pennsylvania Game Commission officers. A few boating accidents occur each year, fatalities are rare.

The Philadelphia City Planning Commission's report on river recreation predicts that use of the Delaware River will increase fourfold in the future. This optimistic estimate is based on the fact that peoples perception of water quality effects their level

RECREATIONAL AND CULTURAL SITES



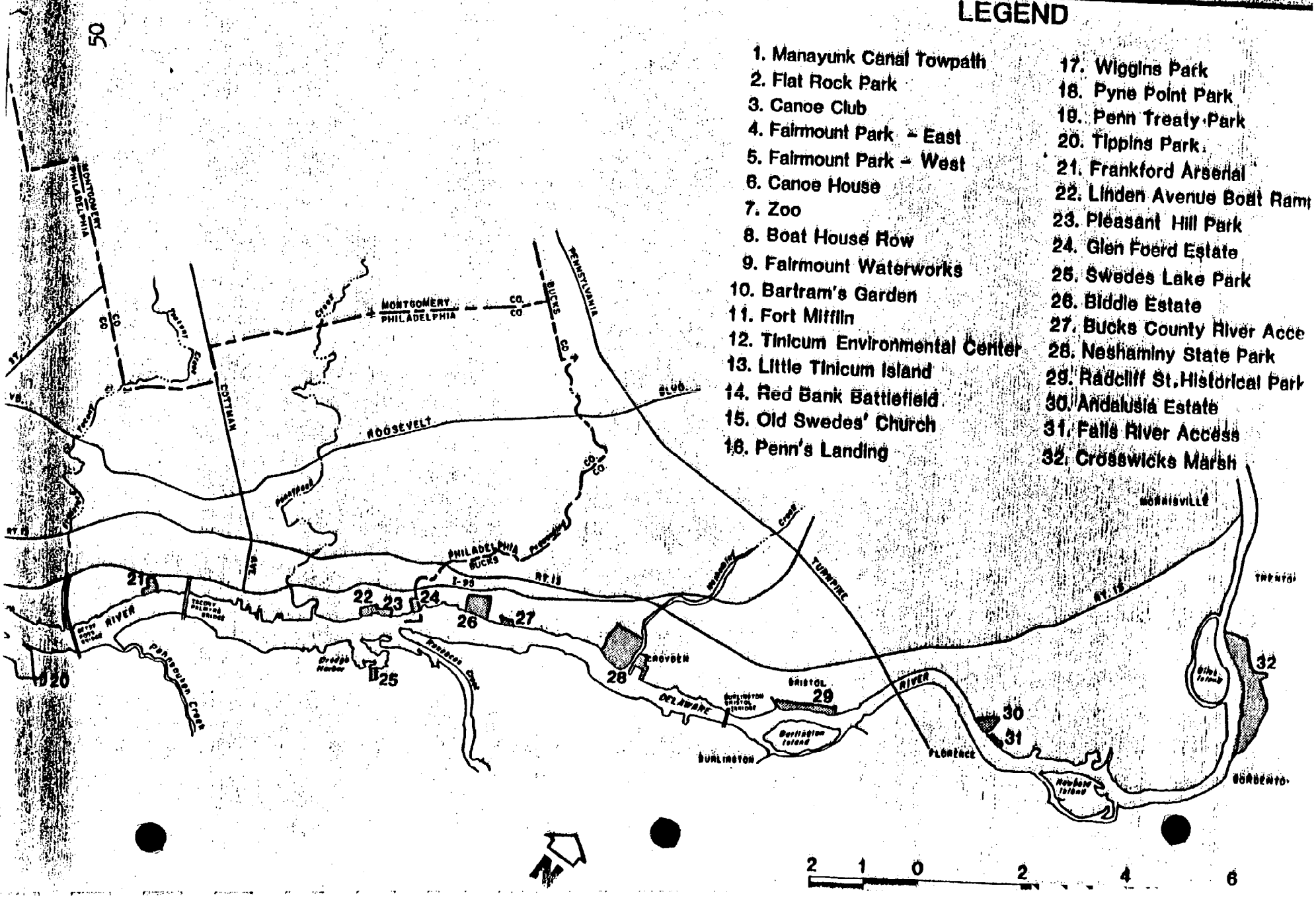
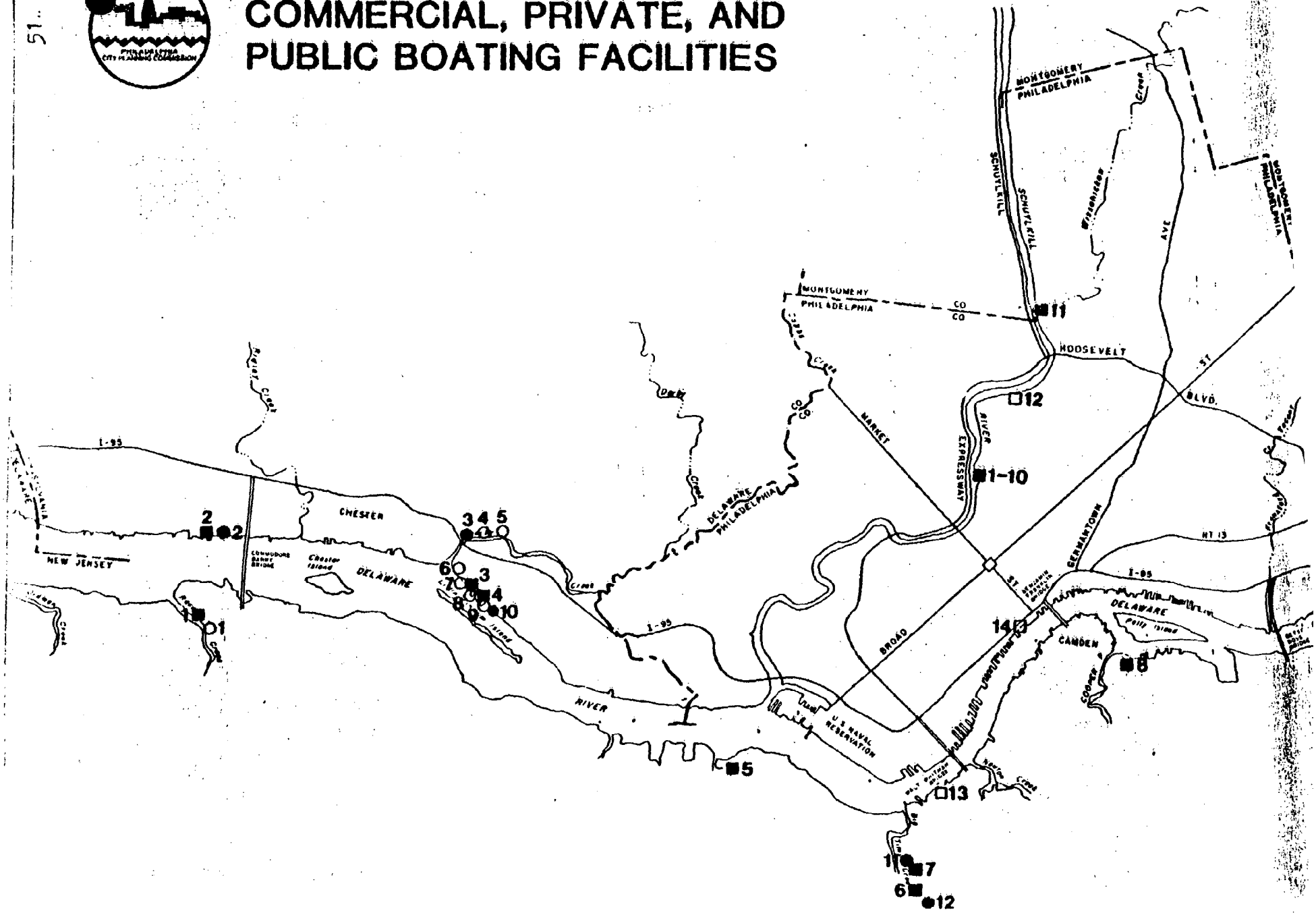
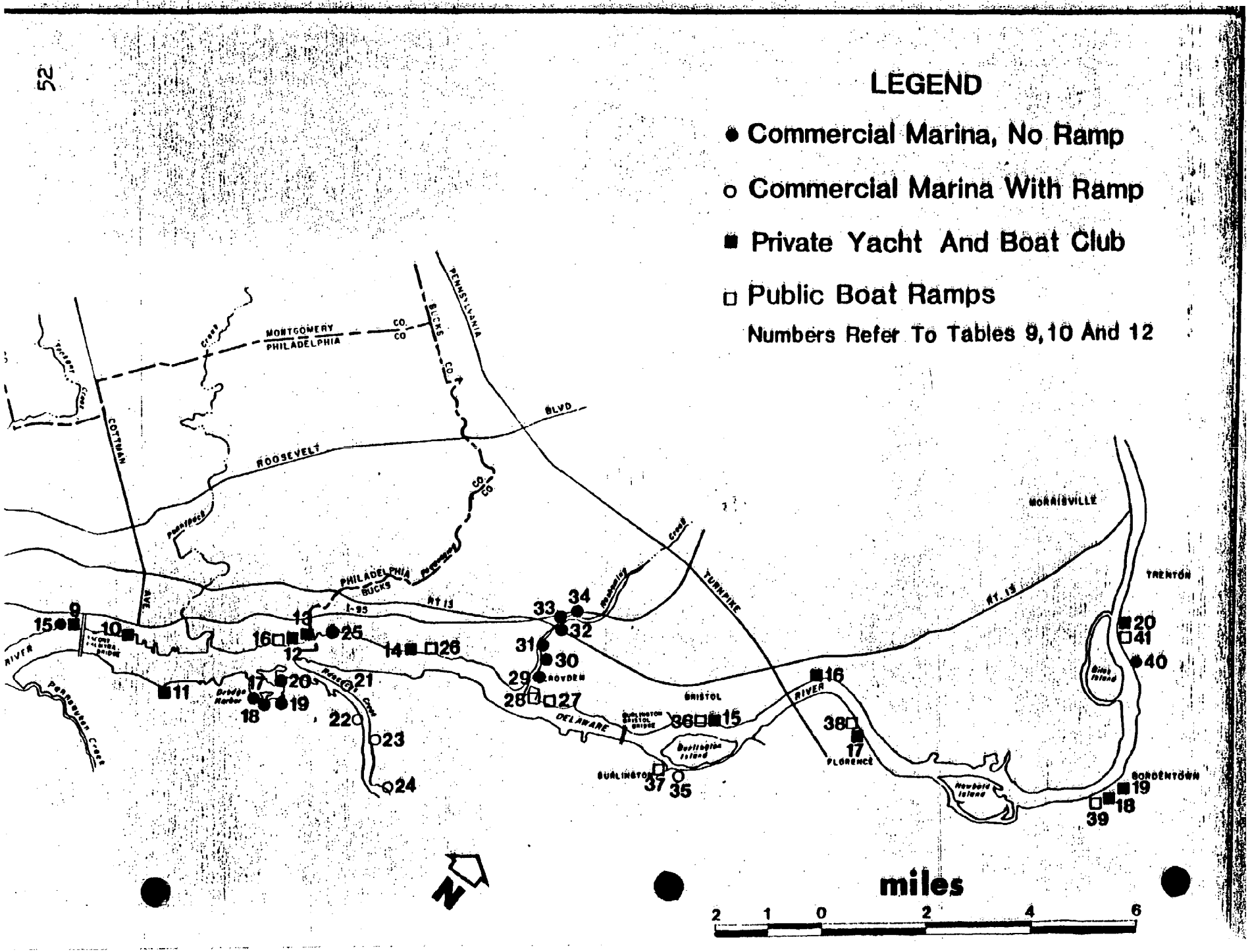

LEGEND
1. Manayunk Canal Towpath
2. Flat Rock Park
3. Canoe Club
4. Fairmount Park - East
5. Fairmount Park - West
6. Canoe House
7. Zoo
8. Boat House Row
9. Fairmount Waterworks
10. Bartram's Garden
11. Fort Mifflin
12. Tinicum Environmental Center
13. Little Tinicum Island
14. Red Bank Battlefield
15. Old Swedes' Church
16. Penn's Landing
17. Wiggins Park
18. Pyne Point Park
19. Penn Treaty Park
20. Tippins Park
21. Frankford Arsenal
22. Linden Avenue Boat Ramp
23. Pleasant Hill Park
24. Glen Foerd Estate
25. Swedes Lake Park
26. Biddle Estate
27. Bucks County River Acce
28. Neshaminy State Park
29. Radcliff St. Historical Park
30. Andalusia Estate
31. Falls River Access
32. Crosswicks Marsh
MONTGOMERY
PHILADELPHIA
BUCKS
PENNSYLVANIA
ROOSEVELT
COTTMAN
TURNPIKE
RIVER
DELAWARE
BRISTOL
BURLINGTON
FLORENCE
MORRISVILLE
TRENTON
BORDENTO
2 1 0 2 4 6

FIGURE 17

COMMERCIAL, PRIVATE, AND PUBLIC BOATING FACILITIES




LEGEND
Commercial Marina, No Ramp
Commercial Marina With Ramp
Private Yacht And Boat Club
Public Boat Ramps
Numbers Refer To Tables 9,10 And 12
MONTGOMERY CO.
PHILADELPHIA CO.
BUCKS CO.
PENNSYLVANIA
BLVD
ROOSEVELT
COTTMAN
AVE
PHILADELPHIA
BUCKS
I-95
RT 13
TURNPIKE
RIVER
DELAWARE
BRISTOL
BURLINGTON
FLORENCE
MORRISVILLE
TRENTON
BORDENTOWN
Burlington Island
Newbold Island
Bites Island
Pennsauken Creek
miles
2 1 0 2 4 6

of use of the river. Improvements that have recently been completed at Philadelphia's sewage treatment were predicted to improve the quality of river water, although the water quality near Little Tinicum Island has not improved. The island is used mostly by local residents. There is no reason to suspect an increase in river use by local boaters because local water quality has not improved.

An increased use of the island by boaters of the Philadelphia region is possible in the future. Water quality has improved in other areas of the river and boating may increase on the river as a whole. Many new boating facilities are being planned. The planned boat basins in Philadelphia and Camden will hold a considerable number of boats. The Philadelphia City Planning Commission estimates that the river can sustain three times the present level of recreational use. "The river area with the greatest untapped potential is in Delaware County." [31]

Considerations for Activites and Facilities on Little Tinicum Island

The activites that need consideration are swimming, hunting, camping and building fires and duck blinds. The water quality of the river for boating and swimming is very poor. Public bathing beaches are regulated by the Department of Environmental Resources. Any area where swimming is promoted (roped off swimming areas, lifeguards,...) must be monitored for bacterial concentrations. Water samples must be collected and analyzed weekly. If bacterial concentrations are greater than the State standard swimming is not permitted until water quality improves. Areas that do not promote but do not prohibit swimming are not compelled by state law to observe these regulations. The Pennsylvania Department of Health recommends observing the bacterial standards regardless if swimming is promoted or not.[32]

The waters surrounding the island will not meet the swimming standards in the near future. If swimming is prohibited a sign must be posted; The owner of the property may be liable for injury regardless. The Department of Environmental Resources Bureau of Legal Services should be consulted on regulation and liability.

Enforcement of a no swimming regulation for Little Tinicum Island would limit the accessibility of the island for most boaters who must wade to shore. It is suggested that the Conservation Officers at Essington be contacted regarding the feasibility and desirability of enforcing a no swimming regulation.

Little Tinicum Island is one of the few areas suitable for waterfowl hunting in Delaware County. The Tinicum National Environmetal Center is a wildlife refuge and hunting is not permitted. Many species of special concern frequent the island. A decision must be made to allow or prohibit hunting. If hunting is allowed, hunters should be educated to recognize species of special concern.

Several duck blinds exist on the island. These blinds are subject to destruction during floods but driftwood is plentiful for their reconstruction. A decision to allow or prohibit the use and/or construction of blinds must be made.

Boaters presently camp overnight on the island. At the current rate of use, camping does not present any conflicts to other uses of the island. Fires are built on the island beaches. The fires in recent years have been small but the potential for a severe fire burning shrubs and trees exists. The fire in 1971 caused a change in the vegetation of the burned areas. Fires may be safely built on the beach in areas where driftwood has been cleared away. This area could also be used for camping. This would prevent the destruction of inland vegetation for campsites. Because overnight campers are likely to build fires in camp this would encourage campers to camp on the beach. Figure Fifteen shows the most popular spots to come ashore. Figure Eighteen delineates the suggested fire and campsite areas.

Facilities that should be considered are docks, moorings, dredging channels, navigational aids, duck blinds, picnic tables, barbecue grills, trash cans, toilets and nature trails. The survey listed many facilites that could be provided. Most respondents replied that they would use these facilities. The feasiblity of providing these facilities must be considered along with the necessity of these facilites. The conflicts that these facilites would create to other uses of the island (wildlife refuge) must be considered.

Docks were requested by 8 of the respondents in the suggestion area and checked off by 27 in question eleven. An unloading dock would help boaters and especially small children come ashore. More people picnic on the beach than they do on their boats. These visitors carry chairs, coolers, and barbecue grills to shore. Access to the island is difficult when the Delaware River Estuary waters are cold, especially in the early spring when the warm air temperature bring boaters to the river even though the river water is very cold.

An estimate of the design and price of a dock was secured from Gorman-Baldwin Associates, RD 3, Porchtown Road, Newfield, NJ 08344 (215-745-5549). The design and price of a small permanent unloading dock were calculated. Floating docks need to be

removed from the river to prevent their destruction by ice. A single pier perpendicular to the shore sill allow boats to pull alongside with their bows facing New Jersey. This docking position will prevent the boats from rolling in the wake of passing freighters. A straight eight foot wide wooden pier fifty feet long will cost between $ 20,000. and 45,000., depending on the geologic composition of the river bottom. The 5.7 foot tide difference will necessitate the use of ladders to reach the pier level by persons embarking from boats at low tide. A fifty foot pier will allow two to four boats to tie-up depending on the tide and their draft. Maintenance costs are not included in this estimate.

Moorings are similiar to buoys and permit a boat to tie-up. Few respondents (15) indicated they would use moorings. Anchoring provides the same service. Small rowboats and canoes would probably use moorings, but these are not essential for these light, small craft. Moorings may be used by fishermen and hunters to prevent drifting downstream. Moorings require a small amount of once a year maintenance. Permits for moorings must be secured from the United States Coast Guard and the PA DER Bureau of Dams & Waterways.

Recreation facilities- picnic tables, barbecue grills and toilets were among the most desired facilities in the survey. Because the whole island is in the floodplain the permenance of any unsecured structure is uncertain. Lands above the high water mark may be considered wetlands, depending on the soil conditions and vegetation. The placement of fill in wetlands is regulated by the Army Corp of Engineers, although the excavation of wetlands is not regulated. Boardwalks and secured picnic tables and grills will require permits. Assistance for the design and alternatives is available from the Army Corp of Engineers.

The most requested facility was trash cans (28 out of 35). There are no commercial haulers who offer trash collection on the river. An alternative would be to secure the services of a marina in Essington to collect the trash and put it in a dumpster on the mainland. Another alternative is not to put out trash cans. The Adirondack Park Agency has adopted the slogan "If you pack it

in, you pack it out." The Adirondack Study Commission recommended the removal of garbage pits from lean-tos and campsites because they attracted more garbage.[33]

Navigation near Little Tinicum Island is difficult in a large boat. The back channel is narrow and shoals extend the island on both ends. Tides make the situation more difficult, but local knowledge of the waters makes navigation possible. Access to Little Tinicum Island from the main channel is easier. Dredging a channel or any area of the river is regulated by the Army Corp of Engineers. Sites for the disposal of dredged spoils are scarce. The thick river sediments move and shoal continously making any channel improvements or dredging only temporary. Permits for dredging are reviewed by the Army Corp. Many factors are considered during permit review, including feasiblity, need for maintenance, need for improvement and effects on the environment. The regular maintenance required of a dredged channel in The Delaware River near the island would probably make the project cost prohibitive.[34]

Buoys or aids to navigation could help boaters. A sign posting the times of high and low tide would help boaters judge the rivers conditions. This sign would require daily adjustments. A system to indicate the depth of water at high and low tides would be valuable. The United States Coast Guard in Gloucester, NJ could be consulted to plan the location of buoys or markers. An application for a permit to install private markers must be secured from the Coast Guard District Office in New York, NY. A request could also be made to the District Office to have the Coast Guard install and maintain Public Markers.

Nature observation was the fourth most frequent activity in days per year on the island. Walking on the beach was rated fifth. These activities could be facilitated by cleaning a path along the south beach and by creating a trail across the island to the north shore. A trail along the north shore is not feasible because of the convoluted shoreline, wide mud flats and thick common reed stands. Along the south beach bulrush marsh mud flats force walkers upland into piles of wood debris. A trail could be created

above the high water mark, but clear of the shrubs and scrub/forest. In many areas the path would need to be cleared through driftwood piles. Figure Eighteen shows a suggested trail route.

Two projects should be considered- removing the trash debris and/or removing the driftwood. One of the notable survey comments was to clean up the beaches. Floatable trash has been accumulating on the island for years; removing this would increase the aesthetic beauty of the south shore. The driftwood should remain on the island. The driftwood piles up on the island through the natural destructive power of storms and floods. It acts to stablilize the island and provides wildlife habitat. Removing the driftwood is a large undertaking which requires a barge and crane. The land transport and disposal site must be arranged by the landowner.

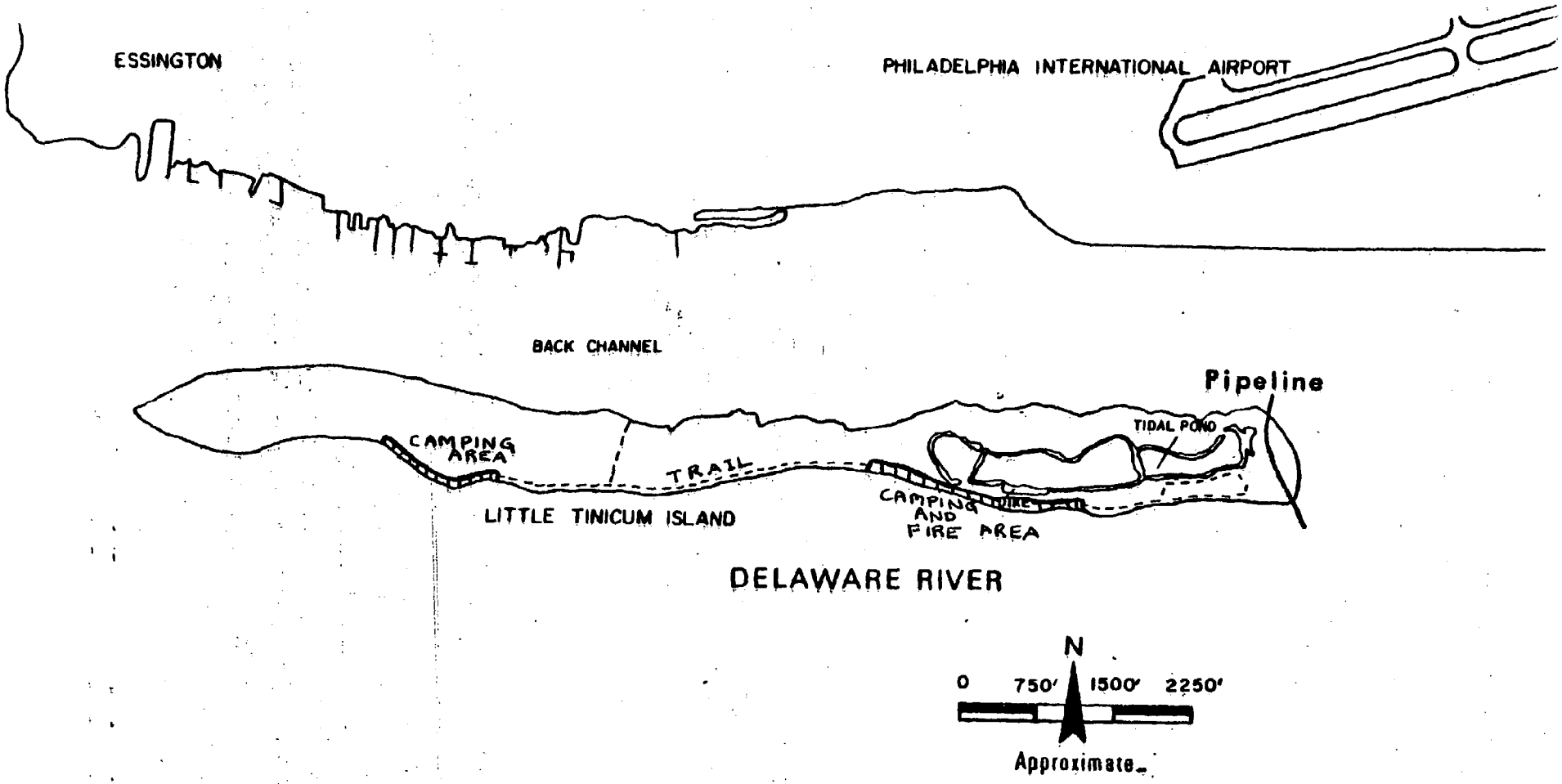
Additional comments from the survey need quick consideration. A request for a refreshment stand is impractical because of the low number of visitors, practical problems of construction and utilities, and flooding. One respondent asked for a breakwater; this request should be addressed to the Army Corp of Engineers. One respondent suggested the island support a state marina. The marinas in Essington provide adequate facilities for boaters. Fuel is available for boaters up Darby Creek. Ferry access to the island was suggested. A private concessionaire from one of the marinas in Essington could supply this service more effeciently and cost effectively than could the Bureau of Forestry. Boats could also be rented from these marinas for access to the island.

Many respondents indicated they would use toilets if provided on the island. It would be very difficult to empty portable or pit toilets because of the island location. In situations similiar to this island, the Pennsylvania State Parks use composting toilets which do not require electricity or plumbing.

Facilities Construction Costs

The cost of constructing facilities on the island is higher than land-based projects because of the difficulty of transporting equipment, supplies and construction personnel to the island. The cost of transporting all supplies and equipment for a small recreation area is estimated at $ 125.00 per hour for two workers

FIGURE 18 CAMPING and FIRE AREAS



and a specialized boat. The minimum bid for this job may be as high as $ 1000.00. If the transportation of equipment is combined with other work (dock construction or facilities installation) the transportation may be lower.

Once equipment and supplies are transported to the island by a waterfront construction company, a land-based construction company can install the facilities. The cost of installing the facilities will depend on the design and location. The U. S. Army Corp of Engineers will assist in these details (for example- methods to anchor picnic tables in a floodplain).

Figure 19 - Facilties Construction Costs- summarizes the cost of facilities, the cost of installation and anchoring supplies and the cost of labor. If facilities do not need to be anchored, the cost of installation will be minimal. Trash cans may be mounted on eight foot wooden posts to prevent animal disturbance or relocation by humans or flood. Fire circles should be anchored to prevent relocation to fire hazard areas (scrub/forest).

The cost of contracted labor may range from $ 20.00 to $50.00 per hour per person depending on the ease of accessibility to the island for the workers. Finding a contractor to install the facilties may be difficult because of the unique nature of the project. The minimum bid for just the installation of facilities may be approximately $ 500.00.

The cost of constructing the nature trail depends on the cost of labor and the route of the trail. If the trail is routed through driftwood labor costs will be high.

FIGURE 19

FACILITIES CONSTRUCTION COSTS

Facility	Equipment	Supplies	Labor	Total
Dock[1]				$20,000-45,000.
Mooring (each)	$75.00[2]	-	1.5 hrs.[3]	$120.00
Picnic Table[4]	$75-80.00[2]	$30.00	1.5 hrs.	$155.00
Fire-ring Grill[4]	$50.00[2]	$30.00	1.0 hrs.	$110.00
Trash Can[4]	$35.00	$15.00	1.0 hr.	$100.00
Composting Toilet[5]	$4000.00	-	$1000.00	$5000.00

1 Total Cost, Gorman-Baldwin, Associates, RD 3, Newfield, NJ 08344

2 Equipment cost as per PA DER, Bureau of State Parks, 1985.

3 Labor Rate equals $ 30.00 for these computations.

4 Equipment installed and secured, transport to island not included.

5 Clivus Multrum USA, Dept. FH, 14A Eliot Drive, Cambridge, MA 02138.

Four Plans for Little Tinicum Island

Four plans are presented for consideration. Plan A to the current use and facilites of the island. Plan B is designed to maximize habitat and wildlife protection. Plan C provides more for recreational use of the island. Plan D may be utilized if large recreational demands occur in the future. In addition to selecting a plan, activites and facilites specific to each plan also must be selected.

Plan A

Doing very little or nothing to the island was suggested by seven respondents. The current visitors to the island are enthusiastic and appreciative of the island. The current level and areas of use by visitors are having little impact on the island. The benefits of this plan is that the freedom and independence of visitors are preserved.

The negative impact of this plan are that no restraints are imposed on the activities which could disturb wildlife and destroy habitat. Luckily, the current level of use is low so that these impacts are minimal. The presence of hunters has a questionalbe impact on the birds. Waterfowl are certainly discouraged from using the island during the hunting season. Song and upland birds may not be disturbed by hunters.

Only one trails crosses the island north to south. It is very difficult to cross the western two thirds of the island because of thick shrubs and reeds. Few visitors travel to the north shore; fishermen and hunters frequent the area in boats. Most shore activity occurs in diked areas and beaches. The vegetation acts as a natural barrier to protect the wetlands wildlife of the north shore.

The current use of the island would fall within the regulations of the Bureau of Forestry as a natural area. The only current activity which is prohibited in natural areas is the building of duck blinds. The current activites of swimming, hunting and camping are permitted in natural areas.

The Delaware River water does not meet the bacteriological

standards adopted to evaluate the health safety or risk of illness to swimmers and boaters. This means that persons swimming in the Delaware River risk contracting an infectious disease. It must be decided if swimming will be prohibited or not and if this regulations will be strictly enforced.

Natural areas permit backpacking campers in designated areas only. It needs to be decided if boaters who camp are equivalent to backpacking campers. Backpackers differ from car campers in that they have very little equipment, no cars or trailers, require no facilities and cause much less habitat destruction in camp. Because boating campers must carry supplies to the shore their supplies are limited to those roughly equivalent to backpacking supplies. Boaters may have additional coolers and chairs but still represent the same style of camping when compared with other campers.

Campers on Little Tinicum Island prefer the sparsely vegetated beaches and cottonwood groves. Camping in these areas destroys little vegetation. I suggest that campers from boats are equivalent to backpacking campers and may be permitted to camp on the island if it is designated a natural area. It will also be necessary to delineate a camping area.

The cost of plan A includes a sign posting the regulations and signs marking the camping areas.

Plan B

Plan B offers greater protection of habitat and wildlife than the other plans. The island would be designated as a natural area. The permitted activities would be camping and fires only in designated areas and possibly swimming. Prohibited activities would be duck blind construction, and hunting or limited hunting. Facilities that might be provided would be a trail on the beach and possibly trash cans.

Swimming activities have little impact on habitat on the beaches. It must be decided if swimming will be permitted based on other factors, such as health, safety and enforcement. It must also be decided if trash cans will be provided for visitors.

If they are provided, they would be most useful on the south shore in the two areas where most visitors come ashore.

Hunting is permitted in natural areas although the variety of nesting birds on the island must be considered. The actual benefit of a hunting ban to threatened and endangered birds on the island is hard to estimate. The island would become a wildlife refuge and the Pennsylvania Game Commission could enforce the laws.

The Bureau of Forestry and the Pennsylvania Fish Commission together can designate a natural area as an amphibian and reptile protection area. The taking, catching, killing or possession of any amphibian or reptile would be prohibited. This designation would create a refuge for all amphibians and reptiles. Threatened and endangered species are currently protected by state law.

The cost of Plan B includes two trash cans and labor to clear a short trail. The actual cost will depend on the source of laborers and the amount of trail created.

Plan C

This plan provides more recreational facilities for boaters and hunters. The natural area designation would apply. The facilities will increase the safety, convenience and use of the island. The construction of these facilities on the south shore will limit the destruction of wetlands habitat and minimize visitor use of the wetlands. A trail crossing the island would give limited access to view the north shore.

Hunting, swimming, camping and fires would be permitted. A decision regarding the health aspects of swimming must still be considered. Camp and fire areas would be designated. Duck blind construction would not be permitted.

Natural area improvements are restricted to the minimum necessary for public health, safety and interpretive aids. Any activity which results in some form of disturbance must be approved by the State Forester. A nature trail could be constructed through the driftwood if the trail was approved. A boardwalk over the wetlands could be constructed as a safety feature possibly or as an interpretive aid but it would require a permit from the Pennsylvania Department of Environmental and the United States Army

Corp of Engineers. A cedar chip trail would destroy less vegetation and does not require a permit from the Army Corp.

Facilities that would increase the safety of visitors are aids to navigation, docks, moorings, toilets and trash cans. The cost of all these facilities and a nature trail would be about $ 30,000.00 to $ 53,000.00.

Plan D

If the number of visitors increases substantially the island may be designated as a Special Use Area or a State Park. Use regulations may be necessary to limit the destruction of habitat. Access to the island may be limited to the south shore to limit wildlife disturbance and to preserve tidal marsh plants. Boaters could visit the area but could not land. Hunting and fires would not be permitted for safety reasons. Docks, toilets, picnic tables, and trails may be necessary. Grills may have to be provided to control wildfires. In addition to these facilities, a part-time enforcement official may be needed during the summer weekends. If the recreational demand exceeds the capacity of the island, a system to control the number of visitors per day may be necessary. Passes would be issued by an enforcement official.

The cost of this plan would be an additional $ 3000.00 over the cost of Plan C. The wages of an employee are not included as well as a boat for employee use.

Little Tinicum Island is able to support a variety of activities as long as the number of visitors remains low. The addition of island based facilities is not likely to increase the number of visitors greatly. Eastablishing navigational aids and docks may increase visitors. Because the number of boaters on the Delaware River is predicted to increase, the number of visitors to the island should be monitored periodically. Visitors sign- in books could be placed on the island during August and November to record the number and origin of visitors. If the recently built Chester Ramp becomes more popular, the number of visitors may increase in 1986.

Plan A, B and C were formulated to accomodate the current number of visitors and a moderately increased level of use. If recreational demand increases, it may be necessary to restrict the number of visitors to the island in order to achieve and maintain the goals of the selected plan. This is especially true for Plan A which is based on the assumption of a low number of visitors. Plan B which protects wildlife and habitat requires a limited number of visitors. If recreational demand increases, visitor and boat access will have to be restricted in order to maintain Plan B if this plan is chosen. Limiting boats to anchoring in designated areas such as the camping and fire areas would restrict the number of visitors. The maintainence of Plan C under increased recreational demands will also require restricted access to the island. If visitor access is not restricted Plan C will fail and Plan D which requires an enforcement official will need to be adopted.

More elaborate plans, including permanent structures were not considered because of the significant possiblity of flood destruction. Only small anchored structures were considered feasible, such as picnic tables and grills.

None of the activities or facilities presented with each of the plans is mandatory. Plan B which protects the wildlife may involve the construction of docks, toilets and trash cans and not be inconsistent with the goal of wildlife protection if built properly, located sensibly and visitor access restricted. Plan C which provides for recreation may not necessarily involve the construction of facilities.

No other categories of land used by the Bureau of Forestry are appropriate for Little Tinicum Island. The island is too small to be a Wild Area. It has no harvestable timer stands of noteworthy size. The Bureau of Forestry's policy is to maintain but not develop new picnic facilities. New picnic areas should be provided by State Parks.

ENDNOTES

1 Rand McNally Company, New Jersey Map (New York, 1980)

2 United States Geological Survey, Topographic Map, Bridgeton Quadrangle.

3 National Oceanic and Atmospheric Administration, United States Department of Commerce, Chart of Delaware River, W mington to Philadelphia - National Ocean Survey (Washington D.C., 1983)

4 Jack McCormick and Associates, Preliminary Ecological Evaluation and Recreational Census, Little Tinicum Island and Vicinity (United States Army Corps of Engineers, Philadelphia PA, 1971), p. 6 - 9.

5 Bill Sisson, Pennsylvania Historical and Museum Commission Bureau of Historic Preservation, Harrisburg, PA (personal communication, October 1985).

6 Commonwealth Land Title Insurance Company, Title Report Tinicum Real Estate Holding Corporation, Delaware County Deed Book 408 page 79 and 97, (April 25, 1977).

7 Adapted from Pennsylvania Department of Environmental Resources, Divison of Coastal Zone Management, Four Environmentally Significant Areas, Delaware Estuary Coastal Zone Working Paper p. 16.

8 Commonwealth Land Title Insurance Company, p. 4.

9 C. L. Orbaker and Associates, Inc., Appraisal Report Little Tinicum Island (April 26, 1977) P. 6.

10 McCormick, p. 10.

11 McCormick, p. 3 - 4.

12 United States Soil Conservation Service, Soils Report Chester and Delaware Counties, PA, Sheet 58.

13 United States Army Corp of Engineers, Delaware River Survey Eddystone to Tinicum Island and Tinicum Island to Schuylkill River, 1966.

14 Delaware River Basin Commission, Water Quality Data, Paulsboro New Jersey, 1984 - 1985, Trenton, New Jersey.

15 Pennsylvania Department of Environmental Resources, Bureau of Water Quality Management, Water Quality Criteria (1985).

16 United States Environmental Protection Agency, Chesapeake Bay: A Framework for Action (Philadelphia District, 1983).

17 Delaware River Basin Commission, op. cit.

18 American Public Health Association, Standard Methods for the Examination of Water and Wastewater (Washington, D.C., 1985) p. 827 - 830.

19 Mrs. Haffly, Director of Public Health, Chester County Office, Pennsylvania Department of Public Health.

20 Mr. Seymour Gross, Delaware River Basin Commission (personal communication, October 1985)

21 Philadelphia City Planning Commission, Philadelphia's Plan for River Recreation, (Philadelphia, 1984), p. 10 - 11.

22 McCormick, p. 27.

23 Pennsylvania Department of Environmental Resources, Bureau of Forestry, Pennsylvania Natural Diversity Inventory (1985).

24 Norman Fassett, A Manual of Aquatic Plants (Madison, WI, 1980) p. 343 - 351.

25 Elbert Little, The Audobon Society Field Guide to North American Trees (New York, 1980).

26 John Groves, The Philadelphia Zoo, Report prepared for this study.

27 McCormick, P. 49.

28 Lee Tilton, Pennsylvania Fish Commission (personal communication, November 1, 1985).

29 Philadelphia City Planning Commission, P. 58 - 59.

30 Ibid., p. 40 - 41.

31 Ibid., p. 45.

32 Mrs. Haffly, Pennsylvania Department of Health, Chester County Office (personal communication, November 1985).

33 Eleanor Brown, The Forest Preserve (New York, 1985).

34 Dick Hassel, United States Army Corp of Engineers, Regulatory Branch, Philadelphia, PA (personal communication, November 1985).

BIBLIOGRAPHY

American Public Health Association, Standard Methods for the Examination of Water and Wastewater, 16th edition, Washington D.C., 1985.

Brown, Eleanor, The Forest Preserve, The Adirondack Mountain Club New York, 1985.

Fassett, Norman, A Manual of Aquatic Plants, University of Wisconsin Press, Madison, WI, 1980.

Fernald, Merritt Lyndon, Gray's Manual of Botany, American Book Compnay, New York, 1950.

Grimm, William Carey, Recognizing Native Shrubs, Stackpole Company, Harrisburg, PA 1966.

Grimm, William Carey, How to Recognize Trees, Stackpole Company, Harrisburg, PA, 1962.

Little, Elbert, The Audobon Society Field Guide to North American Trees, Alfred A. Knopf, New York, 1980.

McCormick, Jack and Associates, Preliminary Ecological Evaluation and Recreational Census, Little Tinicum Island and Vicinty, United States Army Corp of Engineers, Philadelphia, PA, 1971.

Pennsylvania Department of Environmental Resources, Division of Coastal Zone Management, Four Environmentally Significant Areas. Delaware Estuary Coastal Zone Working Paper.

Philadelphia City Planning Commission, Philadelphia's Plan for River Recreation, Philadelphia, 1984.

United States Environmental Protection Agency, Chesapeake Bay: A Framework for Action, United States Government Printing Office, Washington D.C., 1983.

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APPENDIX ONE

State College Field Office
Resource Contaminant Assessment Report No. 84-2

A Preliminary Survey of Contaminants in Fish and Wildlife at the Tinicum National Environmental Center Philadelphia and Delaware Counties, Pennsylvania

Department of the Interior
U.S. Fish and Wildlife Service
State College, Pennsylvania

April 1985

Prepared by: Cynthia L. Rice, David J. Putnam
Project Leader: Charles J. Kulp

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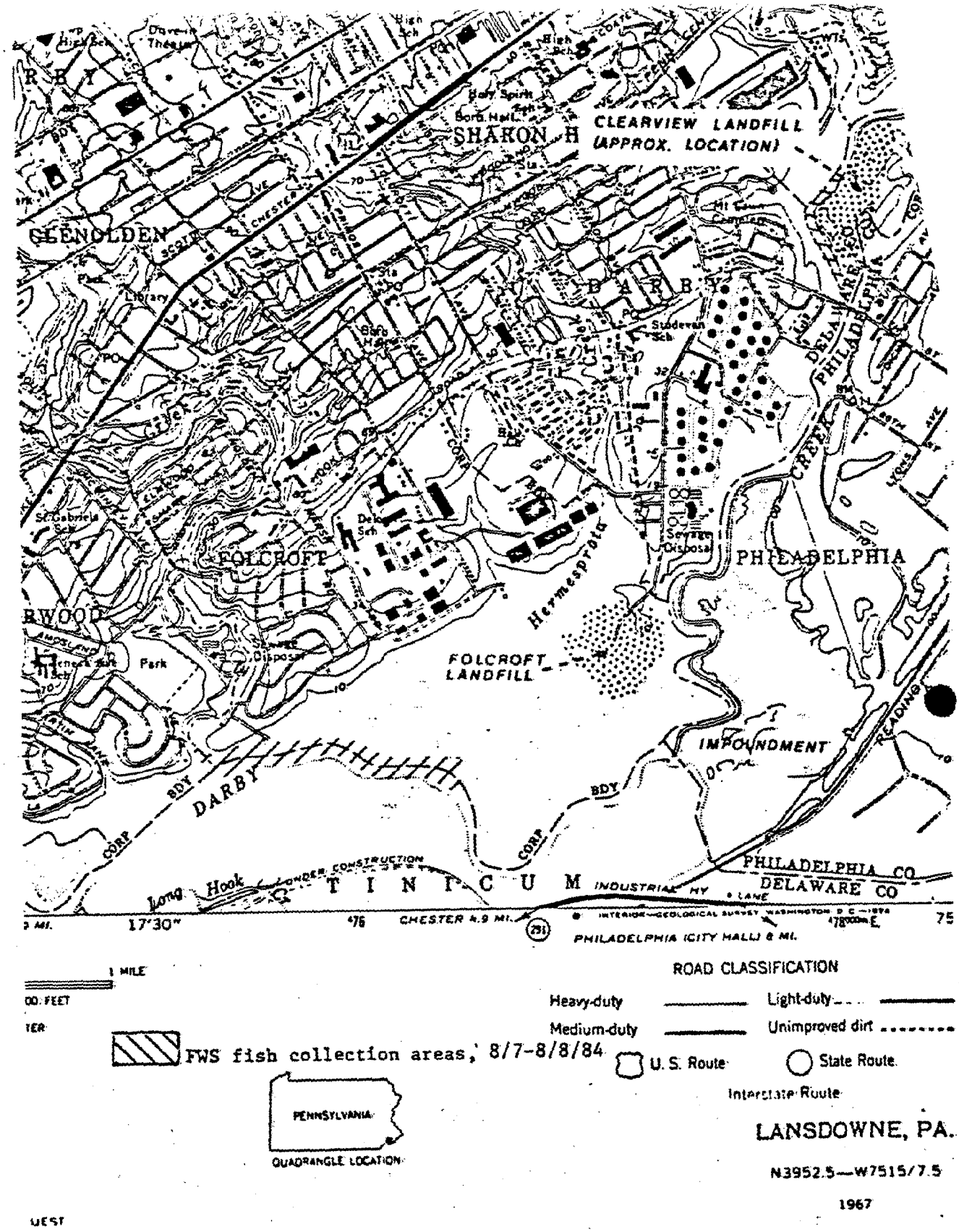


Figure 2. Map of collection areas.

As analytical results were received from the laboratory, copies were immediately forwarded to "interested parties" including state and federal agencies. A copy of our transmittal letter with a complete contact list for the Tinicum results is found in Appendix A.

Fish

Table 1 provides the data on our two whole fish samples, as well as criteria for each organochlorine established by the National Academy of Sciences/National Academy of Engineering (NAS/NAE) (1972) for the protection of piscivorous (fish-eating) fish and wildlife, and the U.S. FDA action level. NOTE: While our data can be compared directly to the NAS/NAE criteria, this is not true for the FDA Action Level, as our samples represent residues in whole fish, not fillets as generally used by FDA. Whole fish analysis includes the viscera which are generally high-lipid tissues in fish. Since organochlorines are highly lipophilic, whole fish organochlorine residues are expected to be somewhat higher than fillet residues.

Both fish samples exceed the NAS/NAE criteria for dieldrin, cis-chlordane, trans-nonachlor and PCBs. In addition, the brown bullhead sample taken near the Folcroft landfill exceeds the NAS/NAE criterion for DDT and its metabolites.

Table 1 also shows the average and maximum concentrations of these compounds detected in whole fish collected from over 100 locations nationwide for the 1980-1981 National Pesticide Monitoring Program. Both Darby Creek samples exceed the NPMP averages for DDE, DDD, dieldrin, trans-nonachlor and PCB (1260). Also shown in Table 1 are the ranges of whole fish tissue concentrations found in this office's (State College Field Office-SCFO) 1981-1982 survey of over 40 areas in Pennsylvania with known or suspected contaminant problems.

Brown bullheads, largemouth bass and American eels collected in the electrofishing effort in Darby Creek near the Clearview Landfill were submitted to Dr. Hans Rothenbacher, a PSU Veterinary Pathologist, for pathological examination. Dr. Rothenbacher found a condition known as "hemorrhagic erosive dermatitis" in these fish, a condition which could be caused by exposure to toxic chemicals. An examination of brown bullheads, channel catfish, white suckers and white bass from nets set in Darby Creek near the Folcroft Dump revealed fatty livers, another condition which is associated with environmental stress and may be caused by exposure to toxic chemicals.

Turtles

Organochlorine/PCB Analysis - Five turtle fat and five turtle leg meat samples were analyzed for organochlorine compounds. No organochlorines were found above detection limits in the meat samples. The ranges and means of the five turtle fat analytical results are shown in Table 2.

The value of selecting snapping turtles as indicators of organic contamination was realized and described only recently. Stone et al. (1980) hypothesized that because snapping turtles are long-lived, fairly sedentary, omnivorous, common, and widely distributed geographically, they should be excellent indicators of aquatic pollution. Stone collected turtles from various locations in

the Hudson River and other waters around New York state; the residue levels of p,p'-DDE, dieldrin and PCBs found in their samples is provided in Table 3 for comparison with the Tinicum sample results. Table 3 also shows residue levels of p,p'-DDE and PCBs detected in one turtle fat sample from each of the Upper Hudson River near Hudson Falls, and Irondequoit Bay in Lake Ontario by Olafsson et al. (1983); and PCB levels in 14 turtle fat samples from various Minnesota locations by Helwig and Hora (1983). The latter authors concluded that the highest levels of PCBs found in their study (up to 60.5 mg/kg) were from snapping turtle fat from the Mississippi River below the Twin Cities. At other Minnesota locations, PCBs were less than or equal to 5 mg/kg in turtle fat.

Table 1. Organochlorine compounds in whole fish samples collected from Darby Creek near Clearview and Folcroft Landfills, compared with NAS/NAE criteria, FDA action levels, NPMP average and maximum levels for 1980-1981, and range of levels detected by this office (SCFO) at over 40 locations in PA in 1981-1982. Results in ppm (wet weight). NOTE: Our samples were whole fish and therefore our residue levels are not directly comparable to FDA action levels.

Compound	NAS/NAE Criteria (ppm)	FDA Action Level (ppm)	Brown Bullheads (Folcroft)	White Suckers (Clearview)	NPMP Whole Fish Average	NPMP Whole Fish Max.	SCFO Whole Fish Range
p,p'-DDE	1.0		0.70	0.38	0.20	2.57	N.D.-1.46
p,p'-DDD			0.53	0.30	0.07	3.43	N.D.-1.29
p,p'-DDT		5.0	N.D.	N.D.	0.06	2.69	N.D.-1.50
Dieldrin	0.1 ppm, singly or in combination with other organochlorine insecticides, excluding DDT	0.3	0.17	0.35	0.04	0.72	N.D.-0.07
Heptachlor epoxide		0.3	N.D.	N.D.	0.009	0.27	N.D.-0.03
Oxychlordane			N.D.	N.D.	0.009	0.33	N.D.-0.03
cis-Chlordane			0.43	0.48			N.D.-1.09
trans-Nonachlor			0.17	0.20	0.04	0.77	N.D.-1.55
cis-Nonachlor			N.D.	N.D.	0.02	0.27	N.D.-0.09
Endrin			N.D.	N.D.	0.006	0.3	N.D.
Est. Toxaphene		5.0	N.D.	N.D.	0.27	21.0	N.D.-0.20
Est. PCB, 1260	0.5	2.0	1.8	2.0	0.25	2.63	N.D.-6.36

N.D.-none detected. Lower limit of reportable residues = 0.1 ppm for pesticides and 0.5 ppm for PCBs. PCB "estimate" could be off by 50% up to an order of magnitude.

Table 2. Range of organochlorines in five turtle fat samples (ppm wet weight) from Tinicum NEC.

Compound	Range	Mean
p,p'-DDE	0.49 - 3.4	1.598
p,p'-DDD	N.D. - 0.70	0.368
DDT	N.D.	0
Dieldrin	0.23 - 0.45	0.336
Heptachlor epoxide	N.D. - 0.13	0.046
Oxychlordane	0.26 - 0.75	0.474
cis-Chlordane	0.22 - 0.80	0.572
trans-Nonachlor	0.42 - 1.2	0.686
cis-Nonachlor	N.D. - 0.32	0.214
Endrin	N.D.	0
Toxaphene (Est.)	N.D.	0
PCB (Est.)	4.7 - 23	13.24

N.D.- none detected. Lower limit of reportable residues = 0.1 ppm for pesticides and 0.5 ppm for PCBs. PCB "estimate" could be off by 50% to an order of magnitude.

Table 3. Residue levels of organochlorines in snapping turtle fat from Tinicum NEC compared to levels reported in previous studies.

Compound		Tinicum Turtles n = 5 (ppm wet weight)	Olafsson et al., 1980: Upper Hudson River n = 1 (ppm wet weight)	Olafsson et al., 1980: Lake Ontario n = 1 (ppm wet weight)	Stone et al., 1980: Hudson River n = 11 (ppm fat basis)	Stone et al., 1980: Other New York Waters n = 9 (ppm fat basis)	Helwig & Hora, 1983: Minnesota n = 14 (mg/kg)
p,p'-DDE	Range	0.49 - 3.4	14.999	87.598	N.D. - 57.50	N.D. - 81.3	
	Mean	1.6			<11.11	11.50	
Dieldrin	Range	0.23 - 0.45			<0.2 - 26.5	N.D. - 34.10	
	Mean	0.336			<8.45	4.24	
PCBs	Range	4.7 - 23	3,608.314	633.292	306 - 7,990	0.36 - 2,281	<0.2-60.5
	Mean	13.24			2,990.6	464.16	21.7

n = sample size
N.D. = not detected

We are unaware of any studies that have reported residue levels in snapping turtles for the other organochlorines detected in our samples (heptachlor epoxide, oxychlordane, etc.).

No organochlorines or PCBs were detected in our turtle meat samples. This is consistent with the findings of Stone et al. (1980) and Helwig and Hora (1983), who found meat residues to be much lower than fat residues. Helwig and Hora (1983) concluded that "the low lipid content of the turtle meat greatly reduces the potential bioaccumulation of PCBs in the meat" (p. 189).

Metals

Five snapping turtle livers were analyzed for the metals lead, copper, zinc, vanadium, cadmium, aluminum, thallium, mercury, arsenic and selenium. The ranges and means of our results are shown in Table 4.

Livers were selected for the metals analysis because this organ has been shown to concentrate metal contaminants in other organisms (Jenkins, 1981). The specific metals were selected by the PSU researchers.

We are unaware of any previous studies on metal levels in turtle livers with which to compare these data.

Oil Analysis

Two turtle leg meat samples were submitted to our laboratories for polycyclic aromatic hydrocarbon (PAH) analysis. In its analytical procedure for testing for PAHs, the laboratory also apparently tests for aliphatic hydrocarbons. The results of our turtle samples showed no PAHs to be present, but a wide variety of aliphatics including tridecane, tetradecane, octylcyclohexane, pentadecane, nonylcyclohexane, hexadecane, heptadecane, pristane, octadecane, phytane, nonadecane, and eicosane. The levels of these compounds ranged from undetectable to 0.21 ppm.

To our knowledge, no one has ever tested for aliphatics in turtle meat tissues, and we are therefore unable to draw any conclusions concerning whether these results indicate petroleum contamination (and if so, whether these levels are life-threatening for turtles).

Table 4. Residues of metals in five snapping turtle liver samples from the Tinicum NEC. Results in ppm wet weight.

Metal	Range	Mean
Lead	N.D. - 0.19	0.038
Copper	1.4 - 3.0	1.94
Zinc	30. - 36.	35
Vanadium	N.D. - 0.20	0.04
Cadmium	N.D.	--
Aluminum	1.9 - 6.6	3.88
Thallium	N.D.	--
Mercury	0.04 - 0.10	0.072
Arsenic	N.D. - 0.08	0.016
Selenium	0.27 - 0.78	0.526

N.D. - none detected. Lower limit of reportable residues = 0.10 ppm for lead, copper, zinc, vanadium, cadmium, and thallium; 1.0 ppm for aluminum; 0.02 ppm for mercury; and 0.05 ppm for arsenic and selenium.

Fish Sampling

Residues in fish samples collected from Darby Creek near the Clearview and Folcroft landfills exceeded the NAS/NAE criteria for the protection of piscivorous fish and wildlife for a number of organochlorines (see RESULTS section). Further studies would be needed, however, to determine the source of this contamination.

PCB levels were reported by the lab as an "estimate", meaning that the reported value could be incorrect by 50% up to an order of magnitude in either direction. To get a more accurate assessment of the PCB levels in these fish, we have resubmitted the tissues to a second lab for re-analysis.

Recent work by the PaDER and the EPA have shown high concentrations of heavy metals in Darby Creek water adjacent to the Folcroft Dump and in Darby Creek sediments near the Clearview landfill. Any future fish samples collected in this area should include heavy metal analyses to determine if these contaminants are accumulating in fish tissues.

Turtle Sampling

All of the turtles were reported to have been collected from within the NEC's large impoundment during the evening of July 5 and the morning of July 6. Because we were forced to hold the turtles over a weekend to allow a pathologist to examine them before they were killed and samples taken, there is a possibility that some metabolization of contaminants may have occurred, which could have affected the tissue residues detected.

In addition, because the turtles were obtained from a commercial trapper, the PSU researchers were supplied with somewhat smaller turtles than we would like to have collected. If Stone et al. (1980) are correct that "the adipose tissue may accumulate organochlorine toxicants throughout the life of a turtle" (p. 49), older turtles should be better indicators of the presence of organochlorine pollutants. We made no attempt to age the turtles.

Further studies at the NEC using snapping turtles should be better controlled, with age determinations made. Furthermore, fat appears to be the best turtle tissue to test for organochlorine contaminants. Future studies should concentrate on collection of fat samples. In addition, every effort should be made to collect future turtle samples from Darby Creek, as this waterway would be in the most direct contact with any contaminants that may be emanating from the Clearview and Folcroft Landfills.

The same reservations about the PCB estimates described under the above discussion about our fish sampling apply to the turtle fat samples, and we are also having these re-analyzed by another lab. We hope to have the results of both fish and turtle PCB samples in approximately three months.

CONCLUSION

Fish and wildlife species at the Tinicum National Environmental Center are being exposed to a variety of organic and inorganic contaminants. Some of these are concentrating in biological tissues to an extent that exceeds established criteria for the protection of fish and wildlife health. Additional surveys should be conducted to determine the extent and source of this contamination.

REFERENCES

Helwig, D. D. and M. E. Hora. 1983. Polychlorinated biphenyl, mercury, and cadmium concentrations in Minnesota snapping turtles. Bull. Environm. Contam. Toxicol. 30: 186-190.

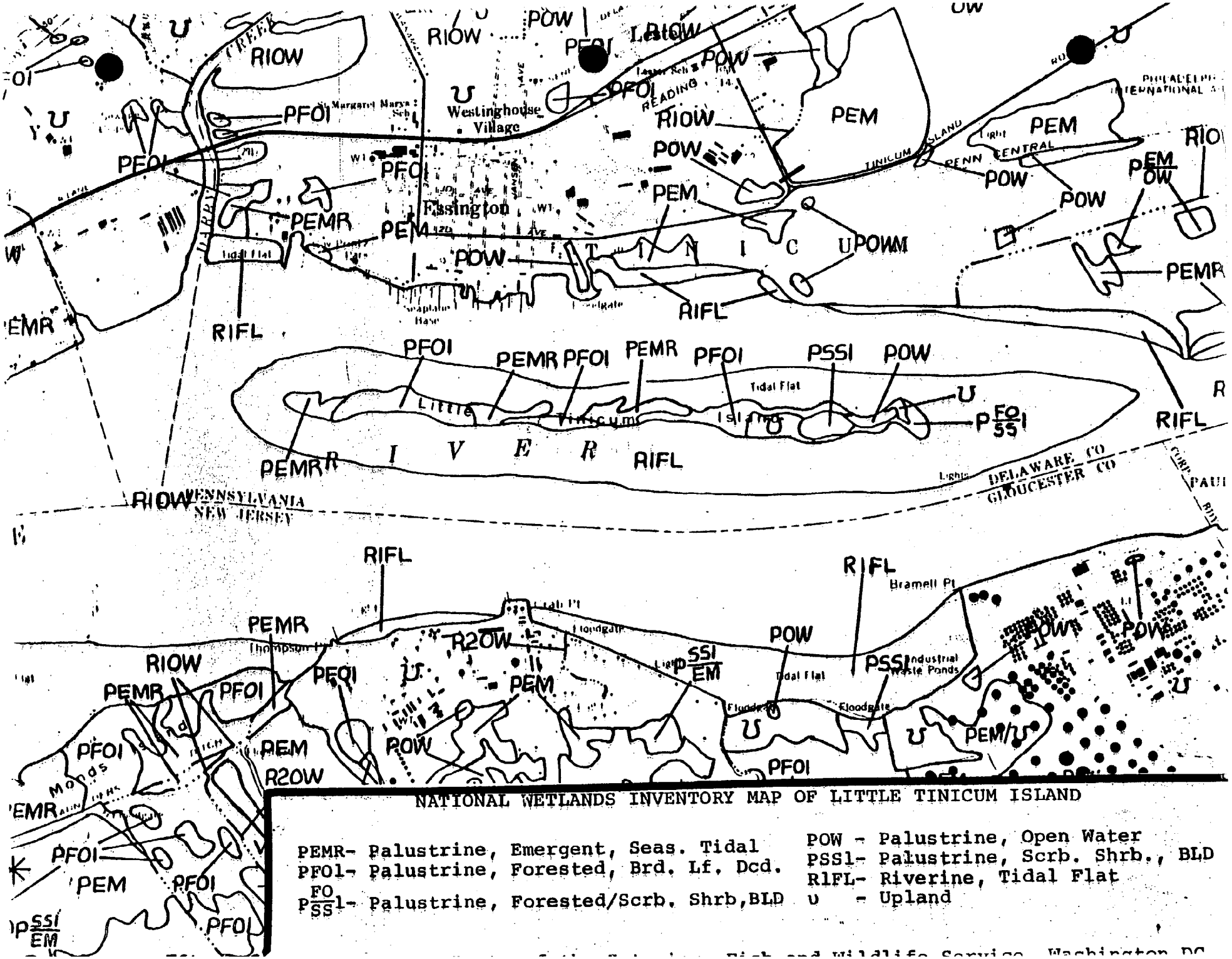
Jenkins, D. W. 1981. Biological monitoring of toxic trace elements (Project Summary). U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Las Vegas, NV. EPA-600/S3-80-090. 7 pp.

National Academy of Sciences/National Academy of Engineering, Committee of Water Quality Criteria. 1972. Water Quality criteria, 1972. Washington, D.C. 594 pp.

Olafsson, P. G., A. M. Bryan, B. Bush, and W. Stone. 1983. Snapping turtles--a biological screen for PCB's. Chemosphere 12(11): 1525-1532.

Stone, W. B., E. Kiviat, and S. A. Butkas. 1980. Toxicants in snapping turtles. New York Fish and Game Journal. 27(1): 39-50.

Wallace McHarg Roberts and Todd. Tinicum National Environmental Center--Summary of the Draft Master Plan.



NATIONAL WETLANDS INVENTORY MAP OF LITTLE TINICUM ISLAND

PEMR- Palustrine, Emergent, Seas. Tidal
PFOI- Palustrine, Forested, Brd. Lf. Dcd.
$P\frac{FO}{SS}1$- Palustrine, Forested/Scrb. Shrb,BLD
POW - Palustrine, Open Water
PSS1- Palustrine, Scrb. Shrb., BLD
RIFL- Riverine, Tidal Flat
U - Upland

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