CONSERVATION PLAN FOR THE MANUMUSKIN RIVER WATERSHED

NEW JERSEY CONSERVATION FOUNDATION
JUNE 1988

NEW JERSEY CONSERVATION FOUNDATION
300 MENDHAM ROAD
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The New Jersey Conservation Foundation is a non-profit membership organization headquartered in Morristown, New Jersey. Nearly 30 years ago, the Foundation began as the Great Swamp Committee, which was responsible for preserving the Great Swamp National Wildlife Refuge in Morris and Somerset Counties in northern New Jersey.

Our mission is to promote conservation of open spaces and natural resources throughout New Jersey by:

1. Acquiring land through donation and purchase for transfer to other entities to preserve natural ecosystems and agricultural lands, and to provide opportunities for recreation and environmental education.

2. Assisting government in preserving various types of open space throughout the state.

3. Demonstrating, promoting and publicizing new techniques, which preserve open space and agricultural lands and encourage appropriate land use.

4. Advocating laws and regulations designed to promote the conservation of natural resources.

5. Providing for environmental education through publications and special programs, and serving as an information and reference center.

6. Providing liaison among citizen organizations, industry and governmental agencies concerned with environmental matters.

This report was prepared under contract with the New Jersey Department of Environmental Protection, Division of Coastal Resources, Bureau of Planning and Project Review and with the financial assistance of the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of Ocean and Coastal Resource Management, under the provisions of the federal Coastal Zone Management Act, Public Law 92-583, as amended.

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Illustrations by Hale Allen.

CONSERVATION PLAN FOR THE MANUMUSKIN RIVER WATERSHED

Cumberland and Atlantic Counties, New Jersey

prepared by

NEW JERSEY CONSERVATION FOUNDATION
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JUNE 1988

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FOREWORD

New Jersey is the most densely populated state in the nation. Much of its most noxious and visually blighted areas are located along major highways, prominently displayed to all who pass through our state. The impression left with many is that New Jersey is devoid of scenic beauty, its quality of life bankrupt.

Those of us who live within its borders know that New Jersey also has many places of incredible natural and cultural beauty, rich in tradition and recreational opportunities. We take pride in these places, while acknowledging that many of their special qualities may soon give way to suburban development, which threatens to overtake all of rural New Jersey. There is a general recognition that something must be done to preserve the unique qualities of our rural areas, but individuals, and even local governments, often lack the necessary knowledge and tools to achieve this purpose.

What is needed is an analysis of an area's special resources; a vision of how to preserve those resources; and a consensus on how to implement that vision.

This Conservation Plan provides an analysis of the Manumuskin River's resources, and a vision of how those resources might be preserved. Our purpose in preparing this Plan is to suggest a variety of options for maintaining the area's unique character. We hope that local citizens and elected officials will explore and add to these options, and select those which are most useful.

Since the land area that drains into the Manumuskin (the Watershed) comprises parts of four towns and two counties, intergovernmental cooperation holds the key to success. Each town must properly manage its portion of the Watershed to insure the continued health of this fragile ecosystem. We are confident that a broad consensus can be forged by local and county leaders which will safeguard the special qualities of the Manumuskin.

In participating in the preparation of this Plan we had the opportunity to learn about the broad array of natural and cultural features which make the Manumuskin Watershed one of New Jersey's treasures. It was an additional privilege to meet some of the people from the local area who care so deeply about its future. Most of the essential information contained in this report was supplied by local people, who gave unsparingly of their time and knowledge. Many of their names appear in various sections of the report, and for their contributions we are most grateful. We hope that the information and recommendations which have been assembled will prove helpful to all those people who have a strong desire to participate in shaping a future for the Watershed that retains the best of the past and present.

We also wish to acknowledge the effort put forward by our team of project consultants. Charles L. Siemon, Esq., donated his invaluable legal and organizational expertise to this project, as a service to the public.

Leslie Sauer of Andropogon Associates, Ltd., served as project manager. Clay Sutton and Bob Zappalorti of Herpetological Associates provided extensive information about the fish and wildlife of the Manumuskin Watershed. All their contributions went well beyond the scope of work.

Finally, to the extent that there is success in preserving the special qualities of the Manumuskin it will be due in large measure to the dedication of Dan O'Connor, who has labored tirelessly over the years to document and safeguard the resources of this region. His love of the Manumuskin is eloquently revealed in the natural and cultural resources inventory section of this report.

We dedicate this report to the many local citizens and government officials who are fighting a constant battle to preserve the resources of the Manumuskin now and for future generations.

Thomas Wells, Assistant Director
New Jersey Conservation Foundation

INTRODUCTION

The purpose of this project is to develop a Conservation Plan for the Manumuskin Watershed which will provide recommendations for conserving resources of the area while accommodating necessary growth. The project focuses on the problems and opportunities in the whole Watershed, rather than on any particular jurisdictional boundary.

This is an especially timely effort because awareness of environmental issues has never been higher. A recent poll undertaken in Cape May and Cumberland counties by Ed Salmon, member of the New Jersey Assembly, indicated that the No. 1 voter issue was a clean and safe environment. There is also a high degree of shared community spirit, due in part to the successful countywide effort to oppose the selection of a site along the Manumuskin for a hazardous waste management facility. At the same time, the National Park Service is conducting a two-year study, in cooperation with a locally appointed task force, to determine whether segments of several area rivers, including part of the Manumuskin, are eligible for inclusion in the National Wild and Scenic Rivers System.

In order to develop strategies for an effective Conservation Plan, an inventory of the natural and cultural resources of the Watershed was undertaken, as well as a review of existing zoning regulations and a sequence of interviews with key informants from public and private agencies, whose names are listed at the end of this section. Further public participation and comment was heard in two public meetings held at the Maurice River Township School on 30 July and 3 September 1987.

At the first public meeting, the major investigators preparing the Resource Inventory were introduced and the work in progress was reviewed, including brief slide presentations on the plants and animals of the Manumuskin Watershed. Those present were invited to comment on their areas of concern in the Watershed. At the second public meeting, there was a slide presentation on the historic structures and a review of the existing zoning and the preliminary recommendations developed for the Conservation Plan. General comments were solicited as well as information on recreational use and scenic resources in the Watershed.

The preliminary and final drafts of this report were submitted for review to the State of New Jersey Department of Environmental Protection's Division of Coastal Resources, Office of Natural Lands Management, the Office of Green Acres, and Division of Parks and Forestry and the Pinelands Commission, as well as the municipalities along the creek corridor, Cumberland County Department of Planning, the Citizens United to Protect the Maurice River and Its Tributaries and The Nature Conservancy. Their comments have been incorporated into this report.

We wish to acknowledge the help of the following individuals who provided valuable information.

MAURICE RIVER TOWNSHIP
John Feltes, Mayor
Leslie Ficcaglia, Vice Chairman, Planning Board

CITY OF VINELAND
Joseph E. Romano, Mayor
Mary Festa, Principal Planner
Charles I. Williams, Jr., Chairman, Environmental Commission

CITY OF MILLVILLE
Sumner Lippincott, Mayor
Richard Jones, Principal Engineering Aide

BUENA VISTA TOWNSHIP
Bonnie Caregnato, Township Clerk
John Quigley, Committeeman

CUMBERLAND COUNTY
Ed Salmon, Former Freeholder; Member of the N.J. Assembly
John Flickinger, Director, Health Services
Steve Kehs, Director, Planning Board

ATLANTIC COUNTY
John Ratala, Director, Planning Board

STATE OF NEW JERSEY
Thomas Breden, Coordinator/Ecologist, Natural Heritage Program
Robert J. Cartica, Office of Natural Lands Management
Helen Petit Chase, Section Chief of Residuals Management, Bureau of Municipal Waste Management
Jeanne M. Donlon, Chief, Bureau of State Land Acquisition, Green Acres Program
JoAnn Frier-Murza, Program Manager, Endangered & Nongame Species Program, Division of Fish, Game & Wildlife
Darryl Jennus, Division of Coastal Resources, Project Manager Joseph Miri, Chief, Office of Water Policy
Larry Niles, Principal Zoologist, Division of Fish, Game & Wildlife
Robert Tudor, Assistant Director, Division of Coastal Resources

PINELANDS COMMISSION
John C. Stokes, Assistant Director, Planning & Management
Barry Brady, Resource Planner
Charles Horner, Manager, Development Review
Brian Lefke, Commissioner for Atlantic County
Robert Zampella, Biologist

NATIONAL PARK SERVICE
Evelyn Swimmer, Landscape Architect
Lisa Dewey, Outdoor Recreation Planner

NATURAL LANDS TRUST, INC.
Andrew Johnson, Executive Director
John E. Hiros, Director, New Jersey Region

THE NEW JERSEY CONSERVATION FOUNDATION
David Moore, Executive Director
Dirk Van Nest, Regional Director
Tom Wells, Assistant Director

THE NATURE CONSERVANCY
Bruce Runnels, Director, New Jersey Field Office

CUMBERLAND COUNTY CONSERVATION LEAGUE
Daniel O'Connor, President

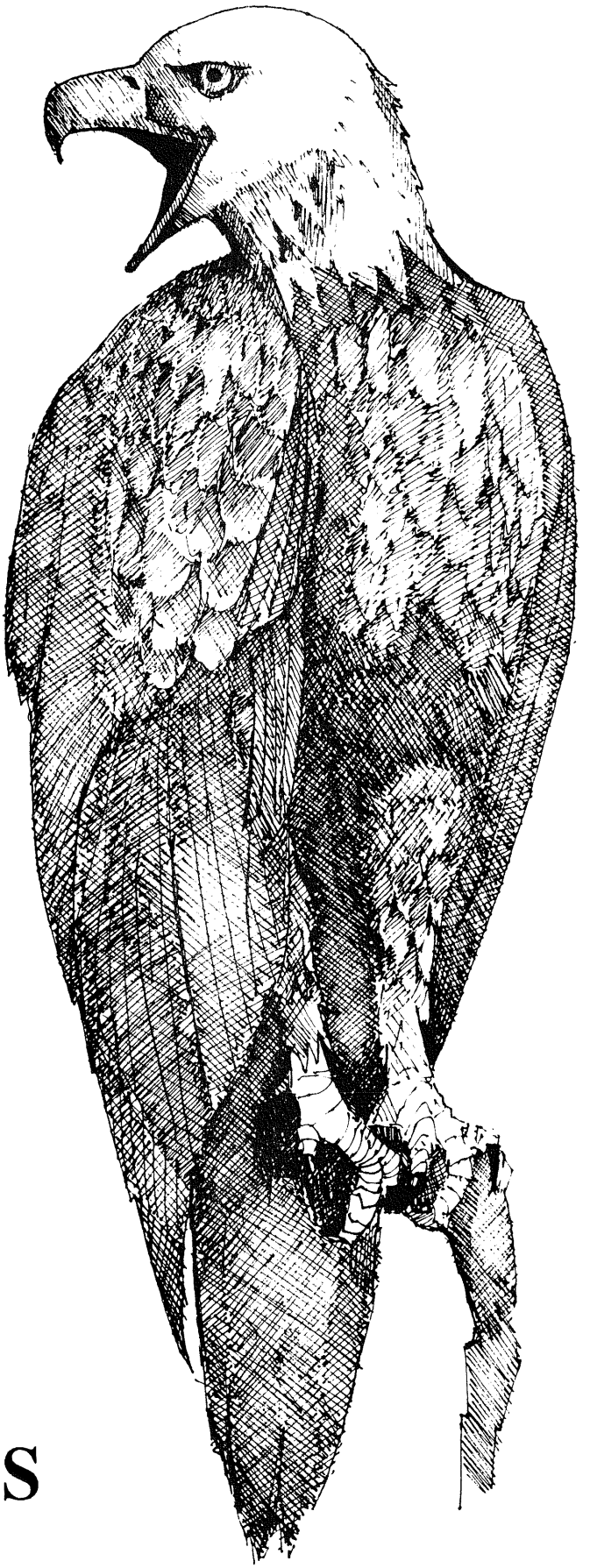
CITIZENS UNITED TO PROTECT THE MAURICE RIVER & ITS TRIBUTARIES, INC.
Donald Fauerbach, Director
Keith Chain, President
Jane Galetto, Vice Chairman
Peter Galetto, Member

NEW JERSEY SILICA SAND
Thomas Lafferty, President, Warner Co. (parent company of NJ Silica Sand)

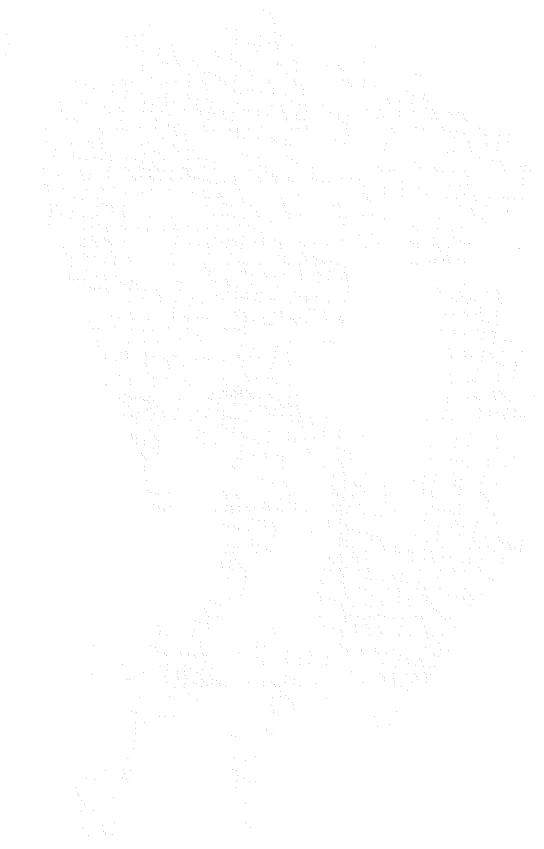
ATLANTIC ELECTRIC
Robert F. Daugherty, Manager, Environmental Affairs Department
Morgan T. Morris, General Manager, Operations Services
Gary Murphy, Manager, Real Estate

LANDOWNERS
Arthur Ogren, Sr., Ogren Property
Jake Simon, J and M Land Co., Simon Properties

In addition to those people listed above, we wish to thank the many local residents who provided assistance and valuable information to the preparation of the Natural and Cultural Resource Inventory. Please refer to that section of the report for a complete listing.



FINDINGS



I. OVERVIEW

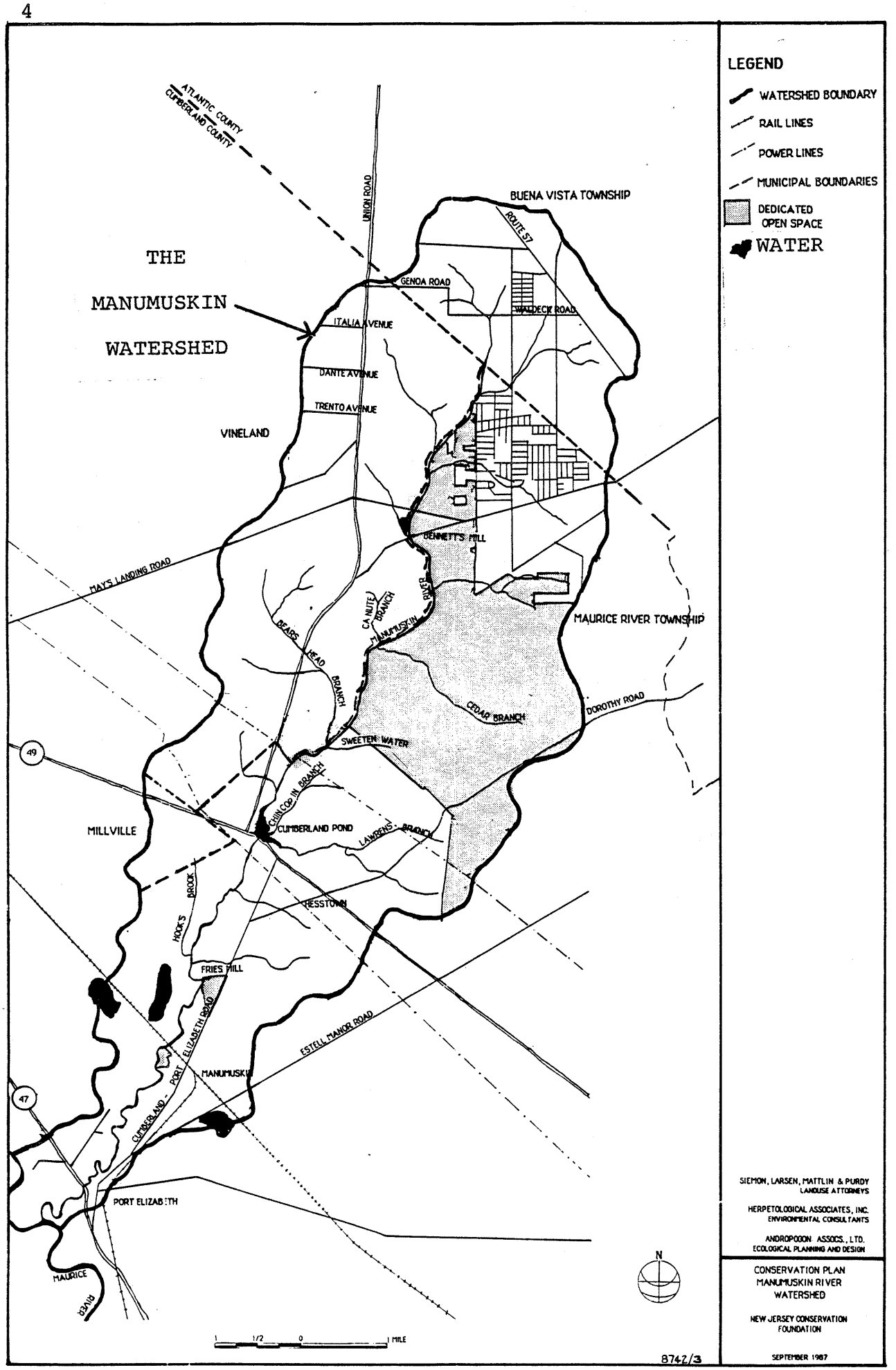
Despite the fact that it is largely privately owned, the Manumuskin Watershed is remarkably undeveloped. The Manumuskin was one of only two streams out of 80 sampled in the one-million-acre Pinelands National Reserve found to have pristine water quality. The other, McDonald's Branch, is in Lebanon State Forest. Even within the Watershed, one of the two pristine branches of the Manumuskin, the Bear's Head Branch, occurs entirely on private land, while the other, Cedar Branch, is within the boundaries of the Peaslee Wildlife Management Area.

About 85% of this rural drainage basin is forested and nearly one-quarter supports wetlands. There are no sewage treatment plants, landfills or industrial discharges in the Watershed, which has a population of fewer than 100 persons per square mile. The Nature Conservancy described the estuarine portion of the river which supports the globally rare Sensitive Joint Vetch as "the least disturbed tidal freshwater wetlands in New Jersey."

This status is a fragile one. Development pressure is increasing, especially in the upper basin, which is only 25 miles from Atlantic City. The completion of Route 55 will provide a direct link with the Philadelphia area. A variety of overlapping jurisdictions complicate administrative and regulatory efforts within the Watershed. Portions of four municipalities lie within the 38-square mile drainage basin: Maurice River Township, the City of Vineland and the City of Millville in Cumberland County, and Buena Vista Township in Atlantic County. Approximately 75% of the Watershed lies within the Pinelands Protection Area or the CAFRA zone; the remainder, protected only by municipal zoning, is potentially more vulnerable to large facility sitings precisely because it is not within either jurisdiction. Publicly owned land, which comprises nearly 20% of the Watershed, is largely confined to the east side of the Manumuskin River.

Ultimately, only acquisition for conservation purposes will provide an adequate level of protection of the pristine conditions found in this Watershed. Time is a critical factor since degradation may occur with even limited development in areas which are presently undisturbed.

NEW JERSEY


THE
MANUMUSKIN
WATERSHED
ATLANTIC COUNTY
CUMBERLAND COUNTY
UNION ROAD
BUENA VISTA TOWNSHIP
ROUTE 57
GENOA ROAD
WALDECK ROAD
ITALIA AVENUE
DANTE AVENUE
TRENTO AVENUE
VINELAND
BENNETT'S MILL
MAYS LANDING ROAD
CA NUTE BRANCH
MANUMUSKIN RIVER
BEARS HEAD BRANCH
MAURICE RIVER TOWNSHIP
CEDAR BRANCH
DOROTHY ROAD
SWEETEN WATER
49
TUNCOCHIN BRANCH
CUMBERLAND POND
LAWRENCE BRANCH
MILLVILLE
HOOK'S BROOK
HESSTOWN
FRIES MILL
ESTELL MANOR ROAD
PORT ELIZABETH ROAD
MANUMUSKIN
47
CUMBERLAND
PORT ELIZABETH
MAURICE
RIVER
1 1/2 0 1 MILE
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LEGEND
WATERSHED BOUNDARY
RAIL LINES
POWER LINES
MUNICIPAL BOUNDARIES
DEDICATED OPEN SPACE
WATER
SIEMON, LARSEN, MATTLIN & PURDY
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CONSERVATION PLAN
MANUMUSKIN RIVER
WATERSHED
NEW JERSEY CONSERVATION
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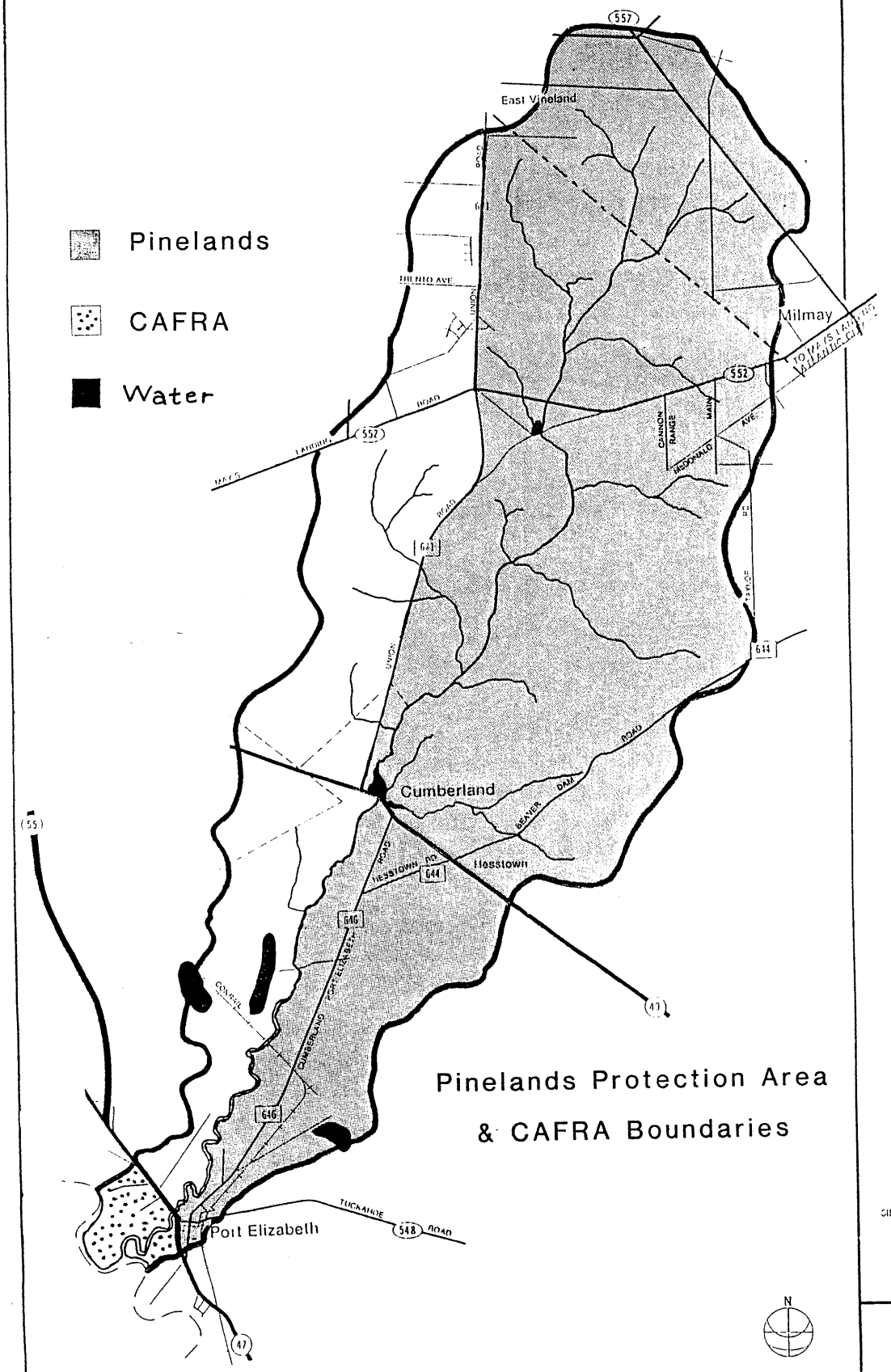
SEPTEMBER 1987



SIEMION, LARSEN, MATTLIN & PUROY
LANDUSE ATTORNEYS

HERPETOLOGICAL ASSOCIATES, INC.
ENVIRONMENTAL CONSULTANTS

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II. SUMMARY OF NATURAL AND CULTURAL RESOURCES INVENTORY

The Manumuskin drainage basin lies within the New Jersey Outer Coastal Plain, the Delaware Bay estuary system, and the Pine Barrens forest region. From its headwaters in southwestern Atlantic County, New Jersey, the Manumuskin River flows in a southerly direction for 12 miles, emptying into the Maurice River, about 7 miles from Delaware Bay. The river becomes tidal at a point three miles upstream of its confluence with the Maurice River. The river corridor is mostly natural and undisturbed except for a few single-family residences in the northern section and the town of Port Elizabeth where it joins the Maurice River.

The drainage basin is underlain by a 4000-foot thick plain formed over the course of the past 170-200 million years by the deposition of layers of sediment washed down from the Appalachian Mountain region. It is composed largely of sand and contains a number of aquifers, the most important of which is the Cohansey Formation, deposited over 5 million years ago.

Sand, gravel, and clay have been mined locally, with extensive sand mining beginning about 1915. Six hundred twenty acres support surface mining today.

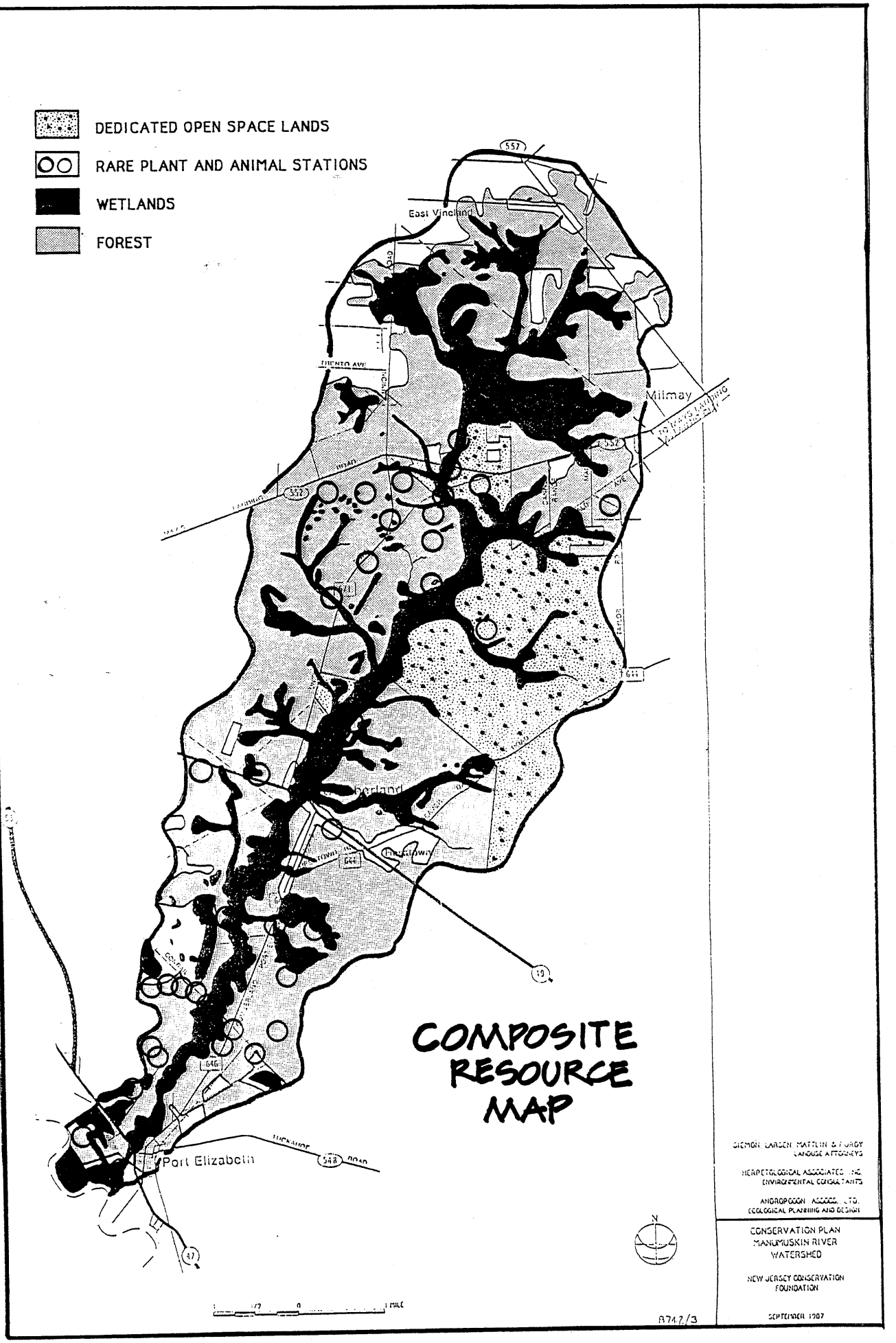
The upland soils are basically dry, porous, well-drained sands with low fertility, minimal organic matter and clay, which are classified either very strongly acidic (pH 4.5-5.0) or extremely acidic (pH less than 4.5). Deposits rich in "bog" iron ore were smelted in the nineteenth century. Other iron concretions, known locally as ironstone or sandstone, were used as a building material for foundations and chimneys.

The average precipitation is about 43 inches, about half of which is evapotranspired back into the atmosphere and half of which sustains the flow of the Manumuskin River. The water table fluctuates annually, peaking in spring after rising all winter and dropping to its lowest by fall, which reflects the sharp seasonal differences in the rate of evapotranspiration.

The quality of the surface water in the Manumuskin basin is probably its most important attribute. Virtually the entire non-tidal portion of the Watershed has superb water quality, which is largely due to the nearly complete forest cover.

The upland forests of the region are predominantly oak but pine stands are also extensive, especially in the lower basin where Virginia pine dominates recently cut areas. Nearly all of the basin was once cleared for charcoal production.

The lowland vegetation includes Atlantic white cedar stands and hardwood swamps. Extensive logging and subsequent replacement by hardwoods has dramatically reduced the extent of the cedar. Pitch pine occurs in transition areas between upland and lowland. There are also some wetlands formed by excavation and impoundments, including former bogs once flooded for cranberry farming. Of special interest are the vernal ponds. These intermittent coastal plain ponds are dry in summer and fall and contain a number of rare plants and animals. Aside from harboring specific rare plants and animals, these


DEDICATED OPEN SPACE LANDS
RARE PLANT AND ANIMAL STATIONS
WETLANDS
FOREST
East Vineland
Milmay
Port Elizabeth
COMPOSITE RESOURCE MAP
SIEMON, LARSEN, MATTLIN & PURDY
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WATERSHED
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vernal ponds are themselves a rare community type. A portion of the state's largest wild rice wetlands extends into the tidal portion of the Manumuskin from the adjacent Maurice River. Three microhabitats occur which are especially important to rare plants: the sand and gravel shorelines of the undercut slopes of river meanders, mud flats, and firm, high peaty areas. Two electric transmission lines also cross the Watershed, providing relatively undisturbed open habitats in the expanse of forest.

Thirty-two rare plants were known to be extant in the drainage basin in 1987, making it one of the most botanically significant areas in New Jersey. One plant is found nowhere else in New Jersey and at least five globally rare species occur. Many other rare plants may be present.

The reptile and mammal diversity is extraordinary, reflecting the excellent water quality and undisturbed nature of the area. The state's largest and perhaps only population of the Northern Scarlet Snake is found here. The most serious threats to the wildlife include lowering of the water table, the development of critical habitats and traffic mortality.

The Manumuskin has extreme ornithological significance for New Jersey. Fifteen of New Jersey's twenty-five threatened and endangered species of birds are breeding in the basin. Wintering waterfowl and raptor populations, particularly the bald eagle, are among the greatest in New Jersey and comprise what is probably the largest concentration of these birds in the state using land not currently in public ownership.

Fish species present include species confined to or characteristic of either brackish or acid freshwater areas as well as those which can be found in both. Although there is only limited information available on invertebrate species and much more field survey work is needed, it is likely that a number of globally rare species can be found here.

Small bands of aboriginal hunters and gatherers appeared in the Delaware Valley region 10,000-12,000 years ago, and prehistoric sites along the Manumuskin are found primarily in the tidal portion of the basin. Older sites may exist in association with the intermittent coastal plain ponds.

Development along the Manumuskin began after about 1720, when the large tracts of land granted by the West Jersey Society proprietors began to be sold in smaller parcels. Historic cultural resources include a late eighteenth-century church, school, inn, hotel, and some grist and saw mills and homes from the same period, as well as an ethnic Italian settlement of the late nineteenth and early twentieth century.

Agriculture is one of the region's oldest economic activities, although its future in the area is uncertain. Much of the land in the southern portion of the basin which was once cleared is now abandoned and has returned to woodland.

As might be expected, simply from its largely undeveloped character, the Manumuskin drainage basin is a beautiful place, rich in scenic resources and popular for outdoor recreation. The long tradition of economic dependence upon local natural resources in this rural area is expressed in its variety of recreational activities which take people out into the forests, streams and fields. Hunting, fishing, ORV riding, and boating are particularly popular activities.

III. CONSERVATION STRATEGY

The Manumuskin Watershed represents a rare phenomenon in the northeast megalopolitan corridor, an entire Watershed in pristine condition which is still largely privately owned. The Natural and Cultural Resources Inventory documents the uniqueness and importance of the Manumuskin Watershed from both a state and federal perspective. The Composite Resource Map portrays the Watershed as a major expense of undeveloped forest with a mosaic of special resources, including critical habitats and cultural sites. Levels of ecological diversity here are as great as any in the state. By any standard of measure, the Manumuskin Watershed merits preservation as one of the finest examples of a nearly undisturbed natural environment in New Jersey.

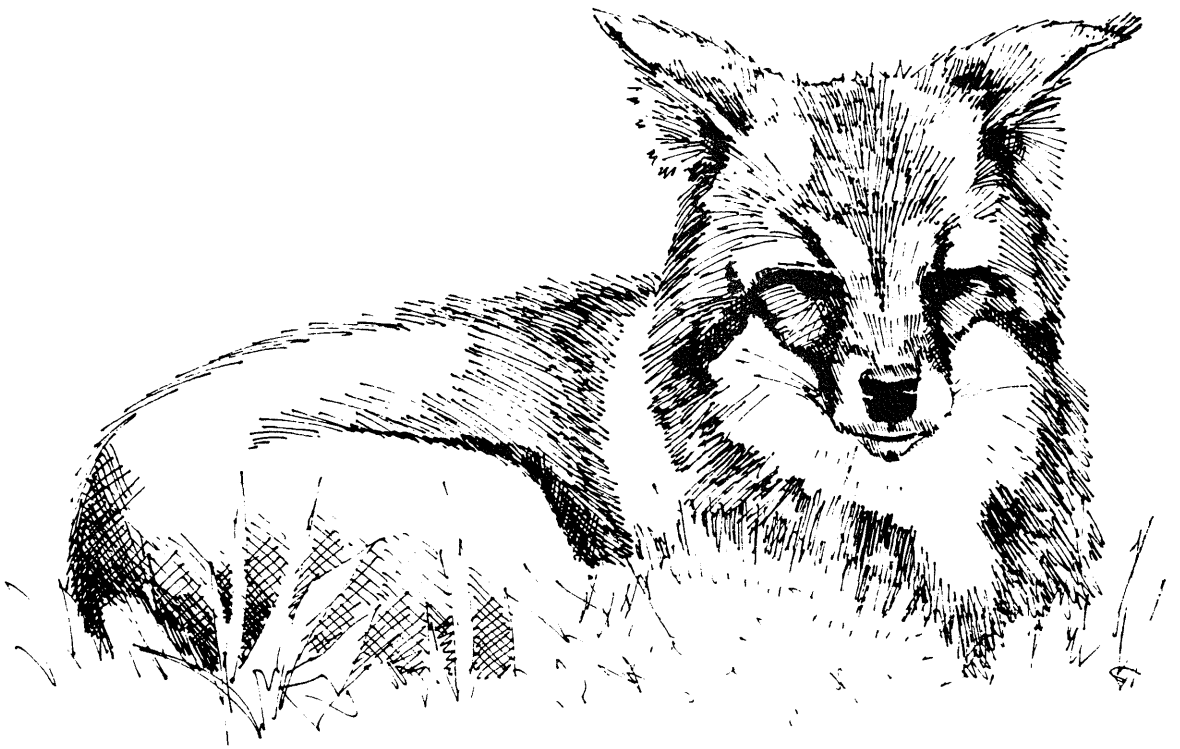
Maintenance of the pristine surface water quality is fundamental to protecting the remarkable diversity and characteristic species composition found in the Watershed. Water quality is largely a function of land use. The inert and poorly buffered local soils have little capacity to absorb contaminants, resulting from agricultural operations and local development. Therefore, limiting the overall amount of future development in the Watershed will be a key requirement in protecting its unique qualities.

In addition to the amount of future development, the pattern of that development will be an equally important factor in the future of the Watershed's resources. Many of the rare species found in the Watershed, particularly animals, are dependent upon broad expanses of undeveloped forest, where human disturbance is minimal. Therefore, permitting even very low density residential development could threaten the use of this area by many rare species. In addition, a pattern of private residential ownership would significantly curtail opportunities for the types of recreational activities which are most important in the Watershed.

In consideration of the above factors, our conservation strategy can be summarized as follows: **1) Limit the overall amount of development in the Watershed** and **2) Preserve as much undeveloped forest area as possible.**

Low-density residential zoning is viewed primarily as an interim measure, to be followed by a major land acquisition effort, which is the cornerstone of the Conservation Plan. Acquisition efforts will seek to establish a large core preserve protecting the expanse of existing undisturbed forest in the basin. Initial priorities include expansion of the Peaslee Wildlife Management Area to the western portions of the Watershed and protection of entire tributary basins. These goals are facilitated by a current pattern of few but very large holdings throughout most of the undeveloped area.

There is already an invaluable level of citizen support for conservation of the Watershed's resources. This is demonstrated by the current, congressionally mandated wild and scenic rivers study of the Maurice, Menantico and Manumuskin river systems. The Conservation Plan seeks to further strengthen citizen involvement and to achieve a greater degree of cooperation between public agencies. Additional monitoring of both natural and cultural resources is also strongly recommended to adequately document, identify and protect exceptional sites.



RECOMMENDATIONS

I. GENERAL RECOMMENDATIONS

A. LONG-TERM CONSERVATION STRATEGIES

1. The high level of local citizen group participation should be enhanced as an effective force in conserving the Watershed's resources.

The Citizens United to Protect the Maurice River and its Tributaries, Inc., and the Cumberland County Conservation League have played crucial roles in the past as advocates of the basin's natural resources. These citizen watchdog activities should be expanded. The Citizens United group is already extending its membership beyond Maurice River Township. Broader representation through the Maurice River Watershed, including Vineland, Millville, and Buena Vista, should foster cooperation among the municipalities and provide a larger perspective on local problems. Additional funding should be sought to hire permanent staff at the citizen-group level to provide for a continuous review of projects in the regulatory process, including CAFRA, Wetlands, Waterfront Development, and Pinelands, as well as municipal reviews. Continued coordination with state agencies is also important.

The relationship between the municipalities and the state often becomes a complex web of contradictory and bureaucratic red tape. Inexplicable delays are routine and staff turnover is high in some state agencies. A well-organized citizen group can provide important information about the resources of the basin, which is useful both in the development review process, and in stimulating broad-based public support for measures which will conserve the basin's unique resources. In addition, a citizens' group can maintain a constant presence before regulatory agencies, advocating conservation of natural resources in order to balance the continual pressure brought by development interests to compromise those resources. The Pinelands Commission's development review staff should be a particular focus for support and encouragement.

The two municipalities (Maurice River Township and Vineland) in conformance with the Pinelands Commission's Comprehensive Management Plan handle "minor development" applications, such as single-family dwellings, but commission staff review preliminary and final local approvals for compliance with the plan and may revoke approvals or impose additional conditions. Several municipal officials have expressed concern that enforcement of permit conditions is spotty, and there may be a tendency to grant "waivers of strict compliance" too readily. Environmental groups which have followed the implementation of the Pinelands Plan throughout the entire Protection Area have also expressed growing concern about the lack of a system of monitoring and enforcement. Indeed, enforcement of regulatory programs at all levels of government needs improvement. Local citizen organizations can provide the stimulus and resources for improved enforcement activities. Citizen organizations have been effective in this regard in the Passaic River Basin in northern New Jersey and along the coast in Ocean County.

2. New development should be restricted in existing areas of undeveloped forest and the overall amount of development in the Watershed should be limited.

Existing residential zoning should be changed, where necessary, to provide a level of protection which meets or exceeds the requirements of the present Pinelands Plan Forest Area designation in all areas which are currently undeveloped forest. The greatest amount of land within the Watershed which is presently undeveloped and not protected under Pinelands-Forest requirements lies in the City of Vineland, to the west of Union Road (outside the Pinelands Protection Area), and in Buena Vista Township (within the Pinelands Protection Area).
As described in the previous section of this report, the pristine character of the Manumuskin could be degraded by even low levels of development extending throughout the Watershed. Thus, even in areas which are or may in the future be designated as Pinelands-Forest (or a similar designation outside the Pinelands Protection Area), it is recommended that appropriate mechanisms be provided to promote infill and expansion of existing developed areas and clustering of development in undeveloped areas, rather than uniform low-density development throughout undeveloped forest areas. It is especially important that no new road improvements be initiated which open rural lands for development. In addition to regulatory means to accomplish this purpose, private conservation organizations are uniquely suited to promoting this goal through limited development projects. A detailed analysis and recommended amendments to local zoning follows this section.

3. Acquisition of a large core preserve area within the Manumuskin Watershed should be given the highest priority, together with acquisition and/or protection of selected critical habitats which lie outside the core preserve area.

Protection of the Watershed's resources will be best secured by the acquisition of significant amounts of land by both public and private agencies to establish a large core preserve area spanning both sides of the river.

The following acquisition guidelines are recommended:

a. Acquisition efforts should focus initially on expanding the Peaslee Wildlife Management Area in a westerly direction.

b. Efforts should be made to acquire entire tributary basins.

c. Critical habitats for rare species should be acquired. In particular, this should include an expansion of The Nature Conservancy's Project Area in the southern portion of the Watershed.

Current acquisition efforts in the Watershed are in concert with these recommendations. The Green Acres Program, Office of State Land Acquisition, has recommended expanding Peaslee Wildlife Management Area to the west and has targeted an area which includes most of the land south of Mays Landing Road and north of Route 49, which lies between the Manumuskin River and the Pinelands Protection Area boundary (Union Road). Preliminary acquisition recommendations by the Pinelands Commission include approximately the same area delineated by Green Acres, as well as additional property to the north

between Mays Landing Road in the City of Vineland and Waldeck Road in Buena Vista Township.Virtually all of this property comprises large undeveloped tracts.

In addition to the land under consideration by the state, it is recommended that additional acquisition of adjacent properties to the west of Union Road in Vineland be accomplished. The purpose would be to extend protection to the Watershed boundary to encompass nearly the entire watershed of the Bear's Head Branch. The area includes portions of three large properties and minor acreage in small parcels.

This acreage includes several rare vernal ponds and extensive critical habitats. It is important to alert the state to the significance of these lands which lie outside the Protection Area boundary, so that acquisition options can be pursued. In addition, it especially important to interest private conservation groups, such as the Philadelphia Conservationists, The Nature Conservancy, and the New Jersey Conservation Foundation. These properties are presently subject to limited development pressure, largely because there is land still available closer to Vineland served by city water and sewer. Although the city is expecting minimal growth south of Mays Landing Road, development pressure is likely to increase with the completion of Route 55 and the continued expansion of the casino impact area. These properties are not protected by Pinelands jurisdiction and current zoning would permit single-family housing on 40,000-square-foot lots. Such development poses significant negative impacts on the Watershed's resources.

Some of the most significant natural habitats in the Watershed lie in the southern portion of the drainage basin and are not easily incorporated in an expansion of the Peaslee Wildlife Management Area. The most critical is the immediate habitat of the Sensitive Joint Vetch, the largest and most viable population left in the world, which grows on the banks of the Manumuskin south of Route 49. The Nature Conservancy has acquired two properties, totalling less than 50 acres, and has established a preserve to protect the Sensitive Joint Vetch. The Nature Conservancy also has a voluntary management agreement and a conservation easement on two other parcels.

Additional acquisition is recommended. The entire lowland and immediately adjacent uplands along the Manumuskin support critical habitat. Acquisition by private interests can be especially valuable where adequate habitat protection may require restricted access and habitat management to favor selected species. Where acquisition is not feasible, every effort should be made to work out management agreements or conservation easements or other less-than-fee agreements to protect critical resources. A discussion of specific land acquisition priorities is found in the "Land Acquisition Recommendations" Section.

Federal funds for Pinelands acquisitions have been exhausted. A bill sponsored by New Jersey Senator Bill Bradley, which recently passed the U.S. Senate, would provide $21 million for Pinelands acquisitions, and specifically designates land in the Manumuskin Watershed.

Acquisition of key parcels which lie outside the Pinelands Protection Area will require an innovative and coordinated approach among private conservation

organizations and the state, since federal Pinelands acquisition funding will not be available for these areas.

Other potential sources of funds for land acquisition include the state's proposed Coastal Wetlands Mitigation Bank, the Freshwater Wetlands Mitigation Bank created under recent state legislation, the National Estuarine Sanctuary Program and the Stewart Trust.

4. The Upper Manumuskin should be added to the National Park Service's current study to determine the eligibility of portions of the Maurice River, Manumuskin River and Menantico Creek for inclusion in the National Wild and Scenic Rivers System.

Effective protection of any portion of the Manumuskin Watershed requires that the basin be treated as a whole. The exceptional natural resources of this basin are widely distributed in the undeveloped forest areas and are not confined to or concentrated in the southern Watershed. Of the five globally rare plants known to be extant in the Watershed, three occur in areas north of Route 49, the present limit of the study area on the Manumuskin. All four species of reptiles and amphibians considered to be threatened or endangered in New Jersey occur in the upper Watershed. Leslie Ficcaglia, a local resident and vice chairman of the Maurice River Township Planning Board, has formally nominated the entire Manumuskin Watershed for inclusion in the study area of the current Wild and Scenic Rivers project in a letter dated 10 November 1987 to Evelyn Swimmer, National Park Service.

Note: As this report goes to final publication in June 1988 this recommendation has been implemented. The Upper Manumuskin has been added to the National Park Service's study, thereby including the entire Manumuskin Watershed in that study.

5. The role of Cumberland County government in inter-governmental coordination for the protection of natural and cultural resources should be strengthened.

County government functions essentially as an advisory and coordinating agency, not as a regulatory body. The county provides support for local agencies and generally has excellent relationships with the municipalities and citizen groups. It was frequently noted in the interviews that Cumberland County "really came through" in the hazardous waste facility siting review and strongly pushed the idea that this was a regionally important issue. The county was also instrumental in influencing adjacent municipalities to join in support of Maurice River Township in this effort and could foster future cooperative efforts.

In response to the growing threat of illegal dumping, the county is initiating a countywide pollution watch effort. Cumberland County also plays a strong role in the management of local agriculture through the Cumberland County Agricultural Board and the Agriculture Development Board.

Ways in which the county could expand its role in promoting conservation and appropriate development in the Watershed include:

a. convening a broadly based task force to direct implementation of this Conservation Plan;
b. insuring that the unique resources of the basin are considered in state and federal plans, policies, and actions; and
c. using its development review powers with respect to county roads and drainage structures to the maximum extent possible in promoting environmentally appropriate development (e.g., effective stormwater management).

6. Intergovernmental agreements should be negotiated which recognize and protect the unique resources of the Manumuskin Watershed.

The Manumuskin Watershed comprises parts of four municipalities and two counties, and is partially under the jurisdiction of the Pinelands Commission as well as CAFRA. The effectiveness of a Conservation Plan will be greatly enhanced if a level of consensus and cooperation can be reached among these various public agencies. It is recommended initially that an intergovernmental agreement be sought among the municipalities which recognizes the need to protect the unique resources of the Manumuskin Watershed and supports a spirit of cooperation at the municipal level in this Watershed-wide effort. Recently, Millville, Vineland, and Cumberland County provided regional support to Maurice River Township's opposition to the siting of the proposed hazardous waste facility. The Cumberland County Environmental Task Force is currently attempting to assist in coordinating these local efforts at a region-wide scale. Another area of successful intermunicipal cooperation is the Joint Enterprise Zone for economic development between Millville and Vineland, which each town's mayor alternately chairs. The project has exceeded its expectations and while not specifically environmental, underscores the potential of such shared efforts.

A similar committee or task force representing citizen groups, local businesses, and municipal, state, and federal agencies could direct implementation of the Conservation Plan.

7. Existing industrial sites should be monitored, and negotiations initiated, to protect critical habitats through management agreements, conservation easements, reclamation planning, or options to buy.

Sand mining has long been a land use in the region. The sand and gravel business is recovering from a severe economic slump and there are no active extractions ongoing today, although sand is being sold from existing stockpiles. Long-term growth is likely to be confined to the expansion of existing facilities.

In the Manumuskin Watershed the largest sand mining operation has occurred on property owned by New Jersey Silica Sand and its parent corporation, the Warner Company. Their holdings include 3,300 acres in Maurice River Township, of which 2,400 acres are located in the Watershed. The recent rezoning of this land from M-3 to "Conservation" prohibits the establishment of new mining activities in this area. As a non-conforming use any mining activities which New Jersey Silica Sand may seek to undertake in this area in the future will be limited, and ultimately phased out. New Jersey Silica and Warner have filed suit challenging the recent zoning change, the outcome of

which is yet to be determined. The New Jersey Silica site supports extensive critical habitats which should be acquired if possible.

With respect to all mining sites in the Watershed, habitats and cultural sites must be delineated and additional monitoring undertaken to ensure long-term protection of special resources through a variety of measures including easements. Mining is a transitional use, and at present there is no comprehensive regulatory process outside the Pinelands which ensures adequate reclamation of mined sites. Reclamation requirements should always be imposed as part of any mining operation approval. However, reclamation is often difficult, due to conversion of habitat from terrestrial to aquatic. The future use of the extensive tracts of land held by mining concerns is an important question that should be addressed at the municipal and state levels.

The Atlantic City Electric Company owns 1,700 acres of land -- nearly all of which is in the City of Millville and one-third of which is in the Manumuskin basin -- which was proposed for a coal-fired power plant. The project is currently on hold until the demand for electricity warrants. However, this is still considered a prime site for a future facility. This facility could have a major impact upon air and water quality when constructed, by which time it is anticipated that technologies will have changed. A fluidized-bed boiler, for example, could eliminate the need for scrubbers, and hence sludge as a site disposal problem. No activity, except spraying for gypsy moth in cooperation with the City of Millville, is currently proposed for the site. Any future forestry activity or proposed removals should be reviewed with conservation organizations, such as the Citizens United to Protect the Maurice River and Its Tributaries, to establish appropriate performance standards. In the meantime, additional monitoring should be undertaken to identify and delineate special resources. It is clear that the company's powerline rights-of-way harbor a number of rare plants and animals, some of which are concentrated at the eastern edge of the property and are fostered by the current management practices. Additional opportunities for habitat and cultural site protection should be pursued.

8. Maintenance of water quality is critical to protecting the natural resources of the Manumuskin Watershed.

A major impetus for restricting development in the Watershed stems from the effort to protect the basin's exceptional water quality. Expansion of Peaslee Wildlife Management Area and acquisition of the core preserve area will provide a substantial level of protection. However, any activity which degrades water quality anywhere in the Watershed has the potential to adversely affect the basin's natural resources. Regulatory protection measures have been strengthened in recent years, especially for wetlands. In addition to the Pinelands Comprehensive Management Plan, several programs administered by the state Department of Environmental Protection's Division of Coastal Resources control certain types of development within the region. These include CAFRA, the Waterfront Development Act, and the Wetlands Act of 1970. The recently enacted Freshwater Wetlands Act will apply to all wetlands in the basin which are outside the Pinelands Protection Area when it goes into effect in July 1988.

A basin-wide program to monitor pH should be initiated to determine appropriate management practices and guidelines for the use of septic tanks and

the application of lime, fertilizer and pesticides in both agricultural and developed areas which are consistent with maintaining or improving existing water quality in the basin. It has been documented that changes in pH and nitrogen can alter plant and animal communities and cause degradation of water quality over time. Protection of water quality should be provided by maintaining forest cover and buffer zones between wetlands and development or agriculture. No lime or fertilizer should be applied in wetland buffer zone areas. There should be no bulkheading or riprap along stream courses. If stabilization is required, the streambanks should be reinforced with plantings of native vegetation.

One of the state's requirements for sludge-farming operations is maintenance of soil pH at a minimum of 6.5. The Manumuskin Watershed ecosystem, which depends upon a much lower soil pH range, would be threatened by an increase in pH to 6.5 or greater. Therefore, sludge-farming should not be permitted in the Watershed.

9. The conservation of the basin's natural resources requires the maintenance of water-table levels and the natural hydrologic regimen.

Alteration of the natural hydrologic regimen would have serious adverse impacts on natural plant and animal communities. Removal of groundwater for consumption outside the Watershed or excessive pumping within the Watershed would decrease streamflow, lower the water table, and adversely affect surface water quality. In 1984, the Pinelands Commission concluded that exporting even minor quantities of groundwater from the Cohansey Formation could have significant impact on ecological resources. George Nieswand, Director of the New Jersey Agricultural Experiment Station and a member of the Technical Advisory Committee which evaluated the ecological implications of exporting water from the Cohansey Aquifer, noted: "It will not be the last million gallons of water from the Pinelands that will do irreparable harm, but, rather, the precedent set by exporting the first million, though the impact of the first million may go unnoticed."

Existing groundwater withdrawals should be monitored, including the quantity of groundwater being withdrawn from storage for irrigation and domestic use. No out-of-basin transfers should be permitted from the Manumuskin Watershed which would effect even a nominal change in water-table elevations. On-site retention and recharge of stormwater runoff in both developed and agricultural areas should be enforced. These efforts should be coordinated with the state Office of Water Policy and the State Water Supply Master Plan. The U.S. Geological Survey should be encouraged to resume water-quality monitoring at the Frie's Mill station on the main stem of the river to provide vital information on the Watershed's hydrology which is essential to effective protection efforts. Additional information is also needed on the condition of the Cumberland Pond Dam.

Drainage and channelization projects by public bodies, such as mosquito commissions and county or city engineering offices, often have negative impacts on natural resources and currently represent a gap in regulatory protection. These projects provide no benefit to the protection of water quality or habitat in the basin and should be discouraged.

B. COORDINATION OF RESOURCE MANAGEMENT THROUGHOUT THE WATERSHED

1. All agencies with an interest in land management in the Watershed should form a group that would meet on a regular basis to share information and to coordinate management strategies.

As the level of funding for land management activities shrinks in relation to the need for such activities, it is increasingly important to use available resources effectively. An interagency group which would meet on a quarterly or semi-annual basis would help to increase the perception of the Watershed as an ecological unit. In addition, it would help to avoid conflicting management strategies and aid resource management professionals through the sharing of information and experience.

2. The role of fire in managing the Watershed's forest communities should be coordinated among resource agencies.

Additional research and information on the history of fire locally is needed in order to develop a fire management plan for the public open space, especially for the Peaslee Wildlife Management Area. Private organizations which own open space locally should also participate in this planning effort. Guidelines for prescribed burning would include a burning schedule modelled on the natural occurrence of fire insofar as is feasible, while reducing potential fire hazards. Prescribed burning should also be undertaken where it can be used to encourage selected species, especially those rare and endangered species which favor successional and/or recently burned landscapes. Participating agencies should include the state Bureau of Forest Management, the Pinelands Commission, the Endangered and Nongame Species Program, the Natural Heritage Program, as well as the U.S. Forest Service, Rutgers Pinelands Program, The Nature Conservancy and municipal agencies.

3. Forestry operations within the Watershed should be adequately controlled to foster the best current management practices for Pinelands habitats.

Forestry has been an important historic land use, though there are no active cutting operations today. The most recent logging occurred during the oil crisis in the 1970s and was primarily for fuelwood. Virtually all the forest in the Watershed has been cut over several times and this has had considerable influence on the current landscape character. Uncontrolled fuelwood cutting and further logging of cedar, however, could negatively affect critical habitats. The Pinelands Comprehensive Management Plan includes forestry standards which should be applied throughout the Watershed. Maurice River Township also has a sustained harvest tree ordinance which attempts to balance cutting with forest regeneration and to eliminate clearcutting. However, there is no local ordinance pertaining to forestry uses outside the Pinelands in the other municipalities.

No further cutting of cedar should be permitted until it can be demonstrated that cedar can be successfully reestablished and sustained over time, and funding provided for requisite habitat management. If appropriately managed, continued forestry could provide an opportunity for maintaining successional habitats.

Participating agencies should include those listed in the previous recommendation.

4. Recreational use is appropriate throughout most of the Watershed; however, some activities, such as off-trail vehicle use, require adequate controls to prevent disturbance of sensitive habitats.

There is at present a permit program administered by the Bureau of Forest Management and the Pinelands Commission for enduro and road-race activities which involve the use of any portion of state land. The Pinelands Commission is currently reviewing an application which includes a portion of the Peaslee Wildlife Management Area. In general, routes are confined to sand roads and firebreaks and can be altered to accommodate critical habitat needs. Casual recreational use is more difficult to control; however, it is important to protect special resources from inappropriate disturbance. Atlantic Electric, for example, has been contacted regarding off-trail vehicular use on a portion of its site which is a habitat for rare snakes. Continued negotiations with off-trail vehicle groups is required to encourage the use of appropriate sites and permitting procedures. Monitoring is also important to ensure that no unacceptable habitat disturbance occurs. In some critical habitats, a caretaker or resident manager may be advisable to provide adequate protection and may include leasing a portion of the property for use in return for monitoring.

C. FURTHER RESEARCH NEEDS

1. Additional monitoring for rare and endangered plants and animals should be undertaken in the Watershed.

One of the most significant characteristics of the Manumuskin Watershed is the occurrence of rare and endangered species. Only limited field survey work could be undertaken during this project, and several species likely to occur could not be verified during the summer season. Additional biological survey work is particularly needed for invertebrates. It is quite likely that several globally rare species may be present in the basin. The value of the Watershed to conserving a broad diversity of species is probably greater than is as yet verified.

At present, the strongest rationale for opposing large-scale development and large facility siting in the area appears to be the presence of rare and endangered species. This was the basis of the DEP's response to the Hazardous Waste Facilities Siting Commission, recommending the elimination of the Maurice River Township site from consideration. The presence of rare and endangered species should be considered in reviewing all proposed future habitat alterations, to eliminate or reduce impacts.

Well-documented information is an essential component of the effort to protect these resources from land uses which would degrade critical habitats. The monitoring of survey work should be coordinated with the state's Natural Heritage Program as well as the state's Endangered and Nongame Species Program. This data should also be useful for determining revisions to the current status lists which have not been significantly altered since their inception.

2. The recommendations included in several reports recently submitted by Herpetological Associates to the County of Cumberland, concerning fish and bird resources of the Manumuskin Watershed, are in accordance with the Conservation Plan and deserve to be implemented.

These recommendations are reproduced in the Appendix. A recommendation which deserves particular attention calls for systematic study by the U.S. Fish and Wildlife Service of the Maurice and Manumuskin Watersheds, with the idea that portions of these Watersheds might warrant designation as a National Wildlife Refuge.

3. A program for the identification and protection of important cultural resources should be developed.

Current protection of cultural resources is provided under the Pinelands Comprehensive Management Plan and CAFRA. However, there are significant cultural resources located outside these boundaries. There is, in general, a lack of community awareness of local history, and a paucity of scholarly archaeological and historical research and documentation. The basin should be studied as a whole, not simply on a site-by-site basis, as provided for in the CAFRA and Pinelands application processes. There are also opportunities beyond the regulatory process, including restrictions of access, cultural easements, historic districts, and management easements, which should be

explored. In order to develop an effective cultural resource protection program, the project should include a fairly extensive cultural resource survey to verify and delineate known sites and identify new ones. R. Alan Mounier is the current authority on both the prehistoric and historic resources of the basin.

4. The completion of Route 55 should be the focus of special efforts to minimize potential adverse impacts and to ensure adequate consideration of the Watershed's natural and cultural resources in the planning process.

This four-lane, limited-access highway connecting Port Elizabeth at the southern end of the basin with the Philadelphia-Camden metropolitan area is expected to be completed within a few years. Pressure is also growing to extend this corridor southeast to the Atlantic Coast, which would necessitate construction across the lower drainage basin and possibly through Port Elizabeth, traversing critical natural habitats and significant cultural resources. Every effort should be made to survey and delineate special resources to ensure disturbance is minimized. The current Wild and Scenic Rivers Study could develop important data for this area of the Watershed. It is also likely that development pressure will increase significantly upon completion of this highway, underscoring the need to implement the Conservation Plan in a timely fashion.

II. ZONING ANALYSIS AND RECOMMENDATIONS

The following is an analysis of local zoning provisions as they relate to our conservation strategy, which is as follows:

1. Limit the overall amount of development in the Watershed, and
2. Preserve as much undeveloped forest area as possible.

For a more thorough discussion of each town's zoning and development ordinances, see the Appendix. Also, see Zoning Map on page 29.

Maurice River Township

Maurice River was one of the first towns to bring its zoning and development ordinances into conformance with the Pinelands Plan. In the portions of Maurice River located in the Manumuskin Watershed, existing zoning provisions are generally in concert with our conservation strategy.

One area which may warrant further consideration by Maurice River is the R-5 Milmay area. Although several roads penetrate it, the R-5 area is primarily undeveloped forest. From a conservation standpoint it would be ideal to change the designation of this area to "Limited Growth." We recognize that this may be difficult based upon other factors. However, opportunities may exist to amend zoning provisions in this area to decrease the area of forest disturbance, while maintaining the proposed number of housing units.

The recent rezoning of the area in the Manumuskin Watershed which was formerly designated as M-3 to "Conservation" is in direct conformance with our conservation strategy. Lying directly adjacent to the Manumuskin River, this area contains expansive wetlands and numerous rare plant and animal stations. The rezoning is currently being challenged in the State Superior Court by the major landowner in this area, N.J. Silica Sand, and its parent corporation, the Warner Company. It is too early in the process to predict the outcome of this litigation.

Millville

The zoning designation of "Land Conservation," which would permit residential development at a density of 1 dwelling unit (du)/2 acres in Millville's portion of the Watershed, is inconsistent with both elements of our conservation strategy - limiting both forest disturbance and development density throughout the Watershed. It would allow for construction of over 200 housing units and related roads and other infrastructure in an area that is currently undeveloped. However, the threat that this area will be developed for residential use in the near future is low, considering that Atlantic Electric owns most of this area as part of a larger tract, which it is holding for potential future development of a generating station. In the interim, this area should be rezoned to permit residential development only at low density.

Vineland

In the portion of Vineland subject to the Pinelands Plan, zoning is generally consistent with our conservation strategy. However, development of the "Pinelands-Rural Development" (P-R) zone, at a residential density of one unit per 5 acres, near the intersection of Mays Landing Road and Union Road could result in significant disturbance of undeveloped forest in close proximity to the Manumuskin River. Options for this area include changing its designation to "Pinelands-Forest" (P-F) or reducing its size substantially to provide a larger buffer of P-F between it and the river.

The other area in the Pinelands portion of Vineland which warrants reconsideration is the "Pinelands-Agriculture" (P-A) zone adjacent to the river and bordering Buena Vista Township. Currently undeveloped forest and without road frontage, this area is surrounded on three sides by P-F zoning. In addition, if the current Pinelands Commission conformance proposal to Buena Vista Township (discussed below) is adopted, this area will be totally surrounded by "Pinelands Forest" designation. It seems only logical to amend the designation of this area to P-F.

The zoning designations in the portion of Vineland which is outside the Pinelands area represent the greatest threats to the integrity of the Watershed. Taken together these designations would permit the development of thousands of residential units on 40,000-square-foot lots. Furthermore, in the area zoned "Woodland" (W) nearly 2,000 acres of undeveloped forest would be substantially disturbed. This area contains the headwaters of the pristine Bear's Head Branch, numerous vernal ponds and a high concentration of rare plants and animals. From a conservation perspective it would be ideal to change the "Woodland" designation to require residential development densities comparable to "Pinelands-Forest" and the "Agriculture" designation to require residential development densities comparable to "Pinelands-Agriculture." In general, any reduction in overall density and clustering of future development away from areas of highest environmental sensitivity would be desirable.

Buena Vista

A majority of the land in the Buena Vista portion of the Watershed is undeveloped forest. Therefore, the existing designation of nearly all of this area as "Agricultural Production" is clearly inappropriate. The increase in the area designated as "Forest Area" under the current Pinelands Commission proposal to Buena Vista (contained in the Appendix) is in conformance with our conservation strategy. The "Rural Development" designation in the area of East Vineland appears to be a reasonable expansion of an existing developed area.

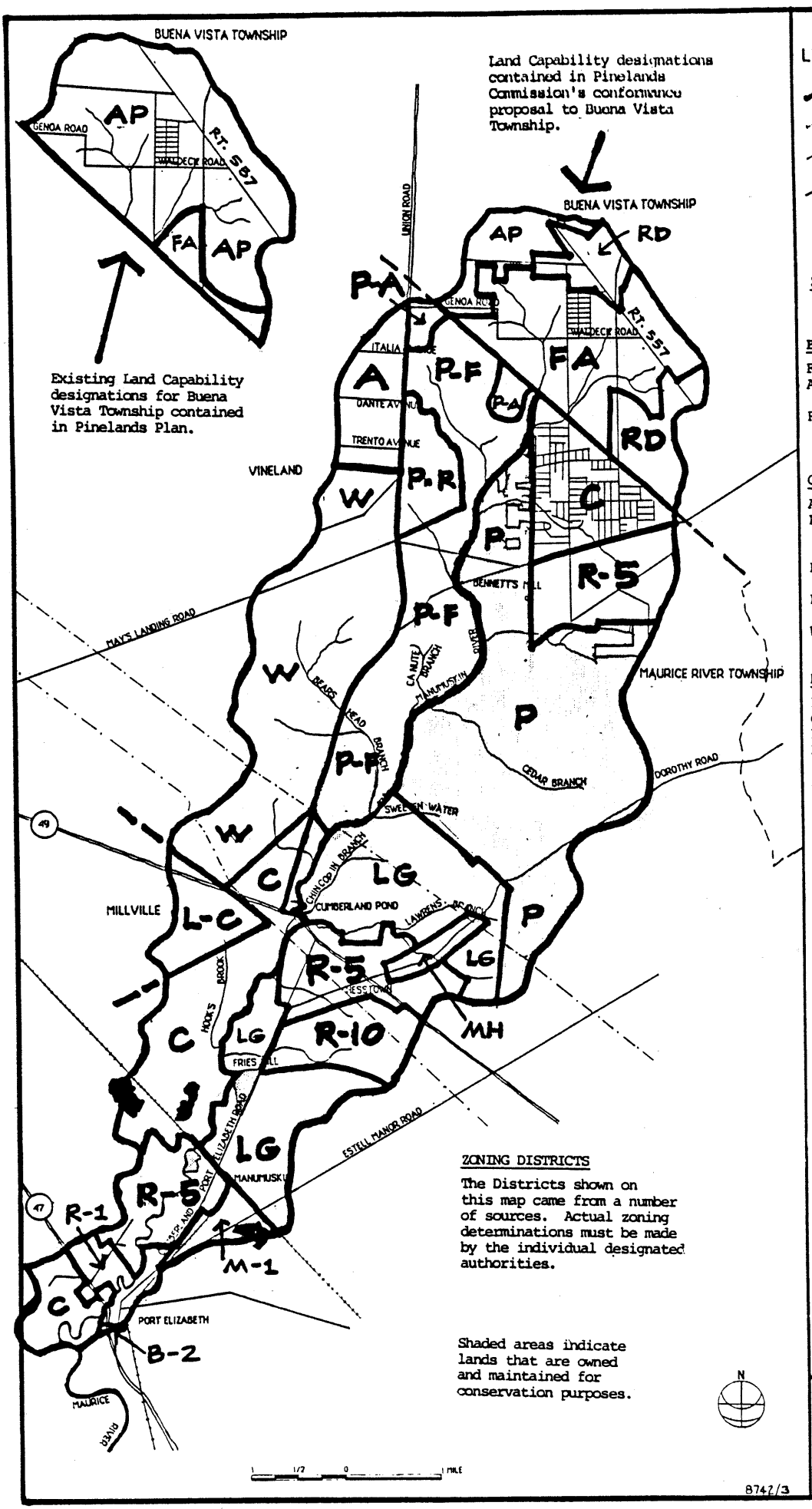
The proposed "Rural Development" designation near Milmay would create an area of new development in what is currently relatively undeveloped forest. Although the Pinelands Commission proposal seeks to limit the impact of development by requiring minimum 5-acre lots in most of this area, and would otherwise permit only "Forest Area" uses, it is still inconsistent with our conservation strategy concerning preservation of undisturbed forest. This area, together with the proposed East Vineland "Rural Development" area, is in close proximity to the Maurice River Township, Milmay R-5 area and the Vineland "Rural Development" area along Union Road. The cumulative impact of concentrating four areas of residential development in the upper reaches of the

Watershed could result in significant reductions in habitat and water quality. It would be far more preferable, in terms of preservation of Manumuskin Watershed resources, to amend this proposed "Rural Development" area by changing the portion of it lying in the Manumuskin Watershed to "Forest Area," and permitting increased density in the area outside the Watershed, if necessary.

The table on the following page lists specific recommended zoning changes giving "Preferred Options" and "Other Options" in descending order of desirability in relation to our conservation strategy.

TABLE 1 - RECOMMENDED ZONING AMENDMENTS

TOWN	EXISTING ZONING	RECOMMENDED ZONING	
		PREFERRED OPTION	OTHER OPTIONS
Maurice River Twp.	Milmay R-5 zone	1. Change the portion of this area within the Manumuskin Watershed to "Limited Growth"; permitting increased density and/or area of this zone outside watershed, if necessary to maintain the currently allowable total number of units.	2. Reduce the area of this zone by creating a buffer area of "Limited Growth" designation adjacent to Peaselee Wildlife Management Area; Maintain the currently allowable total number of units, if necessary, as described in the preferred option 3. Same as Option #2, but, as an additional means of maintaining the currently allowable total number of units raise the permitted density in the portion of this area within the Watershed which remains as R-5 from ldu/5 acres to ldu/3.2 acres.
Millville	"Land Conservation" zone ldu/2 acres	1. Change to permit residential development at a density in the range of ldu/20-25 acres.	2. Maintain existing zoning along Route 49 frontage, lower permitted residential density to ldu/25 acres elsewhere.
Vineland	"Pinelands-Rural Development" zone on Union Road	1. Change to "Pinelands-Forest"	2. Reduce this area substantially, and expand the adjacent "Pinelands-Forest" area to provide a larger buffer along the Manumuskin River.
	"Pinelands-Agriculture" zone adjacent to the Manumuskin River	1. Change to "Pinelands-Forest"	
	Woodland Zone	1. Change to require residential development densities comparable to "Pinelands-Forest."	2. Implement preferred option in the area south of Mays Landing Road, and lower allowable residential density to ldu/10 acres north of Mays Landing Road. 3. Lower allowable residential density to ldu/10 acres throughout the entire zone, establishing higher densities north of Mays Landing Road (e.g. ldu/5 acres) and lower densities (e.g. ldu/15 acres) to the south. Using these provisions as the basic zoning for this area, create a voluntary transfer of development rights option that would allow landowners north of Mays Landing Road to purchase development "rights" from those south of Mays Landing Road, to create residential densities of ldu/2-3 acres to the north and ldu/25 acres to the south. 4. Delete the transfer of development rights option from #3 above. 5. Lower the allowable residential density to ldu/10 acres, without provision for internal density modifications.
	Agriculture Zone	1. Change to require residential development densities comparable to "Pinelands-Agriculture."	2. Change to require residential development densities of ldu/5 acres.
Buena Vista Township	Proposed "Rural Development" Zone near Milmay Note: This recommendation is based upon the Pinelands Commission's current conformance proposal to Buena Vista, and not on the existing Pinelands zoning in this area, which is considered to be generally inappropriate.	1. Change the portion of this proposed "Rural Development" area in the Manumuskin Watershed to "Forest Area"; permit increased density in the area outside the Watershed, if necessary, to maintain the currently proposed total number of units.	2. Reduce the size of this proposed "Rural Development" area in the Manumuskin Watershed, increasing the size of the proposed "Forest Area," to provide a larger buffer around the river's headwater wetlands; permit increased density in the area outside the Watershed, if necessary. 3. Same as option #2 above, but as an additional means of maintaining the currently proposed total number of units, raise the permitted density in the portion of this area within the Watershed which remains as "Rural Development" from ldu/5 acres to ldu/3.2 acres.



LEGEND

- WATERSHED BOUNDARY
- RAIL LINES
- POWER LINES
- MUNICIPAL BOUNDARIES

ZONING DISTRICTS

Buena Vista Township

- FA - Forest Area
- AP - Agricultural Production Area
- RD - Rural Development Area

City of Vineland

- A - Agriculture
- P-A - Pinelands Agricultural Production
- P-F - Pinelands Forest
- P-R - Pinelands Rural Development
- W - Woodland

Maurice River Twp.

- B-2 - Business
- C - Conservation
- L-G - Limited Growth
- M-1 - Resource Industrial
- M-3 - General Industrial
- R-1 - Residential
- R-5 - Residential

Millville

- L-C - Land Conservation

ZONING MAP

SIEMON, LARSEN, MATTLIN & PURDY
LANDUSE ATTORNEYS

HERPETOLOGICAL ASSOCIATES, INC.
ENVIRONMENTAL CONSULTANTS

ANDROPOGON ASSOCS., LTD.
ECOLOGICAL PLANNING AND DESIGN

CONSERVATION PLAN
MANUMUSKIN RIVER WATERSHED

NEW JERSEY CONSERVATION FOUNDATION

SEPTEMBER 1987

III. LAND ACQUISITION RECOMMENDATIONS

Only relatively large parcels were considered for acquisition, based on projected ease and cost of acquisition, and the fact that most of the critically important resource areas lie within large tracts. There are undoubtedly many smaller parcels worthy of acquisition, particularly in Buena Vista Township, that are not within the scope of this project.

Land acquisition priorities are based primarily upon the following two factors:

1. **Spatial and functional relationship to Peaslee Wildlife Management Area**

   This factor is important to the concept of providing a core preserve area, not subject to future development pressure, where unbroken habitat and pristine water quality can be maintained. It is also important from the standpoint of cost and ease of land management, which, in turn, relates directly to the state's potential level of interest in acquisition.

2. **Degree of threat to the site's natural resources based upon existing zoning and development potential**

Using the factors described above, a value of 1 to 10 was assigned for each factor related to the major areas within the Watershed, to arrive at a "Land Acquisition Priority Rating." Table 2 (see page 32) identifies the specific issues considered in determining the relative importance of each factor. The purpose of the table is to display the assumptions and biases that led to the acquisition priorities. We recognize that setting acquisition priorities is an inherently subjective process involving many factors unrelated to location or development threat. Decisions are frequently influenced by considerations of land cost and ease of acquisition.

Summary

The highest priority lands for acquisition are located on either side of Union Road between Mays Landing Road on the north and Route 49 on the south. Within this area lands to the west of Union road received the highest priority rating due to development threat, while those to the east are highly rated because of their relationship to Peaslee Wildlife Management Area. The acquisition area north of Mays Landing Road received the next highest rating based primarily on its relationship to Peaslee. The areas to the south of Route 49 received somewhat lower ratings, but their protection through acquisition or partial acquisition is still of great importance.

The total area recommended for acquisition is approximately 9,000 acres, divided nearly equally between Vineland and Maurice River Township. The parcels slated for acquisition lie generally outside the areas in which each town plans to accommodate future concentrations of population growth.

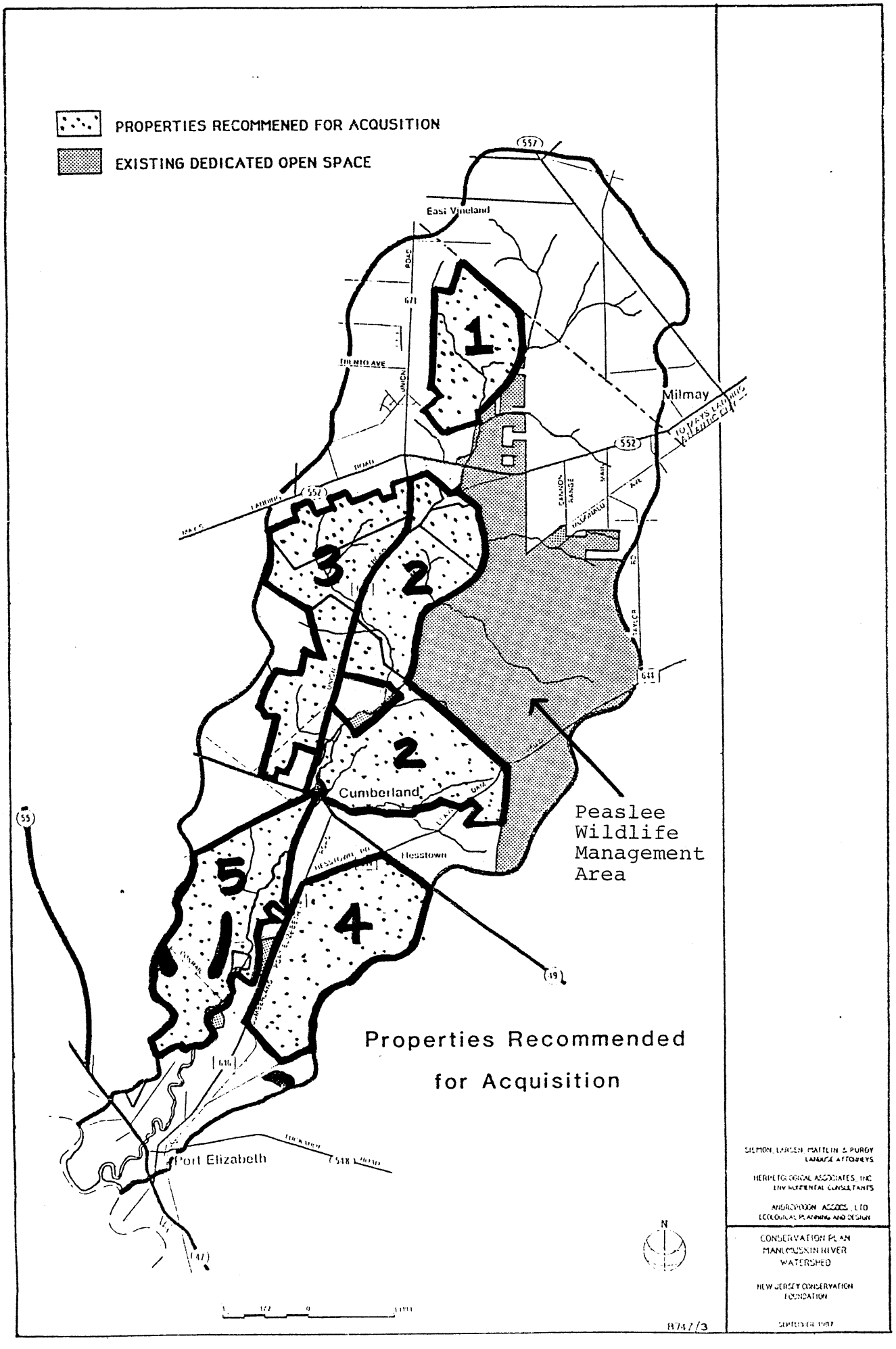
In December 1987, following release of our Draft Conservation Plan, the State of New Jersey, Green Acres Program and The Nature Conservancy purchased

approximately 4,000 of the 9,000 acres mentioned above (see notes in Table 2.) Therefore, as this report goes to final publication in June 1988, approximately 5,000 acres remain to be acquired, in order to implement these land acquisition recommendations.

TABLE 2

LAND ACQUISITION PRIORITY RATING

Land Parcel(s)	Spatial/Functional Relationship To Peaselee	Degree of Threat	Overall Acquisition Priority Rating
Area adjacent to Peaselee north of Mays Landing Road (Vineland) Area #1	6	3	9
	Area directly adjacent to the northern extension of Peaselee, contains most of a tributary watershed.	Much of the area zoned Pinelands Forest, but a significant portion zoned Pinelands-Rural Development	
Area south of Mays Landing Road and north of Rt. 49 east of Union Road to Peaselee (Vineland and Maurice River Twp.) Area #2	10	1	11
	Area directly adjacent to the core area of Peaslee, contains an entire small tributary watershed, the lower portion of the pristine Bear's Head Branch, and land on both sides of the Manumuskin southwest of Peaselee, including Cumberland Pond.	The entire area is zoned for very low density residential use in both Vineland and Maurice River Township.	
Area South of Mays Landing Road and north of Rt. 49 west of Union Road to watershed boundary (Vineland) Area #3	3	10	13
	Area approximately 3/4 of a mile west of Peaselee core area and across Union Road, contains the headwaters of the Bear's Head Branch, including many vernal ponds.	This entire area of unbroken forest is zoned to permit residential development at a density of 1du/40,000 sq.ft.	Note: Southern portion of this area purchased by The Nature Conservancy 12/87.
Area south of Rt.49 and north of Con-Rail, east of Cumberland-Port Elizabeth Rd. to watershed boundary (Maurice River Twp.) Area #4	2	5	7
	Area approximately one mile west of the southern extension of Peaselee, with the pristine upper Muskee Watershed lying in between.	Although the southern portion of this area is zoned for very low density residential, the northern portion would allow residential development at a density of 1du/10 acres.	Note: This area Purchased by the State Green Acres Program 12/87.
Area south of Rt. 49 and generally north of existing and proposed areas of residential development in Port Elizabeth west of Cumberland-Port Elizabeth Rd to the watershed boundary (Maurice River Twp.) Area #5	1	4	5
	Area approximately two miles west and across Cumberland-Port Elizabeth Road from the southern extension of Peaselee.	Although the zoning in Maurice River Twp. calls for very low residential development density, this zoning is the target of a legal suit, the outcome of which is yet to be determined. The 1du/2 acre residential zoning in Millville would pose a greater threat, were it not for Atlantic Electric's plans to hold virtually all of this ares for potential development far in the future.	


PROPERTIES RECOMMENED FOR ACQUSITION
EXISTING DEDICATED OPEN SPACE
East Vineland
Milmay
Cumberland
Hesstown
Port Elizabeth
Peaslee
Wildlife
Management
Area
Properties Recommended
for Acquisition
1
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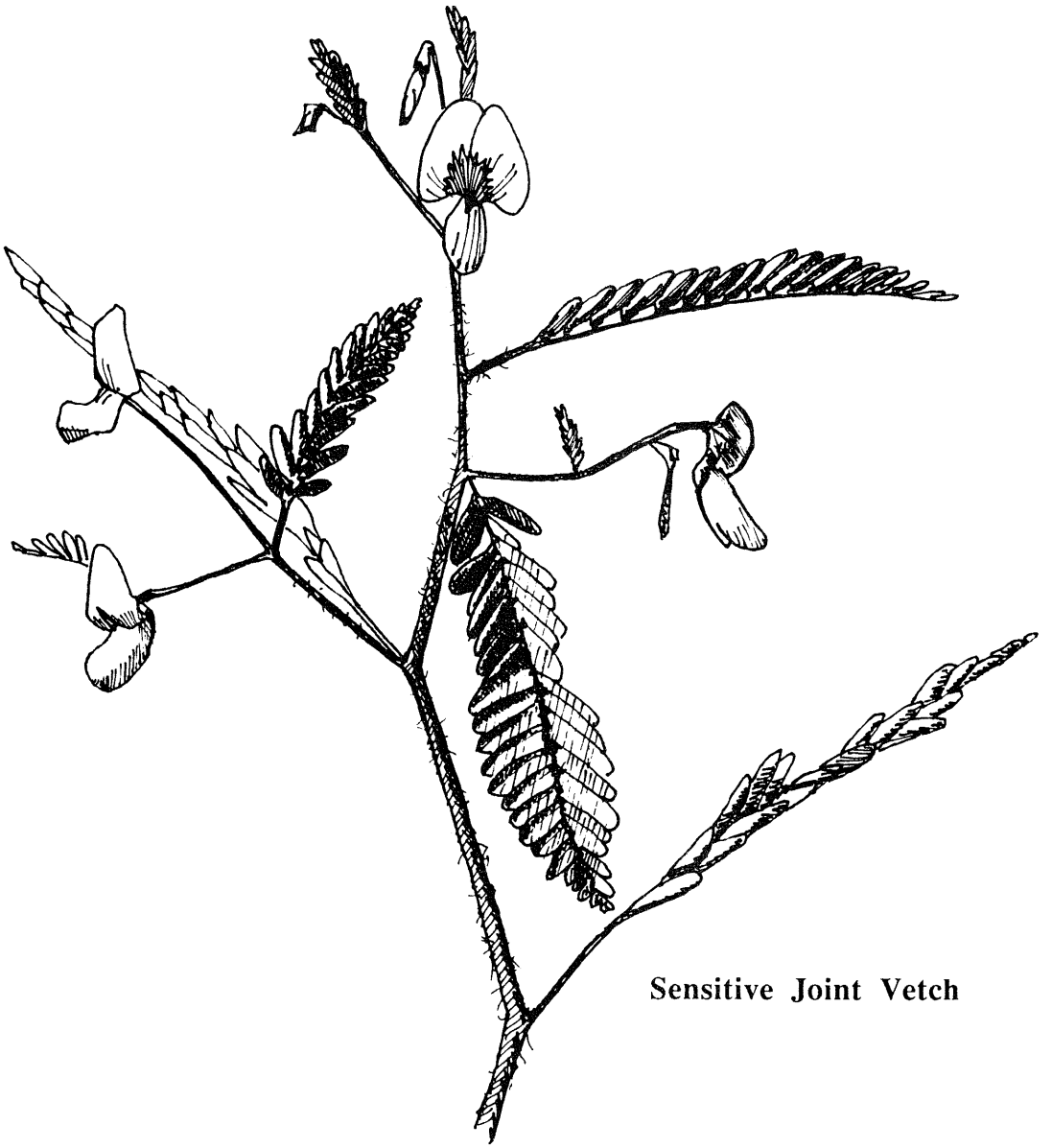

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NATURAL AND CULTURAL RESOURCE INVENTORY

A NATURAL AND CULTURAL RESOURCE INVENTORY OF THE MANUMUSKIN RIVER DRAINAGE BASIN

For the New Jersey Conservation Foundation

by

Herpetological Associates, Inc.

Author

Daniel O'Connor

Contributors

A. Gerry Moore--Rare Plants

Jean Jones--Historic Sites

Clay Sutton--Birds

September, 1987

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This report is a collaborative effort. In preparing it we have relied upon published and unpublished sources, knowledgeable local residents, and numerous individuals with specialized training and experience. Information from all of these sources was compiled and edited under the general direction of Daniel O'Connor, who wrote those sections of the report not otherwise identified by author.

Gerry Moore prepared the rare plant section of the report and provided much information about the vegetation of the drainage basin. The following people made rare plant records or other data available: David Snyder, Keith Seager, Ted Gordon, Cottie Cottrell, Alex Mathie, Gil Cavileer, Jim Stasz, Mike Barnett, Steve Heckscher, and Dick Stalter.

Clay Sutton wrote the bird report, relying heavily upon information obtained from local resident Bob Barber. A substantial amount of field assistance was provided by James Dowdell.

Fish sampling in the tidal portion of the Manumuskin was done by John O'Herron. In the non-tidal portion of the river the work was directed by Dr. Rudy Arndt, who received assistance in the field from Brett Bragin, Clay Sutton and James Dowdell.

Reptile and amphibian studies were performed under the direction of Robert Zappalorti, who was assisted in the field by Bob Barber, Bill Callahan and Peggy Vargas. William Garrison provided information on local sitings of rare species.

The mammal work was done by Bob Barber, who was ably assisted in specimen collection by his cat, Patches.

For much helpful information used in writing of the recreational report we would like to thank William Garrison.

The cultural resource inventory was prepared by Jean Jones. She received assistance from Everett Turner and Richard Jones. The most valuable of Mrs. Jones's informants were two distinguished local historians, Herbert Vanaman and Charles Sheppard Hartman. Others who generously shared their knowledge were: William Otto, Thomas Brown, Samuel DeRosa and James Bertonazzi.

Richard Jones made the acreage estimations using a planimeter. Salinity and pH determinations were made by Daniel O'Connor. Salinity samples were analyzed on a Guildline Autosal salinometer, and pH measurements were made in the field using a Corning pH meter. The report was typed by Lisa Ragone and Wilma Williams. Lisa Ragone also

provided research assistance on the agriculture and history sections of the report. The maps were prepared by Daniel O'Connor and Lisa Ragone.

Many other persons who have made contributions to this report are cited in the text and bibliography. We would like to acknowledge our deep indebtedness to all those who have advanced our knowledge of the natural and cultural resources of the Manumuskin drainage basin.

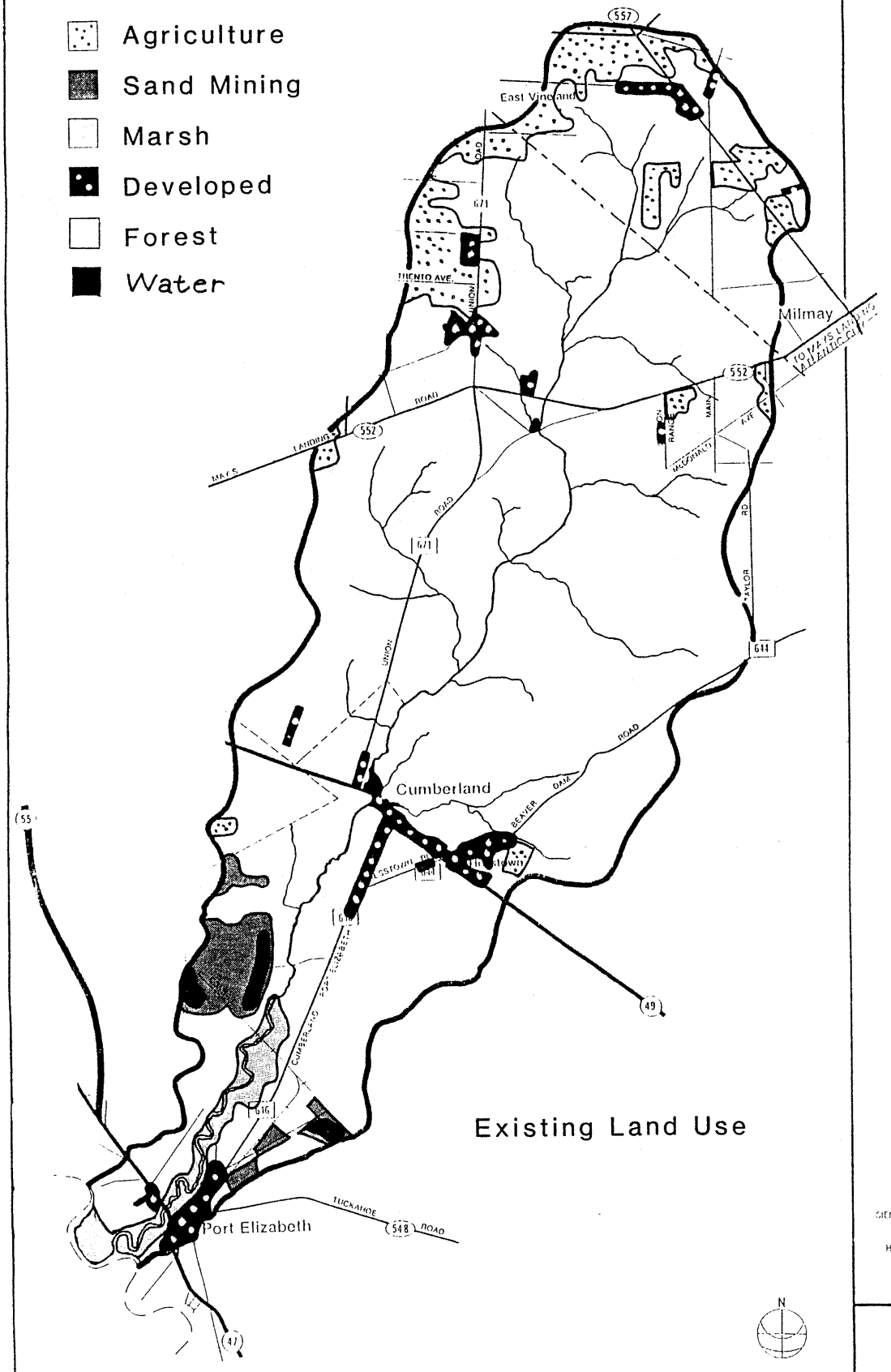
INTRODUCTION

From its headwaters in southwestern Atlantic County, New Jersey, the Manumuskin River flows in a southernly direction for a distance of 12.25 miles, emptying into the Maurice River near the town of Port Elizabeth in Cumberland County seven miles north of Delaware Bay. The River is 16.3 miles long if measured down the centerline of its channel.

The Manumuskin "drainage basin", the land area drained by the river and all of its tributary streams, encompasses 37.6 square miles. The outer boundary of the basin is the "divide" or line of highest elevation that surrounds the basin and separates it from adjacent river drainage areas. Within this border the basin has a maximum width of 4.5 miles and a length of 13.25 miles. Portions of four municipalities lie within the basin. In order of land area they are: Maurice River Township, 21.7 square miles; the City of Vineland, 10.6 square miles; Buena Vista Township, 4.6 square miles; and the City of Millville, 0.8 square miles. Buena Vista Township is in Atlantic County, and the remaining three municipalities are in Cumberland County.

Eighty-five percent of the drainage basin is forested and 2% is tidal marsh. Of the remaining land 8% has been cleared of the native vegetation for row-crop vegetable agriculture, 3% for surface mining of sand, gravel and clay, and 2% for residential development and other community uses (see Existing Land Use Map). Twenty-three percent of the basin has been classified as wetlands by the U.S. Fish and Wildlife Service (Tiner, 1985). The drainage basin is rural in character and has a population density of fewer than 100 persons per square mile. There are no sewage treatment plants or sewered areas, landfills or industrial dischargers within it. Seventy-three percent of the basin lies within the state Pinelands Protection Area boundary and an additional 2% is within the Coastal Zone as defined in the state CAFRA (Coastal Area Facilities Review Act) legislation. Eighteen percent of the basin is protected open space, most of it within the Peaslee Wildlife Management Area.

The Manumuskin drainage basin lies within the New Jersey Outer Coastal Plain, the Delaware Bay estuary system, and the Pine Barrens forest region. Maximum elevation along the northern drainage basin divide is 110 feet above mean sea level. The land surface slopes gently to the south, and the river becomes tidal at a point 3 miles upstream of its confluence with the Maurice River. The range between mean high and low tides is 4.6 feet at Port Elizabeth and 4.0 feet at the railroad bridge (Environmental Science and Engineering, 1981).



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MANUMUSKIN DRAINAGE BASIN ACREAGE ESTIMATIONS

	Acres	Square Miles	Percent Total
Land Use			
Developed	528	0.8	2.2
Sand Mining	620	1.0	2.6
Agriculture	1,882	2.9	7.8
Marsh	446	0.7	1.8
Forest	20,620	32.2	85.6
	24,096	37.6	
Municipalities			
Millville	486	0.8	2.0
Buena Vista Township	2,932	4.6	12.2
Vineland	6,758	10.5	28.0
Maurice River Township	13,920	21.7	57.8
	24,096	37.6	
State Land Use Jurisdiction			
Pinelands Prot. Area	17,517	27.4	72.7
CAFRA Coastal Area	402	0.6	1.7
	17,919	28.0	74.4
Unregulated	6,177	9.6	25.6
	24,096	37.6	
Wetlands			
Riverine	6	0.01	0.02
Lacustrine	208	0.3	0.9
Estuarine	446	0.7	1.8
Palustrine	4,870	7.6	20.2
	5,530	8.6	22.9
Protected Lands			
Peaslee Wildlife Man. Area	4,147	6.5	17.2
City of Vineland	228	0.4	1.0
Maurice River Township	35	0.05	0.1
The Nature Conservancy	39	0.06	0.2
	4,449	7.01	18.5

CLIMATE

The length of daylight in the basin ranges from 9.5 hours in January to 15 hours in June. About 60% of all days are clear and sunny (Robichaud, 1973). Winters are mild and the summers warm and humid. Mean monthly temperature at the Millville Airport (37 years of record) is 32° F in January, the coldest month, and 76° F in July, the warmest month (National Climatic Center, 1947-1984).

Prevailing winds at Millville are from the northwest. However, during the summer months (June-August) winds from the south and southwest predominate. The overall average wind speed is 8 miles per hour. Maximum wind speed is 13 miles per hour from the west-northwest in March-May. Periods of calm occur 12% of the time in the fall, September-November, but only 5% of the time during the spring, March-May (National Climatic Center, 1975).

GEOLOGY

The drainage basin is underlain by a 4,000-foot-thick plain formed over the course of the past 170-200 million years by the deposition of layers of sediment washed down from the Appalachian Mountain region. The plain has also been carved and shaped by the erosive action of water and wind. It is composed largely of sand and contains a number of aquifers (formations in which economically significant quantities of retrievable water are stored).

The most important geological formation underlying the drainage basin is the Cohansey Sand, which was deposited more than five million years ago. Although it is covered by a thin veneer of more recent sediments throughout much of the drainage basin, the Cohansey outcrops (occurs at the land surface) on the lower slopes of hills at elevations between 40 and 60 feet (Martens, 1956). Within the region of the drainage basin, the Cohansey is indistinguishable from the uppermost portion (Unit 4) of the underlying and older Kirkwood formation, which like the Cohansey is water-bearing; the two are known as the Cohansey-Kirkwood aquifer (Rooney, 1971). This aquifer has a maximum thickness of 180 feet and holds billions of gallons of water in storage beneath the drainage basin.

Overlying the Cohansey in upland areas above an elevation of 60 feet is the Bridgeton formation, composed chiefly of sand and gravel deposited within the past two million years. Although much of the formation has been removed by stream erosion, the part which remains reaches its maximum thickness of 20-30 feet as a capping over the Cohansey formation in the upland areas along the drainage basin divide. Material from the Bridgeton formation has also spread down hillsides forming a thin mantle over the Cohansey (Martens, 1956).

Blanketing the southern portion of the drainage basin below an elevation of 40 feet is the Cape May formation, which is composed of sand washed down from the Cohansey and Bridgeton formations and redeposited in the low-lying Manumuskin River Valley over 100,000 years ago. The formation also extends as far north as Bennetts Mill in a narrow terrace that is somewhat wider on the eastern side of the river (Salisbury and Knapp, 1917). The Cape May formation was laid down at a time when sea level was 25 feet higher than at present. After the ocean receded, remnants of sand bars and barrier beach dunes were left scattered over the surface of the lower drainage basin. These dry ridges of windblown sand remain today on both sides of the tidal portion of the river and along the east bank of the Maurice River north of the Manumuskin; several are delineated by the 20-foot or 30-foot contour lines on the Port Elizabeth U.S. Geological Survey topographic quadrangle. They largely account for the "roller coaster" effect

experienced in places as one drives along the Port Elizabeth-Cumberland Road.

Another interesting feature found in association with the Cape May formation is the oyster shell layer exposed on the east bluff of the Maurice River 0.75 miles west-northwest of the Route 47 bridge over the Manumuskin. Shells of a variety of sizes ranging down to very small individuals, as well as numerous examples of double valved (closed) shells have been found here, suggesting that the deposit is a buried oyster reef rather than a "midden" or shell refuse pile left by aboriginal peoples. Oysters presumably colonized the bottom at this location when sea level was higher than at present, probably over 100,000 years ago (Richards, 1966). Oysters of the same species, Crassostrea virginica, are found today in considerable numbers in underwater reefs extending from the mouth of the Maurice River upstream for several miles, but no populations are known to exist within 10 river miles of the shell deposit (Kunkle, 1987).

Lying on top of the Cape May formation in the tidal marsh and swamp floodplain of the river and its tributaries are deposits of peat mixed with silt and clay formed over the course of the past 18,000 years during the Holocene period. These materials are still being deposited; in the swamps they have a thickness of 3 feet or more, and in the tidal marsh of 6 to 10 feet (U.S. Soil Conservation Service, 1978).

Points of contact between the four surficial (appearing at the surface) formations can be seen at various places along the bluffs of the tidal Manumuskin and Maurice Rivers and in the sand and clay pits of the New Jersey Silica Sand Company.

A valuable sand deposit underlies much of the drainage basin, causing sand mining companies to be among the largest property owners in the region. Sand is the primary ingredient used in the manufacture of glass, and the production of glass containers is the most important industry in Cumberland County. About 25,000 bottles can be made from one ton of sand. In 1980, 2.8 million tons of sand were mined in Cumberland County, most of which was used for industrial rather than construction purposes (Bureau of Mines, 1980). About half of the industrial sand is made into glass and a large amount is used in casting metals ("foundry" sand); other applications include abrasives, filtration, oil drilling and the manufacture of ceramics and fiberglass.

It was not until about 1915 that extensive mining of sand began in the drainage basin. Prior to that time some glass sand was obtained from pits near the Maurice River north of its confluence with the Manumuskin (Bowen, 1885). The chief source of glass sand in the basin is the Cohansey formation. Its quartz sands are virtually entirely composed of the mineral silica, and are of medium to fine texture.

Most of the sand deposits lie below the water table. Removal of

the sand is accomplished by hydraulic pumps mounted on the decks of floating dredges. The sand moves in water pumped through pipes to the processing plant, where the sand is washed, sometimes further cleaned with solvents to remove impurities, separated into different grain sizes, and dried. The mining process results in the creation of lakes as much as 70 feet deep and more than 50 acres in extent. A thick clay lens is encountered at a depth of 70 feet below the land surface, and it has not proved cost-effective to penetrate it. The technology exists, however, to mine to depths as great as 200 feet (Regis, 1985).

Clay has also been mined commercially in the drainage basin. Clay used in lining the furnaces of the Eagle Glass-Works was apparently of local origin (Bowen, 1885), and clay has also been mined by the New Jersey Silica Sand Company for many years (Martens, 1956).

SOILS

Within the drainage basin soils are typically about five feet thick. Sixteen soil types have been identified and ordered into four groups (see Table) by the U.S. Soil Conservation Service (1978) on the basis of texture (the relative proportion of sand, silt and clay particles in the soil) and drainage class (the degree to which the soil was saturated by water during its development). This grouping helps to show soil relationships, which depend in part upon the common "parent material" or geological formation from which the soils derived. As Tedrow (1979) has pointed out, "every well-drained soil is associated with a gley," by which he means that particular upland and lowland soil types closely resemble each other in their physical properties and are consistently found adjacent to one another.

The soils with sand or loamy sand subsoil (Group 1) all have similar physical properties: low fertility, low organic matter content, rapid permeability and minimal ability to retain moisture. Most of the soils are 85% or more sand. Groups 2 and 3 have subsoils which contain a higher proportion of clay, which makes the soils more fertile, decreases their permeability and improves their moisture retention. Most of the farming in the basin is done on well-drained soils within this group, particularly Aura and Downer soils (U.S. Soil Conservation Service, 1978).

The soils in the Group 1 complex all reflect the high sand and low clay content of the Cape May formation, from which they appear to be derived. Of the soils in Group 2 and 3, it is probably safe to say that the Aura soil type is derived from the Bridgeton formation. According to Tedrow (1979), the Bridgeton contains considerable quantities of weathered, reddish clay in the matrix. Similarly, one of the main distinguishing features of the Aura soil type is its yellowish-red to red subsoil between the depths of 40 and 60 inches (U.S. Soil Conservation Service, 1978). The action of the atmosphere and rain water has carried the clay particles downward through the soil profile over time. Furthermore, Aura soils, like the Bridgeton formation, cap high points within the drainage basin. Other soils in Groups 2 and 3 may have their origins in either the Bridgeton or the Cohansey formations, or perhaps both, since these deposits blend together in places.

The Group 4 soils (Tidal Marsh and Muck) were deposited during the Holocene period, and are still being formed today in the floodplain of the river. Muck soils are made up primarily of decaying plant material --leaves, stems and roots--whereas Tidal Marsh contains a greater amount of silt and clay deposited during slack tides after high or low water. Prolonged flooding by water in these wet soils inhibits decomposition of the plant matter, resulting in its accumulation as peat over time.

Deposits rich in iron are an interesting feature of many soils in the drainage basin. In poorly drained soils, precipitated iron oxides sometimes impregnate sands, silt and gravels, forming a surface deposit known as bog iron that was smelted for iron in the early part of the nineteenth century (Crerar, 1981). In the upland soils, iron has moved downward into the subsoil and been incorporated into a hardened zone known as ironstone or sandstone. This material was commonly used locally in the nineteenth century in constructing foundations and chimneys (Tedrow, 1979).

All of the soils in the drainage basin are classified by the Soil Conservation Service as either very strongly acidic (pH 4.5-5.0) or extremely acidic (pH less than 4.5).

The nature of the soils influences vegetation. A slight increase in clay content in lowland soils, for example, seems to be a factor which makes it possible for Sweetgum (Liquidambar styraciflua), Tulip Poplar (Liriodendron tulipfera) and Beech (Fagus grandifolia) trees to become established (Haines, 1965).

SOIL SERIES ARRANGED ACCORDING TO SUBSOIL TEXTURE AND NATURAL DRAINAGE

Primary Subsoil Texture	Soil Series in Natural Drainage Classes				
	Excessively Drained	Well Drained	Moderately Drained	Poorly Drained	Very Poorly Drained
Group 1					
Sand or loamy sand	Lakewood		Lakehurst	Atsion	Berryland
	Evesboro		Klej		
Group 2					
Sandy loam		Downer	Hammonton	Fallsington	Pocomoke
Group 3					
Sandy clay loam or sandy loam		Fort Mott			
		Sassafras	Woodstown	Fallsington	
		Aura			
Group 4					
Mixed mineral material or muck					Tidal Marsh
					Muck

HYDROLOGY

In the average year, 3.6 feet (43 inches) of precipitation falls on the drainage basin (this estimate based on data collected at the Millville Airport from 1947-1987 and published by the National Climatic Center). Less than half (20 inches) of the precipitation, equivalent to about 13.1 billion gallons of water per year, eventually makes up the flow of the Manumuskin River. The remaining 23 inches evaporates or is transpired by plants back into the atmosphere (Pinelands Commission, 1980).

Precipitation which has fallen on the drainage basin and percolated into the soil becomes groundwater. The groundwater moves downward until it reaches the "water table", the top of the zone in which the spaces between sediment grains are filled with water. The water table lies just beneath the land surface near streams and bodies of water, but in upland areas along the drainage basin divide is found at depths of as much as 36 feet (Rooney, 1971). The water table underlies the entire drainage basin, rising in mounds under hills and gradually sloping downward toward low-lying swamps and streams where it intersects with the land surface and discharge of groundwater takes place. At its highest point of elevation in the extreme northern portion of the basin, the water table is about 90 feet above mean sea level. Like the land surface, the water table tilts south toward Delaware Bay at a gentle gradient.

The water table fluctuates following an annual pattern. Typically it drops to its lowest level in September and October, then rises throughout the winter to a peak reached in March or April, after which time the water table begins to fall. This cycle also governs streamflow in the Manumuskin River and its tributaries since they are fed primarily by groundwater. As the water table rises streamflow increases, peaking in April, but when the water table drops during the summer and fall, streamflow is greatly reduced and some of the smaller tributaries dry up altogether in September and October. Streamflow in April is two to three times greater than it is in October. At times of peak streamflow, river levels and stream velocities increase noticeably.

The rate of stream flow in turn determines the salinity or salt content of the water in the tidal section of the river. When streamflow diminishes, saltwater moves upstream into the Manumuskin from Delaware Bay via the Maurice River. As streamflow increases, the saltwater is diluted by freshwater, causing salinity levels to fall. For example, at Mauricetown three river miles downstream of the mouth of the Manumuskin, salinity fell from 9 ppt (parts per thousand) on November 12, 1986 to 2 ppt on May 5, 1987 (full-stength seawater has a salinity of 35 parts of salt per thousand parts of water by weight, while freshwater has a

salinity of only 0.1 ppt).

The fluctuations of the water table occur largely in response to sharp seasonal differences in the rate of evapotranspiration (loss of water from the land surface into the atmosphere through evaporation and transpiration by plants). About 85% of the evapotranspiration occurs during the warmest portion of the year, the seven-month growing season from mid-April through mid-October. During this time considerably more water is lost to the atmosphere than is gained through precipitation, causing the water table to drop. As soon as the growing season ends (marked by the shedding of leaves in the fall), precipitation can infiltrate down to the water table with minimal interception by plant roots, and the water table subsequently rises. At a well 0.8 miles west of the railroad bridge the water table rose 16 inches from November 12 through December 5, 1986 in response to an input of 4.5 inches of precipitation (Jones, 1987).

The water table tends to fluctuate more widely and more rapidly underneath hills and along the upland divide of the basin than underneath low-lying areas. During the growing season the water table drops or "flattens" as water from high elevations drains to the surrounding streams. In the winter the water table rises or "mounds" under high points. Groundwater levels in the Orange Street well in Millville about two miles west of the drainage basin have fluctuated only 6 feet from highest to lowest level over an 18-year period of monitoring (1962-1981) by the U.S. Geological Survey (Environmental Science and Engineering, 1981).

The velocity of the groundwater is determined by three factors acting together: the steepness of the slope of the water table and the permeability and porosity of the sediments through which the groundwater moves, all of which vary from place to place in the drainage basin. On the average, however, the water table gradient is .0025 (13.2 feet per mile), the permeability 95 feet per day, and the porosity 0.25 (Rogers, Golden and Halpern, 1987). When these figures are combined in an equation in which the product of the gradient times the permeability is divided by the porosity, the average groundwater velocity within the drainage basin is found to be slightly less than 1 foot per day. Since no point within the drainage basin is more than 1.25 miles (6,600 feet) from the nearest stream, the maximum amount of time a particle of groundwater might take to reach a stream would be about 19 years. About 85% of the groundwater would follow a shallow flow pattern such as this, being discharged into the Manumuskin after travelling underground for a relatively brief period of time. The rest of the groundwater would sink deeper into the Cohansey-Kirkwood aquifer and move beyond the boundaries of the drainage basin. The major "recharge" or collecting areas for the deeper portions of the aquifer are the high upland areas within the drainage basin.

All of the geological formations to a depth of 180 feet beneath the

surface of the drainage basin act as a single hydrologic unit; that is, there are no impermeable barriers that block the flow of water through them. Although thick clay lenses do exist within the Cohansey and perhaps other formations as well, an aquifer pump test done in December, 1980 1.3 miles west-southwest of the intersection of Route 49 and Union Road demonstrated that under long-term (96 hours) pumping, water moved downward through or around the clay layers to the well zone 108 to 168 feet below the land surface (Environmental Science and Engineering, 1981).

Virtually all water supplies in the drainage basin are obtained from groundwater pumped from the Cohansey-Kirkwood aquifer. Shallow wells in the Port Elizabeth area may, however, tap the Cape May formation. The availability of a large underground fresh water supply close to the surface makes crop irrigation inexpensive, and has been a major factor in the success of row-crop vegetable farming in the basin (Rooney, 1971; Fair Agricultural Committee, 1976).

WATER QUALITY

The quality of the surface water of the drainage basin is probably its most important and unique attribute. In a study done for the Pinelands Commission, water quality data collected by the U.S. Geological Survey from 80 stations within the one-million-acre Pinelands National Reserve was compared (Betz, Converse and Murdoch, 1980). Only two (2.5%) of the stations were found to have "pristine" water quality, one of then being the Manumuskin River at Fries Mill Road. Fries Mill Road is located just above the head of the tide and is downgradient from approximately 85% of the land area within the drainage basin. It may be concluded, therefore, that virtually the entire non-tidal portion of the basin was characterized as having superb water quality.

The Manumuskin River data used in the Betz, Converse and Murdoch study was collected by the U.S. Geological Survey during the three-year period May, 1975 to June, 1978. Ninety percent of the samples collected had values less than or equal to the following standards:

Biochemical Oxygen Demand	3 milligrams per liter (mg/l)
Total Nitrogen	1 mg/l
Suspended Solids	10 mg/l
Total Dissolved Solids	50 mg/l
Fecal Coliform	100 colonies per 100 milliliters

These parameters were chosen in order to identify pollution emanating from agriculture, sewage disposal, construction activity, and runoff from suburban and urban development. Because the sandy soils of the Pinelands are relatively inert and poorly buffered, they have little capacity to absorb contaminants, which are able to pass rapidly through the soil column into the groundwater and are eventually discharged into surface waters. Pinelands streams with excellent water quality thus generally drain undeveloped areas of natural vegetation. Water quality in the Pinelands is largely a function of land use.

At the present time, 87% of the Manumuskin drainage basin is undeveloped. Eight percent of the land is farmed and an additional 5% has been cleared of its natural vegetation for surface mining or development. There are no sewage treatment plants, landfills or industrial dischargers within the basin.

Agriculture is a land use which has the potential for causing significant degradation of water quality. The leaching of fertilizer and lime are responsible for elevated levels of nitrate-nitrogen and pH in the waters of certain Pinelands streams (Durand 1982).

Nitrate-nitrogen levels in the Manumuskin as measured by the U.S.

Geological Survey in 1975-1978 were extremely low, however. The mean of 19 samples collected was 0.04 mg/l. Durand (1982) found that Pinelands streams "disturbed" by agricultural runoff had levels of nitrate-nitrogen of from 3.48 to 17.94 mg/l. Rooney (1971) believed that values greater than 1.0 mg/l in groundwater might be indicative of contamination. The Manumuskin is undisturbed in comparison with these standards.

Liming of farmland over the course of the past century has elevated the pH of soils to depths in excess of three feet (Markley, 1979). The pH of groundwater and surface water draining agricultural areas has also been raised. Morgan (1983) found Pinelands streams with a mean pH of 5.9 to be "disturbed." "Undisturbed" streams had a mean pH over 1 pH unit lower than did disturbed streams. The mean pH of the Manumuskin at Fries mill based on 26 measurements by the U.S. Geological Survey was 4.5, which places it in the undisturbed category.

Low pH is the single most important factor controlling the composition of Pinelands aquatic communities. The classic response to elevated pH in Pinelands streams is a reduced abundance of characteristic species, particularly those restricted in their regional distribution to the Pinelands, and an increased abundance of peripheral and introduced species. For example, such characteristic fish species as the Eastern Mudminnow, Blackbanded Sunfish, Banded Sunfish, Mud Sunfish and Redfin Pickerel decline, while the peripheral White Perch, Pumpkinseed, Yellow Perch and White Catfish, and introduced species such as the Bluegill Sunfish, Largemouth Bass, Black Crappie and Carp increase in numbers (Hastings, 1979; Morgan, 1983).

A striking example of two sharply contrasting aquatic ecosystems controlled by pH is the Manumuskin and its neighboring stream system to the west, the Menantico River. While none of the peripheral or introduced fish species named in the preceding paragraph are known to be reproducing in the non-tidal section of the Manumuskin, all of them are found in the freshwater Menantico Ponds Wildlife Management Area (Perrone, 1981). The pH of the streams was measured on August 4th and 6th in 1987 at Mays Landing Road, and was found to average 1.85 pH units higher in the Menantico (pH 5.6-6.4) than in the Manumuskin (pH 3.7-4.6). Presumably the difference is due to the much greater extent of agricultural and residential development within the Menantico basin than in the Manumuskin.

PH levels are not uniform within the Manumuskin River system, but tend to be slightly higher on the main stem than on tributary streams draining undeveloped areas. For example, on August 4th and 6th, 1987, the mean pH on the main stem of the river at Mays Landing Road, the outlet of Cumberland Pond, and Fries Mill Road was 0.35 units higher than the mean pH of Cedar and Bears Head Branches. The pH of the main stem of the Manumuskin varied only 0.2 units among the three stations and was highest at the most downstream station, Fries Mill.

PH levels are not constant throughout the year. They typically drop within 48 hours of rainfall of more than 0.75 inches (Durand, 1982). On August 6, 1987 pH at five widely-spaced stations in the drainage basin dropped uniformly by 0.9 units from levels measured 48 hours earlier on August 4. More than one inch of precipitation fell on the drainage basin in the 24-hour period preceding sampling on August 6. As Tedrow (1979) points out, the greater the rainfall, the more dilute the soil electrolyte. Consequently, stream pH is typically lower during periods of high river flow (Durand, 1982), and thus generally lower in the winter than in the summer (Crerar, 1981). During extended periods of no precipitation, stream pH very gradually increases. The peak pH at Fries Mill measured by the U.S. Geological Survey was 6.0.

Although it is difficult to anticipate how land use in the drainage basin might change in the future, it seems unlikely that there will be any major increase in land cleared for agriculture. On the other hand, development pressures for housing are growing, and there may be an increase in liming and fertilization of lawns as a result of this development. The natural vegetation of the drainage basin is adapted to acidic and nutrient-poor soil conditions and does not require special fertilization or liming. Whenever native plants are replaced with non-native species, however, standard lawn-care practices are likely to cause water quality degradation.

The Pinelands Comprehensive Management Plan (1980) notes on page 36 that the Manumuskin River has "elevated levels of arsenic, probably due to industrial waste discharges." This statement is not supported by any evidence from published or unpublished sources, and appears to be erroneous. Levels of Total Arsenic in surface water and in bottom material at Fries Mill as measured by the U.S. Geological Survey were extremely low (0-0.1 mg/l). Furthermore, there are no past or present industrial dischargers of arsenic in the Manumuskin drainage basin. The results of sampling on the main stem of the Maurice River appear to have been incorrectly attributed to the Manumuskin. Highly elevated levels of arsenic (10.0-41.0 mg/l in surface water) were found by the U.S. Geological Survey at Almond Road and Sherman Avenue in Vineland and Sharp Street in Millville, all three of which stations are on the Maurice River downstream of the Vineland Chemical Company Superfund site.

UPLAND VEGETATION

Oak is the dominant tree of the upland forests in the Manumuskin drainage basin, but Pine stands are also extensive. The composition of upland forests in the basin appears to have been affected more in recent years by timber cutting than by fire. Most fires in the last two decades have been in the upper portion of the drainage basin north of Route 49 (Barber, 1987).

In the lower portion of the drainage basin below Route 49, extensive logging of mature oak forests for firewood and lumber took place in the late 1950s and 1960s. Virginia Pine (Pinus virginiana) is now the dominant tree in the logged areas, in some places forming almost pure stands in which there is little undergrowth and sparse ground cover. It is also the early successional dominant in many fallow agriculture fields and in disturbed areas such as former sand and gravel mining sites. Barring catastrophes which would favor pine regeneration, the Virginia Pine stands will gradually be invaded by and eventually succeeded by an oak forest (McCormick, 1963).

The upper part of the drainage basin along both sides of Union Road was extensively logged for oak in the period 1978-1983. Writing of this area in 1968, Starkey indicated that oak trees aged 60 years and of a circumference in excess of 5 feet were present. Following removal of the trees for firewood, a transitional forest type dominated by Scrub Oak (Quercus ilicifolia) with some Blackjack Oak (Quercus marilandica) has developed. It forms a low, almost impenetrably dense stand in which scattered Pitch Pines left undisturbed by the woodcutters remain. The vegetation is perhaps similar to the dry, cutover forests of the region in 1917 when fieldwork for the first comprehensive soil survey was "difficult in the wooded areas because of the prevailingly dense growth of underbrush, made up mainly of scrub oak" (Engle, et al, 1921). Such forests are known today as "jailhouses" by people who frequent the woods (Moore, 1987). Eventually this early successional stage is expected to give way to a forest dominated by White and Black Oaks (Quercus alba, Quercus velutina) which have sprouted from stumps. In presently extant stands (e.g., within the Peaslee Wildlife Management Area) of this type of mature oak forest, Post Oak and Scarlet Oak (Quercus stellata, Quercus coccinea) are numerous, and Chincopin Oak and Southern Red Oak (Quercus prinoides, Quercus falcata) are present.

Another forest type has formed in places where the land slopes sharply toward streams; here Chestnut Oak (Quercus prinus) is dominant with Scarlet Oak (Quercus coccinea) usually present as well. An example can be seen east of Bennetts Mill and south of Old Mays Landing Road.

Although we have not attempted to carefully research the history of

forest fires within the drainage basin, charred bark, basal wounds on oaks (Little, 1968), and winding firebreak trails are seen frequently in upland areas, particularly north of Route 49. Near Bennetts Mill and Milmay, where a series of fires burned hundreds of acres of forest in 1976, Pitch Pine (Pinus rigida) is the dominant forest tree. Because this species is an invader of open areas with little accumulation of litter on the forest floor, other extensive tracts north of Route 49 where it is the dominant tree probably burned sometime during the course of the present century (Andropogon, 1980). The pure Pitch Pine stands of the central Pine Barrens are seldom encountered in the Manumuskin basin, however, presumably attesting to a less frequent or less intense history of fire activity.

Gypsy moths first infested the drainage basin in 1980, entering from the southeast. Although they have undoubtedly contributed to increased oak mortality, no change in forest composition attributable to this insect pest has been observed locally. Trees in the white oak family are defoliated first and most heavily, followed by those in the black oak group. A thick cuticle over the leaf surface seems to provide some measure of protection to a few oak species such as the Blackjack Oak.

Several micro-habitats in which disjunct (outlying from the main population) or introduced plants have become well established are present within the drainage basin. At the Cumberland Furnace site south of Route 49 and west of the Manumuskin River, the following plants generally not found in the Pinelands are growing on the ruins of a former bog iron furnace complex : Arisaema triphyllum, Asplenium platyneuron, Belamcanda chinensis, Chionanthus virginicus, Plantanthera lacera, Liparis lilifolia, Liriodendron tulipfera, Pyrola rotundifolia, and Quercus michauxii (Ferren, 1978; Gordon, 1982). The furnace was abandoned in 1840, but some structural features such as walls and the stack are said to have been intact as recently as the 1940s (see cultural resources report). Brick, local sandstone, oyster shells, charcoal, mortar, bog iron, and slag may all have contributed to the loamy soils supporting a unique flora at the site. These soils are probably less acidic than are those in the drainage basin generally. Other examples of introduced plants established in the drainage basin are the Gilia rubra, Onosmodium virginianum, and Euonymus atropurpureus populations discussed in the Rare Plant section of this report. The Onosmodium stand is also growing on slag, so that it too is confined to a localized area of elevated soil pH. A vine native to Japan, Akebia japonica, is well established at an abandoned wooden cabin complex 0.5 miles north-northeast of the railroad bridge over the Manumuskin River.

Although older residents recall seeing former charcoal-burning pit sites in forested areas, no specific locations could be ascertained. It is possible that the forest clearings in Vineland described in the section of this report dealing with invertebrates were former pit sites

because such areas "can be discerned by the almost total absence of vegetation and the presence of scattered charcoal" (Sinton, 1982). After the collapse of the local iron smelting industry in 1849, charcoal production undoubtedly declined sharply, but as late as 1861 charcoal burners were still living in Vineland (Landis, 1903).

LOWLAND VEGETATION

Two forest types are found on poorly to very poorly drained soils in the drainage basin: (1) hardwood forests dominated by Red Maple (Acer rubrum), Black Gum (Nyssa sylvatica) and Sweetbay Magnolia (Magnolia virginiana); and (2) White Cedar (Chamaecyparis thyoides) stands. Upgradient of these on moderately well drained soils are forests dominated by Pitch Pine (Pinus rigida).

The Pitch Pine stands cover extensive areas along the main stem of the Manumuskin and its tributaries north of Fries Mill, and are chiefly found on Pocomoke, Woodstown and Hammonton soils. The stands are in areas transitional between upland and lowland, and are likely to have been burned or otherwise disturbed within this century.

Hardwood forests dominate the non-tidal floodplain of the main stem of the river and tributary streams. Only 210 acres of White Cedar remain in the drainage basin. White Cedar is an early successional species, an invader of open, moist areas, typically found on muck soils. In the absence of disturbance, White Cedar is replaced by the hardwoods, which are more tolerant of shade. Types of disturbance favorable to White Cedar include wind storms, low-intensity fires, selective removal of hardwoods by beavers, water impoundment by beavers or man, and clear cutting (Little, 1950). From historical accounts it appears that the trend over the past 250 years has been a gradual replacement of White Cedar by hardwoods. White Cedar probably once formed continuous stands in narrow swamps along tributary streams and in the broader floodplain of the main stem of the river, but has been reduced to ten isolated patches (Andropogon, 1980). Forestry practices which have worked against White Cedar include selective thinning of White Cedar stands for poles; failure to remove bark, branches and foliage from the forest floor after White Cedar harvesting; removal of White Cedar without at the same time destroying hardwoods present; and failure to leave sufficient seed trees when clear-cutting White Cedar stands (Little, 1950).

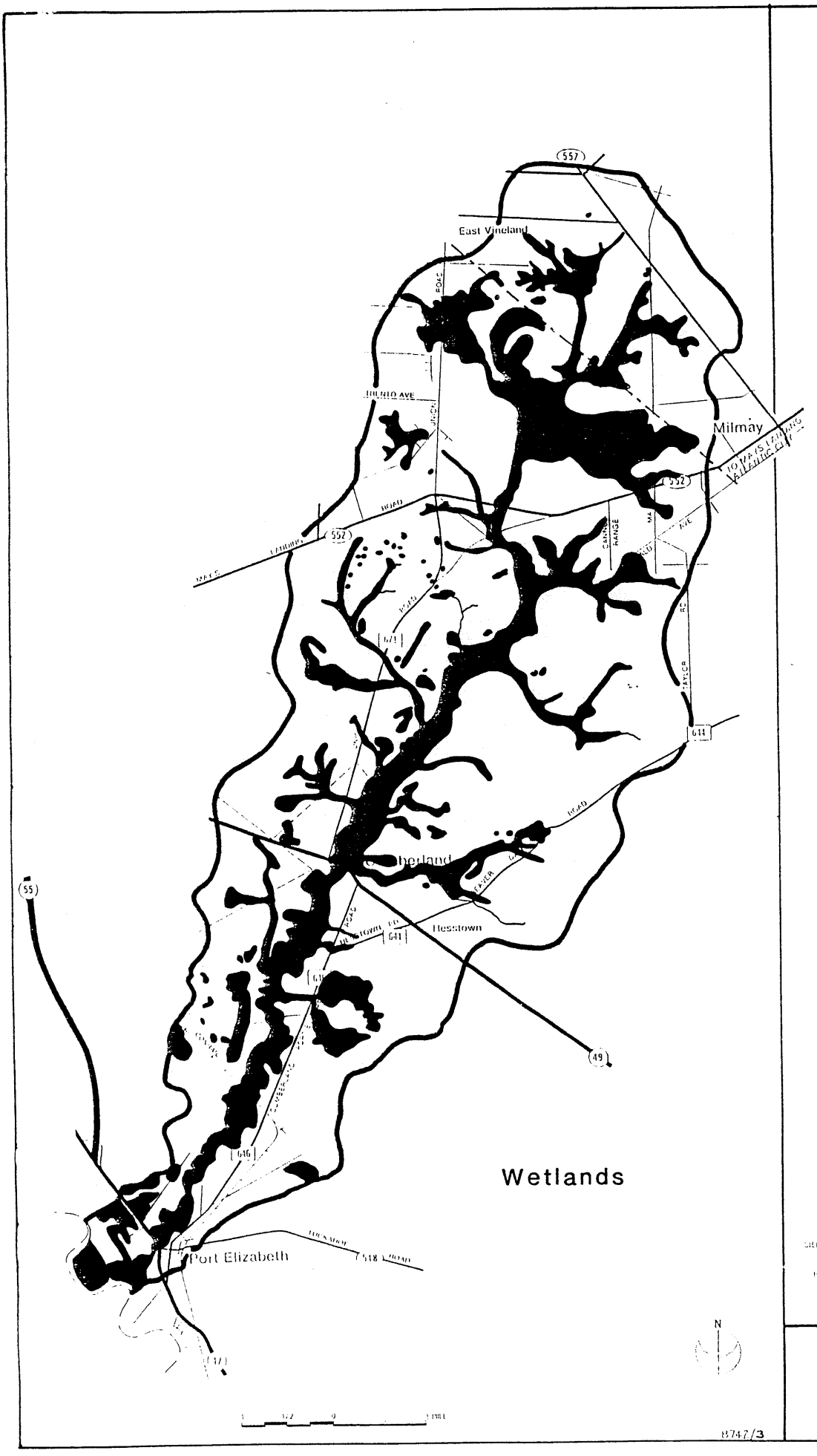
Intermittent coastal plain ponds are shallow depressions found scattered throughout the drainage basin. As discussed in the hydrology section, the regional water table fluctuates over the course of the year, reaching its highest level in the spring and its lowest in the fall. In conjunction with this cycle, intermittent coastal plain ponds fill with water much of the year, but typically become dry in the summer and fall. A group of plants adapted to these circumstances are found in this habitat including: Coreopsis rosea, Lobelia canbyi, Muhlenbergia torreyana, Nymphoides cordata, Panicum wrightianum, Psilocarya nitens and scirpoides, Utricularia purpurea and Xyris smalliana. Several of these plants are globally rare. State rare animal species associated

with the ponds are the Pine Barrens Treefrog, Southern Gray Treefrog and Tiger Salamander. The intermittent ponds are generally less than an acre in size; have depths of approximately 3-6 feet; tend to be oval, elliptical, or horseshoe-shaped; and typically are found in moderately well drained soils upgradient from tributary streams. There are probably more than one hundred of these landforms in the drainage basin. It appears that the long-term trend is for the ponds to fill with decomposed plant material and shrink in size (Wolfe, 1953; Klockner, 1986).

A distinctive marsh vegetational community is found in the tidal floodplain of the river. Here the dominant plant is Wild Rice, Zizania aquatica (Walton, 1973), the most productive of the estuarine wetland plants native to New Jersey, and an important source of food for wildlife (Goode, 1974). The U.S. Fish and Wildlife Service has classified the area, which totals 450 acres, as an "estuarine emergent oligohaline" wetlands (Tiner, 1984). There are only 6,005 acres of this type of slightly brackish tidal marsh in New Jersey, with the Manumuskin floodplain alone accounting for over 7% of the state total. Oligohaline wetlands possess the highest plant diversity of all estuarine wetlands. More than 50 species per acre are found in the vicinity of the railroad crossing over the Manumuskin (Tiner, 1985; Davison, 1984).

Ferren (1975-1976) has identified three micro-habitats within the oligohaline wetlands which are important to rare plants: (1) sand and gravel shorelines on the undercut slopes of river meanders; (2) mud flats; and (3) firm, high, peaty areas. The latter type is particularly important because it is the substrate upon which the drainage basin's most significant rare plant, Aeschynomene virginica, is found. The plant apparently is found only in wetlands areas not formerly reclaimed for agriculture (Engle et al., 1921).

Wetlands areas created by man in the drainage basin include sand mining excavations, borrow pits, mill pond impoundments (Cumberland Pond), and abandoned cranberry bogs (Bennetts Mill Pond). All of these areas are subject to the same successional processes as natural wetland communities. Cumberland Pond, for example, is now 29 acres in size, but is shrinking gradually as plants encroach around its perimeter. The two electric utility right-of-ways crossing the drainage basin have been colonized by a number of shade-intolerant rare plants. Because they are maintained at a relatively constant state of early succession, these habitats have great potential for management and conservation of a number of rare plants.



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RARE PLANTS

by A. Gerry Moore

Thirty-two rare plants are known to be extant in the drainage basin in 1987, making it one of the most botanically significant areas in New Jersey.

One plant found within the basin, the Virginia False Gromwell, Onosmodium virginianum, exists nowhere else in New Jersey, and two plants, the Sensitive Joint Vetch, Aeschynomene virginica, and the Butterfly Pea, Clitoria mariana, are found outside the drainage basin at only single localities in the state. Five plants considered globally rare exist within the basin: Aeschynomene virginica, Carex barrattii, Coreopsis rosea, Eriocaulon parkeri and Eupatorium resinosum. Other globally rare plants historically present in the basin are: Schwalbea americana, Muhlenbergia torreyana and Psilocarya nitens.

Extremely rare plants or clusters of rare plants are found at stations 1, 7, 9, 10 and 16. These areas merit immediate protection.

The most comprehensive list of the rare and endangered flora of New Jersey was used in compiling this report (Snyder, 1987). The list is issued by the New Jersey Natural Heritage Program within the Department of Environmental Protection and provides global and state status rankings for each rare plant. These rankings have been placed in parentheses after the plant's name, and an explanation of symbols used is provided at the end of this report. Rare plant species located in the field were collected whenever it was feasible. The specimens will be deposited at the herbarium of the Academy of Natural Sciences of Philadelphia.

Most of the early botanical work in the Manumuskin River drainage basin was done by Bayard Long in the 1930s and 1940s. Long's fieldwork was restricted to Cumberland County, however. Forty-two species that are now deemed to be either globally or state rare were collected during his early searches. Recent searching by field botanists has resulted in the discovery of 13 more rare plant species, bringing the overall total to 55 plant species that occur or have been known to occur in the drainage basin. Of these 32 species are known to be extant in 1987.

It should be stressed that many of the species not found to date may still be extant. Autumn searching has not yet been performed, and hence the fall-flowering species of the list (e.g. Andropogon elliotii, Aristida virgata, Aster concolor, Eupatorium aromaticum and Gentiana saponaria) may still be present. The uplands of the Manumuskin River drainage basin have not been extensively searched, and little work has been attempted within Buena Vista Township in Atlantic County due to the lack of historical records. More fieldwork in upland habitats could

result in the rediscovery of the following species: Asclepias variegata, Gymnopogon ambiguus, Polygala polygama, Stylosanthes biflora and Stylosanthes riparia. The coastal plain intermittent ponds near Bennetts Mill were quite wet this year; searching during a drier year could turn up Panicum leucothrix, Panicum wrightianum, and Psilocarya nitens.

The freshwater tidal mud habitat is a very difficult one in which to do fieldwork, and as a result has not been as thoroughly searched as would be desirable; more fieldwork could result in new stations for Aeschynomene virginica, Elatine americana, Eriocaulon parkeri, and Gratiola virginiana. Isoetes riparia (G4, S3), a rare quillwort, may also be found since it occurs in freshwater tidal mud along the Maurice River. Unconfirmed reports exist for Bidens bidentoides (G3, S2) in the freshwater tidal mud at station 16, and more searching in this habitat may result in its rediscovery. There is also a modest chance that more fieldwork in the freshwater tidal areas of the Manumuskin River could result in the discovery of Micranthemum micranthemoides (GH, SH), a plant for which there are currently no known extant stations in the world. Although this plant has been extirpated from the Delaware River system, many of its associated species (e.g. Elatine americana and Eriocaulon parkeri) occur along the Manumuskin.

Annotated List of Rare Plants

Aeschynomene virginica (G2, S1): The Sensitive Joint Vetch is classified by the New Jersey Natural Heritage Program as "imperiled globally because of rarity". This legume is one of the nine rarest plants found in the state. The sole stable population of A. virginica in New Jersey is found in the wetlands bordering the Manumuskin River at station 19. This population is the largest one in natural habitat remaining in the world. A small marginal population also is found in Burlington County.

The population of Aeschynomene virginica is located within a 150-acre wetlands that is itself unique. Dr. Wayne R. Ferren, Jr., a botanist at the University of California-Santa Barbara who has studied the area, has described it as, "one of the best examples of wetland transitional between brackish and freshwater and in a region transitional between Inner Coastal Plain upland vegetation and Pine Barrens" (Ferren, 1982).

A seven-acre property on which a substantial portion of the A. virginica population is located was donated to the New Jersey Conservation Foundation in 1981 by Jean Curnow Corson and Frank Battaglia, and conveyed in 1982 to The Nature Conservancy. An additional upstream property of 62 acres was purchased by the Nature Conservancy in 1985, and other properties are currently being acquired as part of the Conservancy's New Jersey

Critical Areas Campaign.

Habitat destruction is believed to be a primary factor responsible for the decline of A. virginica (Bruderle, 1984a). Three factors are believed to be critical to adequate habitat conservation for this species: (1) protection of the marsh where the plant occurs, (2) protection of water quality or source of water, and (3) protection of an adequate amount of upland buffer (Bruderle, 1984b).

Protection of water quality is important for the survival of the plant because water pollution "seems to reduce species diversity, alter species composition and favor pollution tolerant species" (Bruderle, 1984b). A. virginica is found only in "pristine marshes" where species diversity exceeds 50 species per acre (Bruderle, 1984b).

Andropogon elliotii (G?, S2): This grass was found by Bayard Long at two stations. Much Andropogon was relocated at these historical stations in 1987, but fruit was not yet present and the species has thus not as yet been confirmed as presently extant.

Aristida virgata (G3G5,S2): This grass was noted by Long at two locations in the 1930s. It was not relocated during this survey, but may be present since positive identification is not possible until the fall.

Asclepias variegata (G4G5, S2): One station of this milkweed was discovered by Long in 1934 near Port Elizabeth. The area was searched without success in June 1987.

Aster concolor (G4?,S2): This aster was noted at at least two locations by Long in the 1930s. The stations are no longer extant but a new station was discovered in July 1987 (station 5). There is an excellent likelihood that other stations exist within the drainage basin; searching should take place in the fall.

Carex barrattii (G3, S3): This sedge was first noted in the Manumuskin River watershed by Mike Barnett in 1984. His station (station 4) is still extant.

Carex rostrata (G5, S1): This sedge was noted at station 19 by Bob Hirst in 1963, but could not be relocated.

Carya pallida (G5, S3): The sand hickory tree is frequent in the dry oak uplands in the Manumuskin River watershed. At least 7 sites are known and probably many more exist (see stations 3, 10, 13, 14, 15, 18, and 19).

Chionanthus virginicus (G5, S3): Two extant stations occur for the Fringe Tree (stations 2 and 10).

Clitoria mariana (G5, S1): One of only two stations for this legume in

New Jersey occurs at station 10, where it was seen in 1987.

Coreopsis rosea (G3, S2): This tickseed is extant at stations 1 and 9, where it was also historically known.

Desmodium laevigatum (G5, S2): This trefoil was rediscovered in the Manumuskin River watershed by David Snyder in 1987, and is present at stations 3 and 7.

Desmodium strictum (G3G5, S2): Two stations for this trefoil currently exist: 10 and 21. Station 10 is quite large; over 50 plants were noted here.

Desmodium viridiflorum (G5?, S2): This trefoil is extant at station 22.

Elatine americana (G5?, S3): This waterwort currently exists at station 19. More stations for the plant may exist in the Manumuskin River drainage basin since the plant is a very tiny creeper that occurs in a habitat (fresh water tidal mud) that is very difficult to explore on foot.

Eriocaulon parkeri (G3, S2): The Parker's pipewort currently occurs at station 16. More stations are quite possible since, like the preceding species, it occurs in a wet habitat where field work is quite difficult.

Epilobium angustifolium (G5, S2): Fireweed occurs in recently burned clearings and was noted by Bayard Long near the town of Cumberland. His station has been lost to succession. Other areas with ideal habitat were searched without success.

Euonymus atropurpureus (G5, S2SE): One extant station for the Burning Bush is currently known (station 12). Another station along Dorothy Road was destroyed this year. The species is not historically known from this area and these recent stations may be planted sites, since they occur near abandoned homesteads.

Eupatorium aromaticum (G?, S2): One station historically occurred near Bennetts Mill, but was searched without success this summer. Searching in the fall when this boneset is flowering may result in its rediscovery.

Eupatorium resinosum (G3, S2): This globally rare boneset is currently found at two locations in the Manumuskin River drainage basin (stations 6 and 9). The species is quite abundant at station 9.

Gentiana saponaria (G5,S3): This gentian is historically known to occur at Fries Mill, but has not thus far been relocated in 1987. Searching should continue in the fall.

Glyceria laxa (HYBRID, S2Q): This grass was noted by Long at Bennetts

Mill in the 1930s, but has not recently been found here. Recent taxonomy work has deemed this taxon to be a hybrid.

Gratiola virginiana (G?, S2): This hedge-hyssop is extant at station 16. More stations are possible since it is difficult to do fieldwork in the plant's tidal mud habitat.

Gymnopogon ambiguus (G4, S3): This grass was noted by Long at two stations. Autumn searching may result in the rediscovery of the species.

Hypericum gymnanthum (G4G5, S2): This St. John's Wort was historically reported from the Bennetts Mill area, but could not be found in 1987.

Lobelia canbyi (G4, S3): One station currently occurs for this lobelia (station 9); over 100 plants were noted.

Lespedeza stuevei (G4?, S2): Two extant stations for this bush clover occur (stations 7 and 10). It is also historically recorded from the basin.

Muhlenbergia torreyana (G3, S3): This grass was found by Frank and Bob Hirst in an intermittent coastal plain pond habitat in the Bennetts Mill area in the 1960s. Recent searching, however, has failed to relocate it.

Nuphar microphyllum (G?, SH): Bayard Long noted this pond lily in Cumberland Pond in 1934. Recent taxonomical works have revised the Nuphar genus, and what Long was calling Nuphar microphyllum is now Nuphar luteum ssp. pumilum v. microphyllum (Kartesz and Kartesz, 1980). The plant was not relocated during the survey.

Nymphoides cordata (G3G5, S3): This floating heart currently occurs at station 1.

Onosmodium virginianum (G3G5, S1): The Virginia False Gromwell was rediscovered this summer by David Snyder at station 7, where Long noted it in 1932. This is currently the only extant station for this plant in the state. Over 20 plants were found.

Panicum leucothrix (G?, S1): This grass was noted in the Bennetts Mill area in the 1930s. It has not recently been found here, however.

Panicum wrightianum (G?, S2): This plant was noted by Long at station 1 in 1932, which was checked this year without success. It may have been too wet a season for this grass. Checking the station during a drier year may result in the rediscovery of the plant.

Phoradendron flavescens (G5, S2): Mistletoe was noted by A. Marts on December 25, 1928, in the vicinity of the town of Cumberland. It was

not relocated here in 1987, but there have been recent unconfirmed reports for the plant in the Port Elizabeth area.

Platanthera ciliaris (G5, S2): The yellow fringed orchid was reported by Long to occur at Bennetts Mill and Hesstown. It has not been recently seen at these two stations, but it currently occurs at station 9.

Platanthera cristata (G5, S3): The crested yellow orchid currently is found at stations 2 and 16. Long noted this plant in the 1930s east of the Manumuskin.

Polygala polygama (G5, S1): This milkwort was noted by Long in 1934 near Bennetts Mill. In spite of intensive searching the plant could not be relocated in 1987.

Potamogeton confervoides (G5, S2): This pondweed was noted by Long in Cumberland Pond in 1932 and also found there this summer (station 11).

Potamogeton oakesianus (G?, S2): Although this pondweed was not historically known to occur in the area, it was found this year in Cumberland Pond (station 11).

Psilocarya nitens (G3, S2): This baldrush was noted by Bob Hirst at station 1 in 1962. It may still be extant, but was not relocated in 1987.

Psilocarya scirpoides (G3G5, S2): This baldrush was noted by Ted Gordon at station 1 in 1984, and is believed to be extant in 1987 at the same location.

Quercus michauxii (G5, S3): The basket oak is currently extant at station 10, where a few trees of this species occur. Fine specimens used to exist along the western border of Cumberland Pond but were recently cut down.

Schizaea pusilla (G4, S3): The curly-grass fern was noted by Long in 1933 in the Ingersall Branch, but could not be relocated. Much of the white cedar (Chamecyparis thyoides) at the station was cut down and has been replaced by red maple (Acer rubrum).

Schwalbea americana (G2, S1): This globally endangered Chaffseed was noted by Long in 1933 east of Bennetts Mill. In spite of much searching throughout the area the plant could not be relocated, even though ideal habitat was present.

Scleria nitida (G?, S3): This nut rush currently occurs at station 9. Bayard Long and Frank Hirst also noted the plant in the Manumuskin River watershed in the 1930s and 1960s, respectively.

Solidago elliottii v. ascendens (G4G5TU, S3): This goldenrod was found by David Snyder at station 7 this summer. Long noted it at Bennetts

Mill in 1940.

Solidago ludoviciana (G?, S3): This goldenrod was found in the Port Elizabeth area by David Snyder in 1981. It has not yet been relocated.

Solidago stricta (G?, S3): The wand-like goldenrod was seen in 1969 by Vince Abraitys, J.L. Edwards and E.L. Laport at station 2. It has not yet been relocated.

Stylosanthes biflora (G5, S3): This pencil flower was noted by Long near Bennetts Mill and Cumberland Pond. Recent searching has failed to relocate the species.

Stylosanthess riparia (G?, SH): This rare pencil flower was noted by Long near Bennetts Mill. Much searching was done in the area, but the plant was not rediscovered.

Toxicodendron toxicarium (G4G5, S3) Poison oak is rather frequent in dry oak uplands in the Manumuskin drainage basin. Five sites are known and probably more occur. It is easily overlooked when growing with the Chincopin oak, Quercus prinoides, which it resembles. It is also probably undercollected for obvious reasons (stations 13, 14, 15, 17 and 20).

Trichostema setaceum (G5, S2): This blue-curl was found at station 15 in 1987. In the 1930s Long noted the species just west of here in the Manantico area.

Utricularia purpurea (G5, S3): Purple bladderwort occurs at station 1 in wetter years, and was noted here in 1987. It historically occurred at Bennetts Mill and Cumberland Pond.

Viola brittoniana (G4G5, S3): The coast violet was found this year at station 8.

Xyris smalliana (G5, SU): This yellow-eyed grass was noted by the Philadelphia Botanical Club on August 4, 1984 at station 1 and it is still extant in 1987.

The state's only extant population of Gilia rubra occurs at station 20. This phlox is not included in the preceding list because it is not regarded as native in the state by the New Jersey Natural Heritage Program. The population has, however, persisted since its discovery in the early 1900s (Stone, 1910).

EXPLANATION OF RANKS

GLOBAL ELEMENT RANKS

G2 = Imperiled globally because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.

G3 = Either rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single western state, a physiographic region in the East) or because of other factors making it vulnerable to extinction throughout its range; in terms of occurrences, in the range of 21 to 100.

G4 = Apparantly secure globally, though it may be quite rare in parts of its range, especially at the periphery.

G5 = Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.

GH = Of historical occurrence throughout its range, i.e., formerly part of the established biota, with the expectation that it may be rediscovered.

GU = Possibly in peril range-wide but status uncertain; need more information. To express uncertainty, the most likely rank is assigned and a question mark added (e.g., G2?). A range is indicated by combining two ranks (e.g., G1G2, G1G3).

G? = Species has not yet been ranked.

STATE ELEMENT RANKS

S1 = Critically imperiled in state because of extreme rarity, usually 5 or fewer sites or with very few remaining individuals or acres. Elements so ranked are often restricted to very specialized conditions or habitats and/or restricted to a very small geographic area of the state. Also included are elements which were formerly more abundant, but now through habitat destruction or some other critical factor of its biology have been demonstrably reduced in abundance. Sizable additional occurrences are unlikely to be discovered.

S2 = Imperiled in state because of rarity, on the order of 6 to 20 occurrences. Historically many of these elements may have been more frequent but are now known from very few extant occurrences, habitat destruction being the primary cause of their rarity. Diligent searching may yield additional occurrences.

S3 - Rare in state with only 21-50 occurrences). Includes elements which are widely distributed in the state but with small popuations/acreage or elements with restricted distribution, but locally abundant. Not yet imperiled in state but may soon be if current trends continue. Searching often yields additional occurrences.

SE - A species clearly exotic in New Jersey, which includes those species not native to North America as well as any other species deliberately or accidentally introduced into the state. Not presently considered a conservation priority, although viable introduced occurrences of G1 or G2 elements may be exceptions.

SH - Despite some searching of both historic occurences and suitable habitat, no extant occurrences currently are known. Not all historic occurrences have been checked, and unsearched potential habitat remains. Until all leads are reasonably exhausted, elements ranked SH are considered possibly extant. While the last observed dates for most elements ranked SH are 50 or more years old, elements observed much more recently are also included when the only known occurrences have been destroyed.

SU - Believed to be in peril but status uncertain. More information is needed to rank accurately. Wherever possible the most likely rank is combined with a question mark (e.g. S2?) to express uncertainty; or a range is indicted by combining two ranks (e.g. S1S2).

SX - Apparently extirpated from state. All historic occurrences checked and a thorough search of potential habitat completed. The localities for many of these elements have been destroyed or greatly altered.

A "T" appearing in either the G Rank or S Rank, indicates that the infraspecific taxa is being ranked differently than the species. A "Q" in the rank indicates that there is taxonomic uncertainty about the taxa being ranked (e.i., taxa is being accepted as full species in this list but may be treated as a variety or form by others).

EXTANT RARE PLANT STATIONS

Station 1: Coreopsis rosea, Nymphoides cordata, Psilocarya scirpoides, Utricularia purpurea, Xyris smalliana

Station 2: Chionanthus virginicus, Platanthera cristata

Station 3: Carya pallida

Station 4: Carex barrattii

Station 5: Aster concolor

Station 6: Eupatorium resinosum

Station 7: Desmodium laevigatum, Lespedeza stuevei, Onosmodium virginianum, Solidago odorata

Station 8: Viola brittoniana

Station 9: Coreopsis rosea, Eupatorium resinosum, Lobelia canbyi, Platanthera ciliaris, Scleria nitida

Station 10: Carya pallida, Chionanthus virginicus, Clitoria mariana, Desmodium strictum, Lespedeza stuevei, Quercus michauxii

Station 11: Potamogeton confervoides, Potamogeton oakesianus

Station 12: Euonymus atropurpureus

Station 13: Carya pallida, Toxicodendron toxicarium

Station 14: Carya pallida, Toxicodendron toxicarium

Station 15: Carya pallida, Toxicodendron toxicarium, Trichostema setaceum

Station 16: Aeschynomene virginica, Elatine americana, Eriocaulon parkeri, Gratiola virginiana, Platanthera cristata

Station 17: Toxicodendron toxicarium

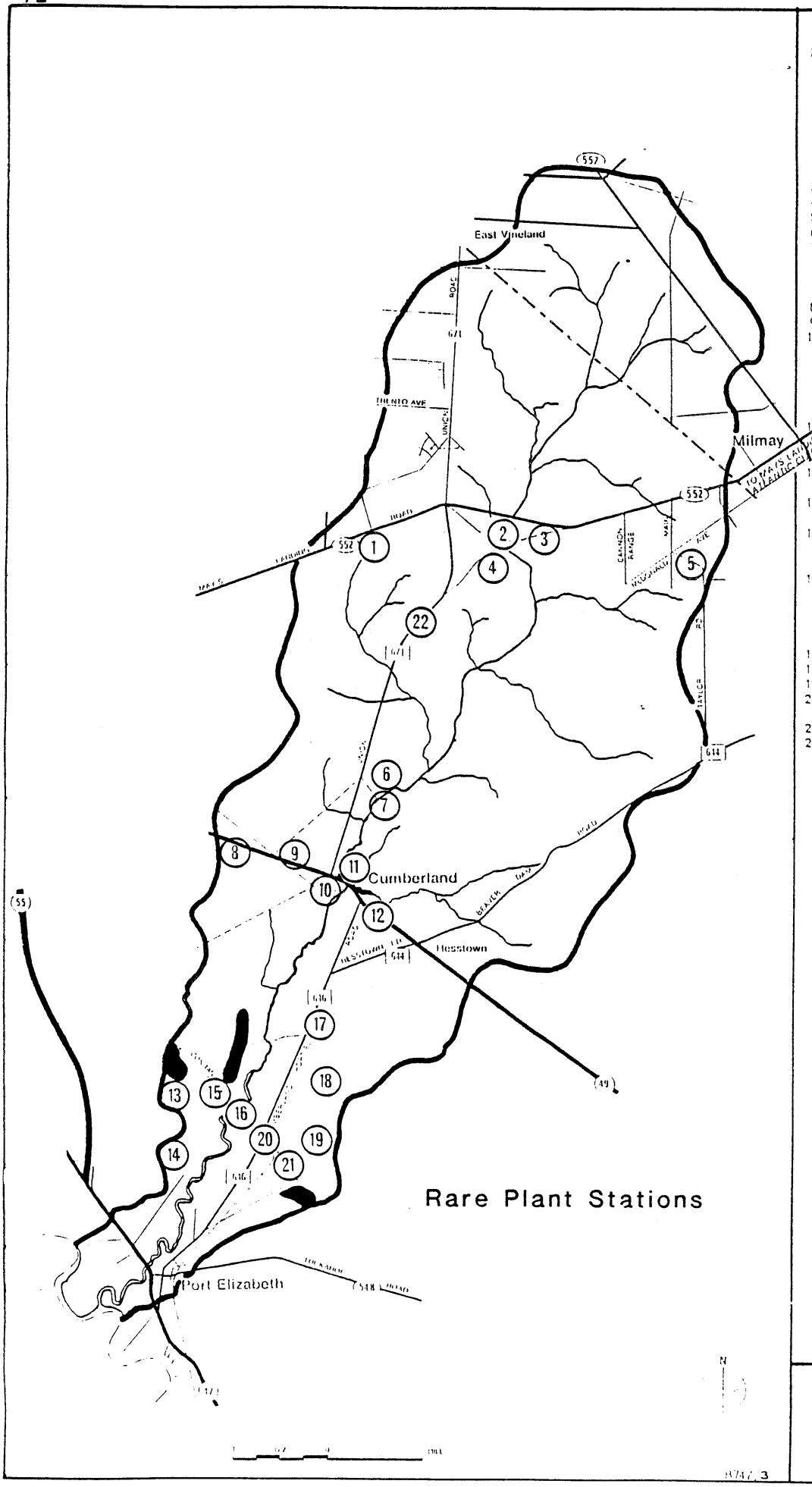
Station 18: Carya pallida

Station 19: Carya pallida

Station 20: Gilia rubra, Toxicodendron toxicarium

Station 21: Desmodium strictum

Station 22: Desmodium viridiflorum



RARE PLANT STATIONS

1: Coreopsis rosea,
Nymphoides cordata,
Psilocarya scirpoides,
Utricularia purpurpea,
Xyris smalliana
2: Chioanthus virginicus,
Platanthers cristata,
3: Carya pallida
4: Carex barratti
5: Aster concolor
6: Eupatorium resinosum
7: Desmodium laeigatum,
Lespedeza stuevei,
Onosmodium virginianum,
Solidago odorata
8: Viola brittoniana
9: Coreopsis rosea,
10: Carya pallida,
Chioanthus virginicus,
Clitoria mariana,
Desmodium strictlum,
Lespedoza stuevei,
Quercus michauxii
11: Potamogeton confervoides,
Potamogeton oakesianus
12: Euonymous atropurpureous
13: Carya pallida,
Toxicodendron toxicarium
14: Carya pallida,
Toxcodendron toxcarium
15: Carya pallida,
Toxcodendron toxicarium
Trichostema setaceum
16: Aeschyuomene virginica,
Elatine americana,
Eriocaulon parkeri,
Gratiola virginiana,
Platanthera cristata
17: Toxicodendron toxicarium
18: Carya pallida
19: Carya pallida
20: Gilia rubra,
Toxicodendron toxicarium
21: Desodium strictum
22: Desodium viridflorum

STUART LANDIS MATTLIN & PUROY
LANDUSE ATTORNEYS

HERPETOLOGICAL ASSOCIATES, INC.
ENVIRONMENTAL CONSULTANTS

ANDROPOGON ASSOCIATES, LTD.
ECOLOGICAL PLANNING AND DESIGN

CONSERVATION PLAN
MANUMUSKIN RIVER
WATERSHED

NEW JERSEY CONSERVATION
FOUNDATION

SEPTEMBER 1987

REPTILES AND AMPHIBIANS

The high number of species (44) found to be extant within the drainage basin in 1986 and 1987 is noteworthy and reflects the excellent water quality and undisturbed nature of the area. There is a large amphibian (primarily toad) food source for reptiles, and the loose sandy soils are ideal for burrowing snakes such as the Northern Pine, Hognose, Worm, Northern Scarlet and Corn Snake. The state's largest and perhaps only population of the Northern Scarlet Snake is concentrated within the drainage basin, as are populations of other state-threatened or endangered species: the Northern Pine Snake, Tiger Salamander, Pine Barrens Treefrog and Southern Gray Treefrog. All three lizard species found in New Jersey were present throughout the drainage basin, which is an indication of both habitat diversity and of an abundant food supply of insects. There are only two other localities in the state, one in Ocean County and one in Atlantic County, where all three lizard species are found.

The main threats to reptiles and amphibian populations are: (1) lowering of the water table, which can interfere with metamorphosis of larval amphibians; (2) destruction of habitat by development, land clearing and pollution; and (3) mortality of threatened reptile populations from increased vehicular traffic, both on- and off-road.

REPTILES

Snakes

Northern Water Snake
Northern Brown Snake
Northern Red-bellied Snake
Eastern Garter Snake
Eastern Ribbon Snake
Eastern Hognose Snake (declining)
Southern Ringneck Snake
Eastern Worm Snake
Northern Black Racer
Rough Green Snake
Black Rat Snake
Northern Pine Snake (threatened)
Eastern King Snake
"Coastal Plain" Milk Snake
Northern Scarlet Snake

Lizards

Eastern Fence Lizard
Five Lined Skink

Ground Skink

Turtles
Snapping Turtle
Eastern Mud Turtle
Stink Pot
Spotted Turtle
Eastern Box Turtle
Diamondback Terrapin
Eastern Painted Turtle
Red-bellied Turtle

AMPHIBIANS

Salamanders
Eastern Tiger Salamander (endangered)
Marbled Salamander
Red-backed Salamander
Four-toed Salamander
Northern Red Salamander

Toads
Eastern Spade-foot Toad
Fowler's Toad

Frogs
Spring Peeper
Pine Barrens Treefrog (endangered)
Southern Gray Treefrog (endangered)
Northern Gray Treefrog
Northern Cricket Frog
Striped Chorus Frog
Green Frog
Bullfrog
Carpenter Frog
Southern Leopard Frog
Wood Frog

Annotations on Rare Species.

Northern Scarlet Snake: four were captured in a drift fence between July and August 1987, including three 1986-year class juveniles; one was found dead on the Port-Elizabeth-Cumberland Road in August, 1987; two adults were observed in 1986; and there are additional records from previous years. The local population extends from the Port Elizabeth-Cumberland Road vicinity in a westernly direction perhaps as far as Millville-Vineland, and is the largest and possibly the only extant

population in New Jersey. There are scattered historical records of the species from Wharton State Forest, but it has not been seen there in recent years. Cumberland County is the last stronghold of the species, and its habitat clearly warrants immediate protection. The species is found in areas of sandy upland soils. This snake should be considered for listing as threatened or endangered in New Jersey in view of its limited distribution and the paucity of current sighting records.

Northern Pine Snake: uncommon but widely distributed throughout the drainage basin. Found nesting in 1986 1.25 miles north-northeast of the Route 47 bridge along the edge of a recently cleared, unpaved roadway. The species nests in areas of early successional vegetation and often makes use of habitats disturbed by man (Burger, 1986). However, it also requires large expanses of undisturbed upland forest adjacent to streams.

Corn Snake: not found in spite of extensive searching. The species was found in or near the drainage basin in 1972 by James Merli, but his recollection of the site location is vague. Ideal habitat for the reptile exists within the drainage basin, and there is an excellent chance that further searching for this rare, secretive, burrowing, nocturnal serpent will reveal its presence.

Timber Rattlesnake: not known to be extant. Due to the absence of any historic records for this species in the general area of the drainage basin, only limited searching for it was done. Suitable habitat for the species does exist, however, and careful searching of upland areas near stands of white cedar may yet produce this reptile.

Eastern Hognose Snake: common and widely distributed.

Pine Barrens Treefrog: common throughout the drainage basin. Found in association with intermittent coastal plain ponds and with tributary streams. In drought years such as 1986 when the intermittent ponds are dry during the spring, breeding success is sharply reduced. If groundwater pumpage or climatic events were to lower the water table over a several year period, reproductive failure could cause a decrease in overall population numbers and localized extinctions. The species has a life span of about three years.

Southern Gray Treefrog: confirmed to be extant within the drainage basin in 1987 by audiospectrogram analysis of taped vocalizations done by Dr. Howard Reinert of Allentown College, Allentown, Pennsylvania. This species is apparently widespread within the drainage basin and is subject to the same threats to its survival as the Pine Barrens Tree Frog.

Eastern Tiger Salamander: extant in 1987 at both an intermittent coastal plain pond and in an abandoned, revegetated, shallow sand and gravel pit. The species is generally found in intermittent ponds and is

known to colonize man-made excavations which fill with water during the winter and spring, becoming dry in the summer. It may be widely distributed throughout the drainage basin, but as yet has been found only in the northern portion. Lowering of the ground water table would also adversely affect the ability of this species to reproduce.

MAMMALS

The Manumuskin drainage basin has an extraordinarily diverse mammal fauna. Thirty-seven species were found to be extant in 1986-1987, and two additional species, the beaver and the mink, although not observed were thought to possibly still be present.

A subspecies of the Masked Shrew currently under review for listing as federally endangered or threatened throughout its worldwide range was tentatively identified as being present within the basin.

Keen's Myotis (a bat), the Silver-haired Bat, and the Black Rat were found to be breeding in the basin, expanding the known ranges of these animals as resident members of the fauna in New Jersey (Wolgast, 1979).

Further field work is needed in order to determine the status of the Beaver, Mink, Woodchuck and Southern Bog Lemming within the drainage basin.

Pouched
Virginia Opossum

Insect Eaters
Masked Shrew
subspecies New Jersey Coast Shrew (under review for listing as federally endangered or threatened)
Northern Short-tailed Shrew
Least Shrew
Eastern Mole
Star-nosed Mole

Bats
Little Brown Myotis
Eastern Pipistrelle
Big Brown Bat
Keen's Myotis
Silver-haired Bat
Red Bat
Hoary Bat

Rabbits
Eastern Cottontail

Rodents
Eastern Chipmunk

Gray Squirrel
Red Squirrel
Southern Flying Squirrel
Marsh Rice Rat
White-footed Mouse
Southern Red-backed Vole
Meadow Vole
Woodland Vole (Pine Vole)
Muskrat
Black Rat
Norway Rat
House Mouse
Meadow Jumping Mouse

Flesh Eaters
Domestic Dog (feral)
Red Fox
Gray Fox
Raccoon
Long-tailed Weasel
Striped Skunk
River Otter
Domestic Cat (feral)

Hoofed
White-tailed Deer

Annotations on Rare Species.

Masked Shrew: a subspecies of the Common Masked Shrew tentatively identified as the New Jersey Coast Shrew or Tuckahoe Shrew (Sorex cinereus var. nigriculatus) was collected in March 1987, but has not yet been definitively identified. Of the more than 200 Masked Shrews collected at a drift fence located about one mile north of the Route 47 bridge, only one specimen taken was the blackish form described as a subspecies in 1932 from specimens collected near Tuckahoe, Cape May County (Green, 1932).

Keen's Myotis: the two specimens caught by a cat one mile northeast of the route 47 bridge in March-April, 1987 and the specimen found roosting under the loose bark of a dead oak tree one mile due north of the same bridge in June 1987 are the southernmost records for this species in New Jersey. They represent an extension of its range to the south from Lakehurst, Ocean County. Presumed to be breeding locally.

Silver-haired Bat: one specimen was caught by a cat in January, 1986, presumably hibernating. This species is also presumed to be resident and breeding one mile northeast of the route 47 bridge.

Black Rat: identified from four skulls found in Great Horned Owl pellets along the river north of Port Elizabeth. This species is not listed as a mammal of the Pinelands by Wolgast (1979). Van Gelder (1984) describes it as an introduced European species that has largely been supplanted by the Norway Rat, and which may currently exist in the state only at port cities where it is being continuously introduced from ships. Since there has been little if any local vessel trade with Europe in the past century in this portion of southern New Jersey, it appears that the Black Rat has in fact been able to maintain itself in the presence of Norway Rats over a much longer time period than was previously believed possible.

Marsh Rice Rat: common in the tidal wetlands along the Manumuskin River. This species has a limited distribution in New Jersey. It is found primarily in the estuarine wetlands fringing Delaware Bay.

Beaver: not observed, but a beaver dam was found in 1986 north of Bennetts Mill (Moore, 1987). Known to be extant in several adjacent drainage basins.

Mink: known historically from the Cumberland Pond area in the late 1950s, this rare and secretive species has not to our knowledge been observed or trapped recently within the drainage basin. Of the total 57,472 fur-bearing mammals trapped in Cumberland County in the 1975-1976 season, only 200 (0.3%) mink were taken (Penkala, 1976). The species is believed to be extant but rare in the Maurice and Menantico Rivers.

River Otter: fairly common south of Route 49. Visits sand mining lakes on the New Jersey Silica Sand Co. property.

Southern Bog Lemming: may be present in drainage basin, but was not found, perhaps because of inadequate searching within its specialized habitat of "sedge-sphagnum-shrub bogs" (Connor, 1959). Future searching for this species should focus on intermittent coastal plain ponds.

Woodchuck: peripheral. Known historically from the drainage basin in grassy fallow fields, possibly still present. Known to be extant in Maurice River Township at the Leesburg State Prison Farm.

Extirpated Species: Timber Wolf, Bobcat, Black Bear.

BIRDS

by Clay Sutton

The Manumuskin River drainage basin has a high ornithological significance. Fifteen of New Jersey's 25 threatened and endangered species of birds occur here on a regular basis. A 1987 field survey indicated that 92 birds were breeding within the basin; an additional 13 species were either found to be breeding just outside of the basin (generally along the Maurice River) or were considered possible rather than confirmed breeders (Sutton, 1987). To date 230 bird species have been recorded within the basin (Barber, 1987), a figure that is indicative of its diverse, high quality habitat. All of the characteristic birds of the Pinelands (Leck, 1979) are present.

The state's largest Wild Rice wetlands extends from Millville to Mauricetown along the Maurice River and up the tidal section of the Manumuskin. Because of this resource, wintering waterfowl concentrations here are among the highest in New Jersey, perhaps second only to those at the Brigantine National Wildlife Refuge impoundments. Nearly 1,500 waterfowl (1,000 Black Ducks and 500 Mallards) were counted on the three mile stretch of the tidal Manumuskin, and an additional 5,500 ducks were observed on the Maurice River at its point of confluence with the Manumuskin (Sutton, 1987).

The Wild Rice wetlands are also highly important to Sora and Virginia Rails. Sora Rail concentrations along the tidal portions of the rivers historically and currently are the greatest known in the state (Bowen, 1885; Stone, 1937). Bobolinks also use these rice wetlands in spectacular numbers in the fall.

Migratory use by Bald Eagles of both the Maurice River and its tributaries, including the Manumuskin, is common in the spring and fall. Numerous birds are found wintering here from December through March, attracted by the abundant waterfowl, muskrat and fish populations of the rivers and their adjacent wetlands. Recent studies have shown as many as 6-8 Bald Eagles roosting and feeding in the area on a given day (NJDEP, 1985, 1986) and as many as 14 individuals using it during the course of the winter (Sutton and Sutton 1987). A minimum of 7 Bald Eagles used the rivers during the winter of 1987 and were seen 19 days straight just north of the confluence of the Maurice and Manumuskin Rivers (Sutton, 1987). This area constitutes one of the main eagle-use areas in New Jersey and one of only three areas where daily use occurs.

Other raptors are present in spectacular numbers as well, including Red-tailed Hawks and Northern Harrier (endangered). Daily use occurs in high numbers; for example, 19 Northern Harrier were present on February 8, 1987. Osprey fish the Manumuskin daily in summer and nest on the

Maurice River at its confluence with the Manumuskin. A minimum of four pairs of Barred Owl nest in the swampy lowlands of the Manumuskin drainage basin, over 10% of the total southern New Jersey population of this state-threatened species.

A small colony of Least Terns nested on the New Jersey Silica Sand Company property south of the western most excavation in 1985 and 1986. Young were raised in 1985 (Barber, 1987). Feeding occurs along the length of the tidal Manumuskin, making the area highly significant to this state-endangered species. Grasshopper Sparrows nested in an old field 0.5 miles northwest of the Route 47 bridge until about 3-4 years ago.

The 1987 breeding bird survey revealed the decidedly "southern flavor" of the Manumuskin basin, with the wetland corridors showing an abundance of Yellow-throated, Prothonatory and Hooded Warblers, Acadian Flycatchers, and Summer Tanagers. The density of Black-billed Cuckoos was one of the highest in New Jersey with at least 12 pairs located. Ruffed Grouse and Wild Turkey were also abundant.

In summary, the Manumuskin basin is rich in birdlife. The numbers and diversity of breeding species are significant in New Jersey. The wintering waterfowl and raptor (particularly Bald Eagle) populations on the lower Manumuskin and adjacent Maurice River are among the greatest in New Jersey, and are perhaps the largest concentrations of these birds using land not currently in public ownership or refuges in the state.

BIRDS

Relative Abundance

C	Common
FC	Fairly Common
UNC	Uncommon
R	Rare
VR	Very Rare
*	Nests locally

Seasonal Occurrence

P	Permanent
SU	Summer
W	Winter
T	Transient in spring/fall

State rarity as breeding species

EN	Endangered
TH	Threatened
DE	Declining

Common Loon	R-T	
Pied-billed Grebe	R-T	EN
Double-crested Cormorant	UNC-T	
Great Blue Heron	UNC-P	TH
Green-backed Heron	FC-SU*	
Little Blue Heron	UNC-SU	
Cattle Egret	UNC-SU	
Great Egret	FC-SU-T	
Snowy Egret	FC-SU-T	
Tri-colored Heron	R-SU	
Black-crowned Night Heron	R-T	
Least Bittern	UNC-SU*	
American Bittern	R-SU-T	TH
Glossy Ibis	R-T	
Mute Swan	R-T	
Tundra Swan	VR-T	
Canada Goose	FC-W-T	
Snow Goose	FC-T	
Mallard	FC-SU*-W-T	
American Black Duck	UNC-SU* C-W-T	
Gadwall	R-T	
Northern Pintail	UNC-T	
Green-winged Teal	C-T	
Blue-winged Teal	FC-T	
American Wigeon	UNC-T	
Northern Shoveler	UNC-T	
Wood Duck	UNC-SU*	
Ring-necked Duck	UNC-T	
Lesser Scaup	UNC-T-W	
Common Goldeneye	UNC-T-W	
Hooded Merganser	R-T	
Common Merganzer	R-T-W	
Red-breasted Merganzer	R-T	
Turkey Vulture	FC-P	
Northern Goshawk	R-W	TH
Sharp-shinned Hawk	FC-T UNC-W	
Cooper's Hawk	FC-T UNC-W	EN
Red-tailed Hawk	FC-P*	
Red-shouldered Hawk	UNC-T-W	TH
Broad-winged Hawk	UNC-SU* FC-T	
Rough-legged Hawk	VR-T	
Bald Eagle	R-W	EN
Northern Harrier	UNC-T-W	EN
Osprey	UNC-SU FC-T	TH
Peregrine Falcon	VR-T	EN
Merlin	VR-T	TH
American Kestrel	R-SU* FC-T	
Ruffed Grouse	UNC-P*	

Northern Bobwhite	UNC-P*	
Ring-necked Pheasant	VR-P*	
Wild Turkey	UNC-P*	
Sandhill Crane	VR-T (1 record)	
King Rail	VR-T	
Clapper Rail	VR-T	
Virginia Rail	UNC-T	
Sora	FC-T	
Common Moorhen	VR-SU	
Semipalmated Plover	VR-T	
Killdeer	UNC-SU*	
Black-bellied Plover	VR-T	
Upland Sandpiper	VR-T	EN
Greater Yellowlegs	UNC-T	
Lesser Yellowlegs	FC-T	
Solitary Sandpiper	VR-T	
Willet	VR-T	
Spotted Sandpiper	FC-T	
American Woodcock	FC-SU*	
Common Snipe	UNC-T	
Short-billed Dowitcher	UNC-T	
Long-billed Dowitcher	VR-T	
Semipalmated Sandpiper	R-T	
Western Sandpiper	VR-T	
Least Sandpiper	UNC-T	
Pectoral Sandpiper	R-T	
Dunlin	VR-T	
Great-black-backed Gull	UNC-W-T	
Herring Gull	FC-T-W	
Ring-billed Gull	FC-T-W	
Laughing Gull	FC-T	
Bonaparte's Gull	VR-T (2 records)	
Forster's Tern	UNC-SU-T	
Least Tern	UNC-SU*-T	EN
Rock Dove	FC-P*	
Mourning Dove	C-P*	
Yellow-billed Cuckoo	FC-SU*-T	
Black-billed Cuckoo	R-T-SU*	
Barn Owl	R-P*	
Eastern Screech Owl	UNC-T-W	
Great-horned Owl	FC-P*	
Barred Owl	R-P*	TH
Long-eared Owl	R-T-W	
Northern Saw-whet Owl	VR-W	
Chuck-wills-widow	VR-SU	
Whip-poor-will	C-SU*	
Common Nighthawk	R-T	
Chimney Swift	C-SU*	
Ruby-throated Hummingbird	FC-SU*	
Belted Kingfisher	FC-T	

Common Flicker	C-SU* UNC-W	
Red-bellied Woodpecker	UNC-P*	
Red-headed Woodpecker	R-T	TH
Yellow-bellied Sapsucker	UNC-T	
Hairy Woodpecker	FC-P*	
Downy Woodpecker	C-P*	
Eastern Kingbird	C-SU*-T	
Western Kingbird	VR-T (1 record)	
Great-crested Flycatcher	C-SU*-T	
Eastern Phoebe	UNC-SU* FC-T	
Willow Flycatcher	R-T	
Yellow-bellied Flycatcher	VR-T	
Alder Flycatcher	R-T	
Least Flycatcher	R-T	
Eastern Wood Peewee	C-SU*-T	
Olive-sided Flycatcher	VR-T	
Tree Swallow	FC-SU* C-T	
Bank Swallow	FC-T	
Northern Rough-winged Swallow	UNC-T	
Barn Swallow	C-SU* C-T	
Cliff Swallow	R-T	EN
Purple Martin	C-SU* FC-T	
Blue Jay	C-P*	
American Crow	C-P*	
Fish Crow	FC-T-W (increasing)	
Black-capped Chickadee	VR-W	
Carolina Chickadee	C-P*	
Tufted Titmouse	C-P*	
White-breasted Nuthatch	UNC-P*	
Red-breasted Nuthatch	FC-T-W	
Brown Creeper	UNC-T-W	
House Wren	C-SU*-T	
Winter Wren	R-T-W	
Carolina Wren	FC-P*	
Marsh Wren	C-SU*	DE
Sedge Wren	VR-T	EN
Northern Mockingbird	FC-P*	
Gray Catbird	C-SU* C-T	
Brown Thrasher	FC-SU*	
American Robin	C-SU* UNC-W	
Wood Thrush	FC-SU*	
Hermit Thrush	FC-T-W	
Swainson's Thrush	UNC-T	
Gray-cheeked Thrush	R-T	
Veery	FC-T	
Eastern Bluebird	R-SU* UNC-T	
Blue-gray Gnatcatcher	FC-SU*-T	
Golden-crowned Kinglet	FC-T-W	
Ruby-crowned Kinglet	FC-T R-W	
Water Pipit	VR-T (2 Records)	

Cedar Waxwing	R-SU* FC-T-W	
Loggerhead Shrike	VR-T	EN
European Starling	C-P*	
White-eyed Vireo	FC-SU* C-T	DE
Yellow-throated Vireo	R-SU* UNC-T	
Solitary Vireo	UNC-T	
Red-eyed Vireo	C-SU* C-T	
Philadelphia Vireo	VR-T	
Black and White Warbler	C-SU*-T	
Prothonotary Warbler	UNC-SU*-T	
Worm-eating Warbler	R-T	
Golden-winged Warbler	VR-T	
Blue-winged Warbler	UNC-SU* C-T	
Tennessee Warbler	UNC-T	
Orange-crowned Warbler	VR-T	
Nashville Warbler	UNC-T	
Northern Parula	FC-T	
Yellow Warbler	C-SU* C-T	
Magnolia Warbler	UNC-T	
Cape May Warbler	UNC-T	
Black-throated Blue Warbler	FC-T	
Yellow-rumped Warbler	C-T R-W	
Black-throated Green Warbler	UNC-T	
Blackburnian Warbler	UNC-T	
Yellow-throated Warbler	R-SU* R-T	
Chestnut-sided Warbler	UNC-T	
Bay-breasted Warbler	UNC-T	
Blackpoll Warbler	FC-T	
Pine Warbler	C-SU* C-T	
Palm Warbler	FC-T	
Praire Warbler	UNC-SU* FC-T	
Ovenbird	C-SU* C-T	
Northern Waterthrush	FC-T	
Louisiana Waterthrush	UNC-SU* R-T	
Kentucky Warbler	R-T	
Mourning Warbler	VR-T	
Common Yellowthroat	C-SU* C-T	
Yellow-breasted Chat	UNC-SU* R-T	
Hooded Warbler	R-SU* UNC-T	
Wilson's Warbler	R-T	
Canada Warbler	FC-T	
American Redstart	UNC-SU* C-T	
House Sparrow	C-P*	
Bobolink	UNC-T	TH
Eastern Meadowlark	R-SU* FC-T	
Red-winged Blackbird	C-SU* C-T	
Orchard Oriole	UNC-SU* UNC-T	
Northern Oriole	FC-SU* FC-T	
Rusty Blackbird	R-T	
Common Grackle	C-SU* C-T	

Brown-headed Cowbird	C-SU* C-T	
Scarlet Tanager	FC-SU* UNC-T	
Summer Tanager	R-SU R-T	
Northern Cardinal	C-P*	
Rose-breasted Grosbeak	UNC-T	
Blue Grosbeak	UNC-SU*-T	
Indigo Bunting	FC-SU* FC-T	
Pine Grosbeak	VR-W	
Evening Grosbeak	FC-T-W	
Purple Finch	FC-T-W	
House Finch	FC-P*	
Common Redpoll	VR-W	
Pine Siskin	FC-W (sporadic)	
American Goldfinch	C-P*	
Red Crossbill	VR-W	
White-winged Crossbill	VR-W	
Rufous-sided Towhee	FC-SU* FC-T	
Savannah Sparrow	UNC-T	TH
Grasshopper Sparrow	R-SU R-T (formerly nested)	TH
Vesper Sparrow	VR-T	EN
Dark-eyed Junco	C-T-W	
American Tree Sparrow	R-W	
Chipping Sparrow	C-SU* C-T R-W	
Field Sparrow	FC-P*	
White-crowned Sparrow	R-T	
White-throated Sparrow	C-T-W	
Fox Sparrow	UNC-W	
Lincoln's Sparrow	VR-T	
Swamp Sparrow	C-SU* FC-T	
Song Sparrow	C-P*	
Acadian Flycatcher	UNC-S* VR-T	

INVERTEBRATES

Much fieldwork needs to be done before the invertebrate communities of the drainage basin can be adequately inventoried. There are a number of globally rare invertebrates recorded from southern New Jersey which could conceivably be found in the drainage basin since appropriate habitat and food plants appear to be present. These include:

MOTHS

Acronicta albarufa
Agrotis buchholzi
Catocala herodias gerhardi
Catocala pretiosa
Cerma cora
Faronta rubripennis
Heterocampa varia
Hypomecis buchholzaria
Itame sp. 1
Lithophane lemmeri
Loxagrotis sp. 1
Merolonche dolli
Meropleon titan
Metalectra richardsi
Metarranthis apiciaria
Metarranthis pilosaria
Metarranthis sp. 1
Neonympha areolatus septentrionalis
Papaipema duovata
Psectraglaea carnosa
Ptichodis bistrigata
Pyreferra ceromatica
Schinia bifascia
Spartiniphaga carterae
Zale sp. 1
Zanclognatha sp. 1

BUTTERFLIES

Mitoura hesseli
Speyeria idalia

DRAGONFLIES

Enallagma recurvatum
Somatochlora georgiana

BEETLES

Nicrohorus americanus

The following individuals are recognized authorities on the rare invertebrates of New Jersey: moths and butterflies, Dr. Dale Schweitzer; dragonflies and damselflies, Dr. Frank Carle; and beetles, Howard Boyd.

A disjunct (outlying from the main distribution) population of the Allegheny Mound Ant, Formica exsectoides, is known to have been present in the drainage basin as recently as 1980, and is presumed to be extant. A paper by the late J.A. Starkey (Starkey, 1968) describes a colony of the ant in Vineland which he believed to be the only one in the coastal plain region of New Jersey. The colony extended over a 50-acre area within an oak forest. Individual ant mounds averaged 4-5 feet in diameter and 10 inches in height, and were found in "roughly circular areas free of trees for a 60-75 foot diameter." Starkey noted that charcoal was occasionally mixed with the soil particles from which the mound was constructed, and mentioned that the forest had at one time been cut over for charcoal production. The land was in fact within the Cumberland Furnace tract, and it seems likely that the clearings were former sites of groups of charcoal pits (Sim, 1955; Sinton, 1982; Robichaud, 1973). According to Starkey, as the forest canopy closed over the clearings, the ants abandoned the mounds. He expressed concern that successional growth of the forest would ultimately cause extirpation of the ant colony. When visited in 1980, several mounds were found to be active along an open trail parallel to the Manumuskin River. In the following year the tract was clear-cut for oak firewood, but the effect of this activity on the colony is not known. More information is needed on the status of the population and its regional distribution. If, as appears to be the case, the population is disjunct or relict (a remnant of a population that was once more widely distributed), protection and management are clearly warranted. The colony was 1.1 miles south of the Old Mays Landing Road bridge on the west side of the river in 1980.

FISHES

Thirty-five species of fish are known to inhabit the Manumuskin River system. They can be separated into three general groups: (1) species which are restricted to the downstream side of the freshwater/brackish water interface within the tidal section of the river; (2) species characteristic of acid waters upstream of the freshwater/brackish water interface; and (3) species which cross the freshwater/brackish water interface. The tidal section of the river extends for a distance of three miles upstream of the river's mouth. The head of tide is at a point about halfway between the railroad bridge and Fries Mill.

As discussed in the hydrology section, stream runoff in the Manumuskin generally declines during the summer months, reaching the lowest levels of the year in September and October. As streamflow decreases, salinity in the river rises, and the interface between brackish water and freshwater moves upstream within the three-mile long tidal portion of the river. Fishes adapted to low salinity and near-neutral pH then enter the Manumuskin from the Maurice River, moving upstream within the zone of brackish water conditions.

After the growing season draws to a close the situation is reversed; river flow increases, salinity and pH levels drop, and the freshwater/brackish water interface moves back downstream. Species adapted to acid freshwater are then able to move downstream from the non-tidal section of the river into the tidal portion.

There are only two species resident on both sides of the freshwater/brackish water interface: the American Eel and the Chain Pickerel. Three anadromous species, the Alewife, Blueback Herring and the Striped Bass enter the tidal portion of the river to spawn in the spring. The Alewife is known to move far beyond the head of tide, ascending up the non-tidal portion of the river as far as the dam at the Cumberland Pond impoundment (Barber, 1987). The Yellow Perch is resident in the tidal section of the river, but may ascend into non-tidal waters to spawn.

The freshwater/brackish water interface is a place of rapid change in pH. Surface water in the non-tidal section of the Manumuskin has a salinity of 0.1 ppt. On July 17, 1987 the pH at Fries Mill 0.4 miles upstream of the head of the tide was 4.5. At the railroad bridge, 0.6 miles downstream of the head of tide, the salinity was 0.3 ppt and the pH 5.6; an increase of only 0.2 ppt in salinity thus resulted in a pH rise of more than one unit. Generally speaking, the fish fauna of the Manumuskin appear to be arrayed on one side or the other of this zone of pH and salinity change. For example, on July 13, 1987 the White Perch

and the Tesselated Darter were collected by John O'Herron at the railroad bridge, but less than 0.2 miles upstream an entirely different assemblage of fish was caught: the Eastern Mudminnow, Creek Chubsucker, Pirate Perch, Blackbanded Sunfish and Bluespotted Sunfish.

All of the fish species found in the non-tidal section of the Manumuskin during sampling on August 1, 1987 are characteristic of acid-water streams. Among them were six of the seven species thought to be restricted in their distribution within New Jersey to the Pinelands: Swamp Darter, Black-banded Sunfish, Banded Sunfish, Mud Sunfish, Pirate Perch and Yellow Bullhead (Morgan, 1983). Six of the seven acid-water fish with a widespread distribution throughout the state were also found: Eastern Mudminnow, Creek Chubsucker, Chain Pickerel, American Eel, Redfin Pickerel and Bluespotted Sunfish. The Tesselated Darter and Spottail Shiner, which are considered peripheral to the Pinelands because they are not found in acid-water, were collected only in the tidal portion of the river downstream of the freshwater/brackishwater interface. All of these findings strongly indicate that the non-tidal portion of the Manumuskin provides undisturbed habitat for both characteristic Pinelands and widely distributed acid-water fish species (Morgan, 1983). There is no indication that the aquatic community has been modified by disturbance. During periods of high river flow, the acid-water fish fauna move downstream into the tidal portion of the river. At times of low streamflow, this migration is reversed and the tidal portion of the Manumuskin becomes a spawning and nursery grounds for migratory and resident species adapted to brackish salinity and near-neutral pH such as the Atlantic Menhaden, Bay Anchovy, Hogchoker, Golden Shiner, White Perch, White Catfish, Spot and Weakfish.

Within recent years two fish species, Bluegill and Pumpkinseed, have been introduced into the Cumberland Pond impoundment annually at the time of the Sportsmen's Jamboree held in September. Stocking is being done by the state Department of Environmental Protection's Bureau of Freshwater Fisheries. It is not known for certain whether these species are reproducing within the low pH conditions of the Pond. Other species such as Brown Catfish, Channel Catfish and Largemouth Bass may have been introduced in the more distant past, but it is not known whether they are still extant (Bolton, 1987).

At least one fish species, the Eastern Chain Pickerel, has been observed in an intermittent coastal plain pond. The species apparently colonized the pond sometime during late 1985 or in 1986, but was extirpated when the pond dried in the summer of 1986 (Moore, 1987). Such extirpations probably occur routinely in most years.

For more information on the fishes of the Manumuskin River drainage basin, readers are referred to the report by John O'Herron and Rudolph Arndt (1987).

FISHES

Herrings
Alewife
Blueback Herring
Atlantic Menhaden

Anchovies
Bay Anchovy

Mudminnows
Eastern Mudminnow

Pikes
Redfin Pickerel
Eastern Chain Pickerel

Minnows
Golden Shiner
Spottail Shiner

Suckers
Creek Chubsucker

Freshwater Catfish
White Catfish
Yellow Bullhead
Brown Bullhead
Channel Catfish

Freshwater Eels
American Eel

Killifishes
Banded Killifish
Mummichog

Pirate Perches
Pirate Perch

Sea Basses
White Perch
Striped Bass

Sunfishes
Mud Sunfish
Blackbanded Sunfish

Bluespotted Sunfish
Banded Sunfish

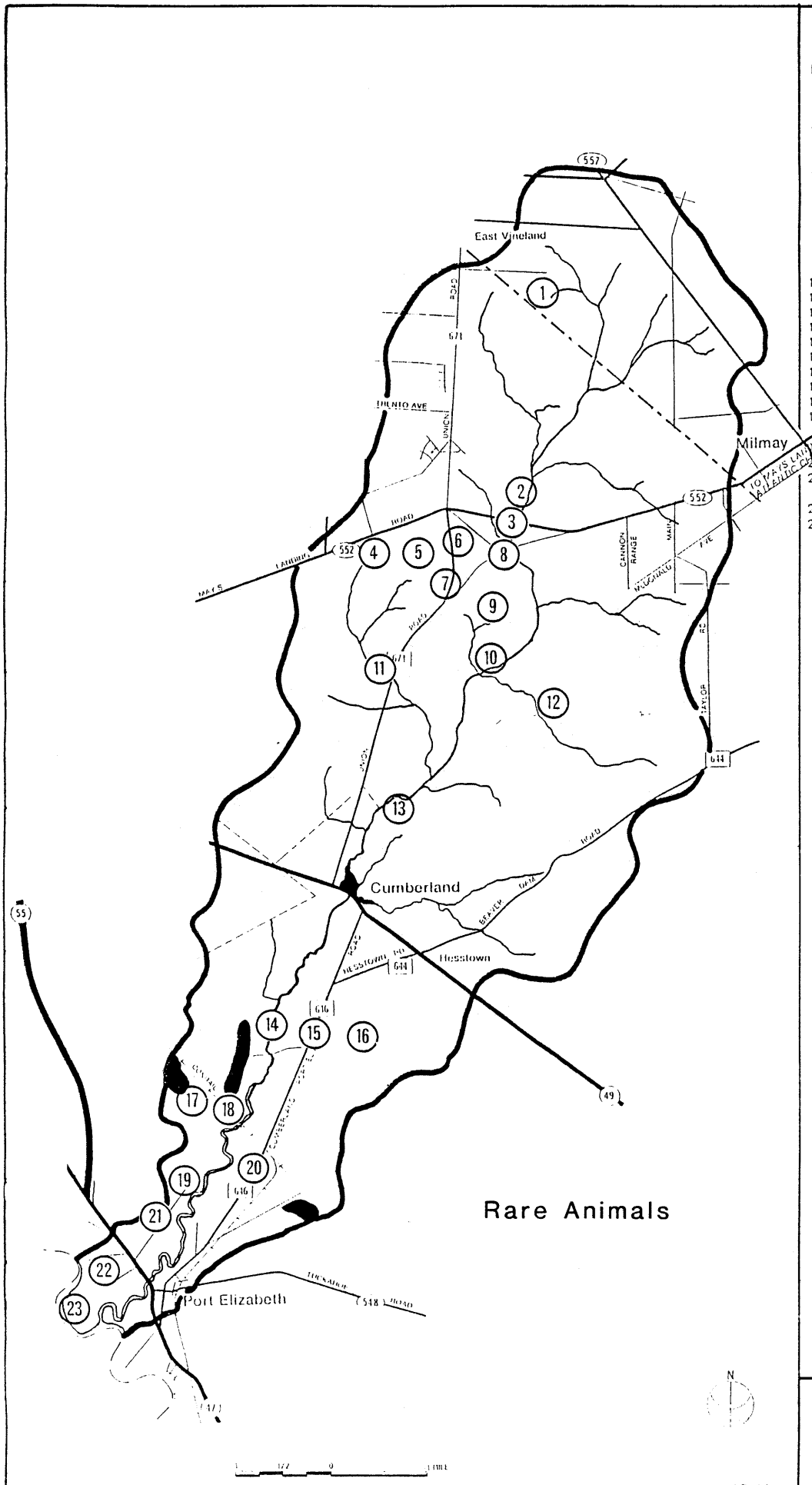
Perches
Swamp Darter
Tesselated Darter
Yellow Perch

Bluefishes
Bluefish

Drums
Weakfish
Spot

Silversides
Rough Silverside
Inland Silverside
Atlantic Silverside

Soles
Hogchoker



RARE ANIMAL STATIONS

1: Tiger Salamander
Southern Gray Tree Frog
2: Barred Owl
3: Southern Grey Treefrog
4: Pine Barrens Treefrog
5: Pine Barrens Treefrog
6: Pine Barrens Treefrog ,
Southren Gray Treefrog
7: Pine Barrens Treefrog
8: Pine Barrens Treefrog.
Southren Gray Treefrog
9: Pine Barrens Treefrog
10: Allegheny Mound Ant
11: Pine Barrens Treefrog
12: Northern Pine Snake
13: Barred Owl
14: Barred Owl
15: Southern Grey Treefrog
16: Pine Barrens Treefrog
17: Least Tern
18: Northern Scarlet Snake
19: Northern Scarlet Snake,
Northern Pine Snake,
Pine Barrens Treefrog
20: Northern Pine Snake
21: North Jersey Coast Shrew,
Pine Barrens Treefrog
22: Barred Owl
23: Osprey

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3742/3

RECREATION

Recreational activities pursued within the drainage basin include hunting, fishing, ORV riding, rifle shooting, boating, hiking, bird watching and nature study, trapping, ice skating, bicycling, horseback riding, snowmobile riding, camping, and artifact collecting.

Hunting is an extremely important recreational and social activity in this rural area. There are four major types of hunting, each of which focuses on a different animal or group of animals within a particular habitat and season: (1) big game (exclusively deer); (2) waterfowl (primarily wood duck in non-tidal wetlands, and black duck, mallard, pintail and teal in tidal wetlands); (3) upland game (mainly grouse, but also rabbit, quail and squirrel); and (4) rail bird.

Deer season is a major community event throughout the drainage basin. Deer are hunted with muzzle loading rifles, shotguns or with bow and arrow. The hunting may be done alone or in groups. During bow season individuals hunt from tree stands raised ten to fifteen feet above the ground. There are also solitary methods of hunting with muzzle loading rifles or shotgun which involve standing still or walking slowly through the woods, pausing frequently. In contrast, groups of 30 to 40 people are needed for the stand and drive system of deer hunting in which part of the group walks through the woods flushing the deer and pushing them toward a line of stationary hunters. Hunting clubs have been formed in order to supply sufficient manpower for this type of hunting, and a number of the clubs (Meadowood, Goodsports, Menantico, Hesstown, and Hickory Gun Clubs) have constructed lodge facilities within the drainage basin in Maurice River Township and Vineland for their members. Unlike solitary methods of hunting deer, the stand and drive technique involves a good deal of interaction and coordination among hunters, which fosters a strong feeling of camaraderie.

A related form of recreation is rifle practice and shooting competitions. The Cumberland Riflemen operate a National Rifle Association-affiliated rifle, pistol and shotgun range in Vineland at which local, statewide and mid-Atlantic region shooting competitions are held.

Rail bird season is a culturally significant, uniquely local type of hunting which focuses on the Sora Rail, a species which pauses during its fall migration south to the West Indies in order to feed on wild rice seeds in the tidal portion of the river. Rail birds are hunted from wooden skiffs poled or "pushed" through the marshes at high tide. The skiffs are a specialized design and are locally made. Formerly "reed birds" (bobolink) were hunted in the same manner, but this has been a protected species for many years. A number of local residents

supplement their incomes by hiring out as skiff "pushers" during rail season in September.

Fishing is also a popular sport. Small motorboats and canoes are used at Cumberland Pond with access points on the south and west border of the impoundment. On the tidal section of the river, boats are put in at a small public landing owned by Maurice River Township on the southeast side of the Route 47 bridge. Shoreline fishermen commonly position themselves along the west bank of the river south of the Route 49 bridge, on the railroad bridge at Manumuskin, and at the previously mentioned public landing below Route 47 in Port Elizabeth. In the freshwater section of the river, Eastern Chain Pickerel and Yellow Perch are commonly caught, while White Perch is reliably present in the tidal section, followed in importance by Alewife and an occasional Striped Bass. The impoundment at Cumberland Pond is stocked annually with Bluegill and Pumkinseed.

Small motorboats and canoes are fairly frequently seen on the tidal portion of the river and at Cumberland Pond. Much boating activity is related to fishing or hunting, but there is also a considerable amount of traffic entering from the Maurice River on weekends in the summertime which seems to be primarily sightseeing or random cruising or speeding.

During the past two decades there has been a great increase in the use of two-wheeled motorbikes in the basin, and, within the last five years, in the use of three-and four-wheeled ATVs (All-Terrain Vehicles). All of these motorized devices may be subsumed under the heading of ORVs (Off-Road Vehicles). There are numerous sand trails crisscrossing every part of the basin used by ORVs, and this form of recreation is almost continuous throughout the year. It has both an organized and unorganized aspect. "Enduros" are motorbike racing competitions organized by local groups. As the name suggests, these are grueling timed competitive events in which adult drivers proceed as rapidly as possible through a series of check points along a marked course, pushing themselves and their vehicles to the limit of endurance. The course may be as much as 50 miles long, winding through woods and crossing streams. Much ORV use is also unorganized recreational activity primarily involving younger people. In addition to local roads and trails, highly disturbed areas such as sand mining excavations and borrow pits are favored recreational locations.

Trapping is both a sport, and for some people, a supplement to income. Muskrat is far and away the most important species trapped in the basin as is suggested by the fact that it comprised 96% of all fur-bearing mammals taken in Cumberland County during the 1975-1976 season (Penkala, 1976). Muskrat and otter, the other short-furred mammal commonly trapped, are predominantly taken in tidal wetlands, but a few may also be captured in the non-tidal section of the river. Mink would be found in the same habitats if they are present in the basin, but beaver are likely to be only in the non-tidal section of the river.

Long-furred mammals--the fox, raccoon and opossum--are trapped primarily in low-lying and upland forested areas. The drainage basin is a good area for trapping because of its undeveloped character.

The wildlife and plants of the drainage basin attract a few naturalists to the area, and many local residents enjoy watching birds or observing deer and other animals. The basin is known regionally for its rare reptiles and plants.

Historic sites and stream corridors are constantly visited by artifact collectors. Probably the majority of these individuals are searching for Indian artifacts, but a substantial number hunt for objects from the historic period using metal detectors or dig in search of bottles and other objects made of glass.

Other forms of recreation are much less important than those thus far mentioned. The numerous unpaved roads and trails which exist throughout the basin make it an excellent place for hiking and horseback riding. However, an important circumstance limits these types of recreation, the abundant insect population encountered from about mid-April through mid-September.

Bicycling, on the other hand, seems to be hindered by the soft texture of the sandy soils, which mandate either wide tires or foregoing off-road traveling altogether in favor of paved roads.

Ice skating and snowmobile riding are limited by the relatively brief periods of sub-freezing weather during the winter months. The intermittent coastal plain ponds along both sides of Union Road south of Mays Landing Road are popular ice skating sites because they are shallow, safe, and freeze more quickly than larger bodies of water. Snowmobiles are seldom seen in the basin, but when weather circumstances permit, travel widely across the terrain.

Camping also seems not to be a major recreational activity locally. There are, however, no public or private facilities in the basin established for this purpose at present.

In summary, the Manumuskin drainage basin is a popular place for outdoor recreation, particularly hunting, fishing, ORV riding and boating. The long tradition of economic dependence upon local natural resources in this rural area is expressed in its choice of recreational activities, which take people out into the forests, streams and fields. Hunting in particular is rich in meaning to local residents; its tools and techniques which have been handed down through the generations form a chief subject of conversation and provide a welcome opportunity for families and friends to spend time together. Hunting, fishing and trapping are in themselves relicts of a disappearing rural way of life, one of careful attentiveness to the changing seasons, to the particularities of small places, and to the living creatures and plants

which surround us.

A unique local event, the Sportsmens Jamboree, celebrates this tradition each fall. For two days the Cumberland County Federation of Sportsmens Clubs invites the general public to a cluster of hunting lodges along Union Road north of Route 49 where the techniques of their ancient sports are demonstrated. Interested people can learn how to shoot a rifle or take aim with a bow, see how muskrats are trapped or spend some time fishing in Cumberland Pond. The function is not just an expression of hospitality, but is also a plea for understanding addressed to the urban and suburban populace which is threatening to entirely displace from this state truly rural communities and the way of life they represent.

SCENIC RESOURCES

As might be expected simply from its largely undeveloped character, the Manumuskin drainage basin is a beautiful place. As one proceeds through the landscape heading from south to north, a meandering tidal river gives way to a densely forested freshwater stream, interrupted in several places by small mill ponds. Farms and orchards mark the uppermost extent of the basin, and small villages are interspersed throughout it.

The tidal portion of the river is one of the most lovely canoeing streams in southern New Jersey. The river winds through an open brackish water wetlands teeming with wildflowers throughout the summer months. A dense stand of Pickerel weed, Pontedaria cordata, gives the wetlands a blue coloration, accented by the intense scarlet of the Cardinal Flower, Lobelia cardenalis, and the large pink and white blossoms of the Rose Mallow, Hibiscus palustris. Skirting the edge of the wetlands are White Cedar and Pitch Pine trees which lend their somber dark green to the scenery year-round.

The uplands rise rather sharply from this floodplain, affording a wide view out over the river. The upland forest is oak and pine. Fallen trees covered with moss litter the forest floor, and in the autumn wildflowers and mushrooms line a trail that parallels the east bank of the river. The red brick Port Elizabeth Methodist Church and cemetary overlook the Wildrice wetlands through which thousands of waterfowl, rail birds and bobolink stream in their annual migration south. Near the old church is a white one-room schoolhouse with a cupola, and further north scrubby thickets in a grassy field mark the site of the earliest glassworks established in the Pinelands. Children find arrowheads on the baseball diamond. Probably half of the homes in Port Elizabeth are more than a century old.

At the head of tide one-half mile north of the railroad bridge, there is a fast land on the west side of the river where a canoe can be pulled out and a picnic enjoyed. In the surrounding area crumbling wooden cabins with ironstone fireplaces, the foundations and raceway of an old gristmill, and an abandoned cedar-shingle and clapboard stagecoach tavern are found along trails crisscrossed by the ridges of tunneling rodents. Fence lizards scurry in the underbrush, bird feathers and owl pellets lie beneath trees, and Hognose Snakes fake death if surprised while sunning in the trail path.

Two miles further north, Cumberland Pond spreads over 29 acres, assuming the color of the skies above it, fringed by pines. The ruins of a long abandoned bog iron forge and furnace--one of 30 such early industrial complexes in the Pinelands--lie in the ground nearby, and the

graves of the families who worked there are marked by tombstones made of iron.

For a distance of four river miles to the north there are no structures within one mile of the Manumuskin on either side. Union Road traverses this small wilderness of oak and pine, occasionally crossed by cathedral spires of White Cedar marking the path of a tributary stream. South of Mays Landing Road the nasal duck-quack-like call of the Pine Barrens Tree Frog can be almost deafening on rainy nights in May. The inch-long male frogs are announcing their presence to females. Courtship is completed in the waters of coastal plain intermittent ponds around which the emerald green frogs are arrayed in shrubs. Black ducks nest in the same ponds, and when the ponds dry out in the summer they fill with a unique group of rare plants. Families ice skate over the surface of the ponds in winter after rising groundwater levels once again fill them.

Along the edge of the river the anthills of the Allegheny Mound Ant are swarming in summer, and like the chiggers, the gnats, the mosquitoes, the flies and the ticks of the drainage basin, the ants advance to bite sharply, memorably, but democratically, all persons regardless of race, creed, sex, age, nationality or any other distinguishing human trait. Near their mounds are two large stones, survey markers implanted by the West Jersey Society of Proprietors nearly 300 years ago when the wilderness was first subdivided and sold to the subjects of His Royal Majesty, King William III.

North of Mays Landing Road is another world. Nearly every part of Italy sent representatives to raise vegetables and fruit on the flat sandy soils here in the 1870s through 1890s. The streets are named for the places from which the settlers came: Piacenzia, Genoa, Trento, Palermo and of course Italia. In this rural area there are two Catholic churches only a mile apart. At one of them a grotto dedicated to our Lady of Lourdes and the stations of the cross have been built of stone, and are lovingly maintained. All of the names on the mail boxes are Italian, names like Smaniotto, Cresci, Cavagnaro, and Badarocco.

Aesthetic judgements are inevitably subjective. This overview of the scenic resources of the basin attempts to incorporate something of both the substance and the spirit of comments made by local residents at the public hearing held on September 3, 1987. There are a variety of landscape types within the drainage basin, virtually all of which have been influenced by man. Nevertheless, the actions of man have not disfigured this area; it is, for the present, still a place of quiet beauty.

AGRICULTURE

Agriculture is one of the oldest economic activities in the drainage basin, and continues to be important today. Among the first soils to be farmed continuously were the tidal wetlands, which were embanked as early as 1745. No more than 400 acres of these soils were ever farmed along the Manumuskin at one time, but they produced good crops of hay and grain and were crucial to the early settlement of the area (Vanaman, 1936).

As commercial fertilizers became available in the nineteenth century, narrow strips of upland were cleared along the floodplain of the river from its mouth to about one mile south of the railroad bridge. Isolated tracts further north along the Port Elizabeth-Cumberland Road, and in the vicinity of Hesstown, Cumberland and Bennetts Mill were also cleared and planted in crops. However, agriculture was a relatively minor land use in the basin until 1873, when the "Italian Colony" was established along Landis and Genoa Avenues in the areas known as East Vineland and New Italy at the extreme northern end of the basin.

Charles K. Landis, the founder of Vineland, made an intensive effort to attract Italian settlers to his community. In the late 1870s he retained Carlo Quairoli, an Italian war hero and graduate of two universities in Italy, to promote settlement and to assist the immigrants with problems experienced in the new homeland. Most of the earliest settlers were from northern Italy, but by 1911 Quairoli estimated that 49% of the immigrants had come from northern provinces, 15% from central, and 36% from southern. The settlers from the first specialized in raising fruits and vegetables. Italian farmers also settled near Milmay in the late nineteenth and early twentieth century (Biondi, 1961; Quairoli, 1911).

Today much of the land in the southernmost portion of the drainage basin once cleared for agriculture has been abandoned and is returning to woodland. Extensive areas formerly used for egg and poultry production near Milmay and along Mays Landing Road west of Union Road have also been recently abandoned. The only place where new lands have been cleared for farming within the past fifteen years is in the vicinity of Chestnut Avenue on both sides of Union Road, and even here more land has been abandoned than brought into production. Deducting 5% of the computed agricultural land use area as consisting of roads and structures, about 1,790 acres (2.8 square miles) is actively farmed today--eight percent of the total land area in the basin. About 1,500 acres are farmed north of Mays Landing Road, nearly all of which are irrigated. These row-crop vegetable farms in the heart of the "Italian Colony" are prosperous.

Fresh vegetables are the chief agricultural product of the drainage basin, although fruit tree crops of peaches and apples are also produced. Typically two vegetable crops are harvested per growing season. Farms are small, averaging 60 acres, and family-owned, although migrant labor assistance is essential. Products are generally sold at the Vineland Cooperative Produce Auction, which operates a facility on Main Road in Vineland from April through November. The cooperative has 665 farmer members in the southern part of New Jersey who sell to 35 buyer-brokers. In 1986 $47 million worth of products were sold at the auction for marketing throughout the eastern United States and Canada to chain stores, wholesale grocers and other receivers. Among the chief crops of the East Vineland area are: parsley, scallions, cabbage, lettuce, onions, peppers, squash, spinach, cucumbers, broccoli, beets, greens, radishes, tomatoes, corn, melons, beans, potatoes and peaches. In all more than sixty different fruits and vegetables are raised locally (Bylone, 1987).

Irrigation is an essential component of the production of high-value vegetable crops. According to Rooney (1971) the annual application rate of water in Cumberland County averages about twelve inches per acre irrigated. Assuming 1,500 acres are irrigated in the basin, the demand would amount to about 489 million gallons of groundwater per year: less than 4% of the total amount added to the groundwater annually from precipitation in the drainage basin as a whole. Approximately 75% of the demand occurs from June through September (Vowinkel, 1984), and some localized dropping of the water table is likely to occur along the northern basin divide during these months.

The long-term future of agriculture in the drainage basin is uncertain. Among the problems voiced by farmers are rising land values, conversion of farmland to development, high labor costs and real estate taxes, increasing foreign and domestic competition, air pollution, decreased funding for research, and conflicts with non-farming neighbors and governmental agencies (Fair Agricultural and Industrial Regulations Committee, 1976).

PREHISTORY

During a 10,000-year-long climatically cold period beginning about 28,000 years ago, a vast glacial ice sheet progressed south across the continent of North America, advancing to within 60 miles of the Manumuskin drainage basin. The glacier was about 3,000 feet thick at the New York-New Jersey border, and its terminal edge has been described as "a great gray wall of ice, channeled by meltwater streams and streaked with deposits of soil and rock, towering several hundred feet... above a desolate tundra-like landscape" (Anderson, 1976).

By binding up precipitation in the form of ice, continental glaciers have a pronounced effect on sea level, which is lowest when glaciation is at its maximum and rises when warming temperatures cause the glacial ice to melt. Sea level fell 340-430 feet below its present height during this last glaciation, causing the Atlantic Ocean to recede 75-100 miles offshore of the present coastline (Sirkin, 1977; Kraft, 1977; Edwards, 1977).

Approximately 18,000 years ago the ice sheet began to melt in response to a global warming trend which continues to the present day. Runoff flooding from the edge of the glacier as it retreated northward gouged deepened channels in the Delaware River and its tributaries and caused sea level to mount. About 12,000 years ago the rising waters of the Atlantic Ocean flooded the valley of the Delaware River and Delaware Bay was formed in the large topographic depression west of the Capes.

During the cold post-glacial period, the vegetation of the coastal plain of southern New Jersey was a tundra-like open grassland. In the Manumuskin drainage basin several hundred intermittent ponds were formed by frost/thaw action at this time. Approximately 11,000 years ago grasslands gave way to pine forests, and by 10,000 years before the present oaks had become the dominant component of the vegetation (Sirkin, 1977).

A change in climate--namely warming temperatures--brought about these shifts in vegetation, which in turn affected animals adapted to the disappearing grassland and coniferous forest habitats. A wholesale extinction of such large mammals as the mastodon, mammoth, moose-elk, giant beaver, ground sloth, saber-toothed tiger, dire wolf, and short faced bear occurred about 10,000 years ago. Other cold-adapted species were able to follow the retreating ice sheet to the north, where mammals such as the musk-ox, caribou, elk, moose, walrus and Arctic hare are found today (Kraft, 1986).

Small bands of people--aboriginal hunters and gatherers--appeared in the Delaware valley region 10,000-12,000 years ago. At least one

fluted Clovis projectile point (arrowhead), the earliest artifact left by these peoples, has been found along the shoreline of Delaware Bay near Fortescue (Jones, 1982), and a camp site continuously occupied over a period of 9,000 years has been identified on the west bank of the Maurice River at the Salem/Cumberland County line (Mounier, 1975).

Another continuously occupied site at least 4,000-6,000 years old has been discovered along the Maurice River about one mile north of the mouth of the Manumuskin. Projectile points, scrapers, pottery, smoking pipes, charcoal, animal bones, hickory nuts and oyster and clam shells have been found in excavations here, providing a glimpse into the subsistence economy of the time period. The presence of objects made from non-local stone such as argillite and quartzite demonstrates that a trade relationship existed with peoples as far removed as the upper Delaware Valley (Mounier, 1974).

Aboriginal artifacts have also been found on the land surface and to a depth of about three feet on the uplands bordering the Manumuskin River at least as far north as Bennetts Mill and probably extending into the headwater areas as well. In most cases surface finds have been made within 300 feet landward of the wetlands edge. Artifacts are particularly numerous along the tidal segment of the river, much of which has been disturbed to some degree by development or agriculture (State Atlas Sheet No. 35, 1886). The depth of disturbance by plows ranges from 6 inches to two feet (Mounier, 1984). Nonetheless, in excess of one mile of forested land along the tidal section of the river has never been cleared, and the non-tidal section of the river is in a virtually pristine condition. In some places undisturbed sites also probably exist below the plow zone. R. Alan Mounier, the foremost authority on the prehistory of the region, has commented that, "The Maurice River tidewater area of southern New Jersey is archeologically rich and much neglected" (Mounier, 1974).

Recent archeological research has demonstrated that intermittent coastal plain ponds (generally referred to as "pingos" in the archaeological literature) in Burlington County, New Jersey were frequently used as hunting sites by aboriginal peoples (Bonfiglio, 1982). Clusters of these ponds are widely distributed within the Manumuskin drainage basin, and are largely undisturbed by man, although they are still to this day favored hunting sites for deer. In Burlington County artifacts have been found in the greatest numbers within 300 feet south to southwest of the perimeter of the ponds. Intermittent ponds have not yet been explored for their archeological value in the Manumuskin drainage basin, but clearly have potential significance.

Another landform which often is associated with prehistoric resources in tidal areas in southern New Jersey is the "island" or knoll of high ground surrounded by salt marsh (Mounier, 1982). Such features are not known to exist in the tidal section of the Manumuskin, but

do occur in the freshwater non-tidal flood plain.

There were an estimated 2,000-10,000 Indians in New Jersey at the time of first contact with Europeans (Robichaud, 1973). Dutch, Swedish and English explorers entered Delaware Bay and River beginning in 1609, preparing the first written accounts and maps of the area. From their observations and those of other visitants along the Atlantic seaboard, some general statements can be made about the interactions of the native peoples with the local vegetation. Indians disturbed the natural vegetation by: (1) clearing areas for encampment; (2) cutting trees in order to obtain wood and bark for use in making utensils, weapons, canoes, shelters, and particularly for fuel; and (3) deliberately setting fires in order to improve the forest as a habitat for deer and other game, to make travel easier by removing undergrowth, and as a means of flushing out game animals during hunting (Robichaud, 1973).

These activities undoubtedly played an important part in modifying the native vegetation. The use of fire was particularly significant. Writing in 1765 Samuel Smith noted that, "The Indians, before the European settlements, used every year regularly to burn the woods, the better to kill deer; the manner was to surround a swamp or cripple with fire, then drive the deer out, who not daring over the bounds, were easily killed with bows and arrows; this practice kept the woods clean, so that the pigeons readily got acorns." Annual fires of light intensity would eliminate forest floor litter and create open areas, thus providing conditions favoring White Cedar and Pitch Pine over competing species. In his North American Sylva, Andre Michaux noted that White Cedar covered "almost alone the whole surface of the swamps" in the primitive forests of southern New Jersey, with Red Maple and Black Gum relegated to the "skirts" (Defebaugh, 1907).

Continuous European settlement in the general region began in 1685 when the Englishman Mark Reeve settled along the Cohansey River in the vicinity of Greenwich (Elmer, 1869). Europeans had established trade relations with the Indians at an earlier date, particularly in order to purchase furs. There may also have been periodic incursions into the area by Europeans for harvest of other resources; for example, Gabriel Thomas, writing in 1698, refers to the "Prince Morise's River (Maurice River), where the Swedes used to kill the Geese in great numbers for their feathers only" (Myers, 1912). Snow Goose flocks numbering in the thousands still overwinter in the wetlands at the mouth of the river.

POST-SETTLEMENT HISTORY

The first order of business of the new colonists was to wrest control over the land from its Indian occupants, and redistribute it to to the Europeans. In order to carry out this purpose the West Jersey Society of Proprietors was established under the auspices of the British government in 1676. By 1693 the Society had succeeded in extinguishing Indian title to the land throughout southern New Jersey. Typically tracts thousands of acres in extent were "purchased" from Indian leaders, then surveyed, mapped, recorded by deed, and finally sold to buyers in America or England.

Under the Society's direction, the first property survey in the Manumuskin drainage basin was carried out in 1691 for Benjamin Bartlett, a London merchant. The tract encompassed an estimated 10,250 acres on the east side of the Maurice River, extending inland almost as far as Cedar Branch on the Manumuskin River. It included most of the land area draining toward the tidal section of the Manumuskin. Part of the western border of the property later became the boundary line between Millville and Maurice River Township. A map of the original survey is in the collection of the Historical Society of Pennsylvania (Richards, 1954), and it is likely that the deed is still extant in the archives of the New Jersey Department of State or the office of the Society of Proprietors in Burlington, New Jersey.

According to Elmer (1869) the Indians "do not appear to have been numerous, consisting mostly of wandering tribes, having no permanent settlements, and no principal sachem or chief." Their "wandering" movements did, however, follow a regular pattern of seasonal progression from one habitat to another. Because the Indian economy was based on the harvesting of plants and animals, the entire community moved to locales where the hunting, fishing, trapping or gathering was best.

Not only did the fixed property boundaries of the new settlers entirely disrupt this way of living, but the Indians were decimated by their first exposure to European diseases such as chicken pox, influenza, measles, smallpox, typhus and dysentery against which they had developed no acquired immunity. Gabriel Thomas reported in 1698 that "the Dutch and Swedes inform us that (the Indians) are greatly decreased in numbers to what they were when (Europeans first) came into this country, and the Indians themselves say that two of them die to every one Christian that comes in here" (Myers, 1912).

Residual Indian land claims existed in the general region until 1758, when final settlements were negotiated by a committee of the state legislature. By this time only a few descendants of the aboriginal peoples remained in Cumberland County, their names occasionally

appearing in church and local government records. According to Elmer the remaining Indians earned their living by making baskets. Samuel Smith described these as being formed of "wild hemp and roots, or splits of trees" in designs which were sometimes "very curious" (Smith, 1765). By the beginning of the nineteenth century Elmer reported that the Indians had "all died or removed" (Elmer, 1869).

The word "Manumuskin" is of Indian origin (Cushing, 1883). It is both the name that the small tribe of Lenape Indians who lived along the banks of the river applied to themselves and their place name for the river (Hartman, 1983). In early documents it is variously spelled Menomuskin, Menowskin, Manumascum, Manimuska, etc. The Indian meaning of the word does not appear to have been recorded, but Samuel Smith observed that the Indians called places "by the names of things remarkable, or birds, beasts and fish" (Smith, 1765).

Writing in 1765, Smith noted that the economy of the new settlements of Europeans then thinly scattered along the coastal streams of New Jersey was based on "raising cattle in the bog undrained meadows and marshes...and cutting down the cedars." Although meat and wood products were the most important sources of income, furs and crops such as wheat and corn were also articles of trade from the time of earliest settlement (Cushing, 1883).

Colonization of Cumberland County progressed in an easternly direction. By 1686, ten years after the appearance of the English, a sawmill was in operation on a tributary of the Cohansey River in the vicinity of what is now Bridgeton. By 1715 one was also functioning on the Maurice River, and five years later Leamings sawmill on the Menantico River--the stream immediately flanking the Manumuskin on the west--was established. These early timbering operations concentrated on White Cedar, which was in demand along the Atlantic seaboard for roofing shingles, clapboard siding, and fence posts and rails. The original sawmills housed vertical frame saws and were powered by undershot wheels (Mounier, 1982). Water power was harnessed by damming streams above the head of tide and diverting the flow through raceways to the waterwheel. Existing beaver dams were often found to be serviceable for this purpose if reinforced, and the locations of such dams were prominently displayed on survey maps until well into the nineteenth century (e.g., the map of Eli Budd's lands dated 1831) (Cronin, 1983; Elmer, 1869).

The first farms in Cumberland County were established along the floodplains of tidal streams, where wetlands grasses could be harvested for use as livestock feed, and cattle and horses pastured in marshland (Elmer, 1869; Sheppard, 1883).

In 1709 the Benjamin Bartlett tract was sold to John Scott of Rhode Island, who had the property resurveyed in 1714. The map of this survey is in the collection of the Cumberland County Historical Society. It shows only two homesteads then in existence along a five-mile length of

the Maurice River from Crowder Run at what is now Dorchester to a point about one-half mile upstream of the mouth of the Menantico River. The sole dwelling within the Scott tract on the east side of the river was the Olaf Ross (William Rawson) home located adjacent to the flood plain of the Maurice River about 0.25 miles downstream of the mouth of the Menantico River. Ross operated a sawmill later known as Clark's Mill on the Menantico above the head of tide and less than one-half mile downstream of the present-day railroad crossing (Vanaman, 1985).

Ross probably came to the Maurice River from one of the settlements inhabited by Swedish, Dutch and Finnish colonists along the Delaware River. These settlements were established beginning in 1638, and in New Jersey centered along Repaupo and Raccoon Creeks in Gloucester County and in the Elsinboro and Penns Neck vicinities in Salem County. The New Jersey settlements were estimated to have a total population not exceeding 1,200 persons in 1659 (Cushing, 1883).

Shortly after 1720 Scott sold a half-mile-wide strip of land fronting on the east side of the Maurice River between the Manumuskin and Menantico Rivers to members of the Hoffman family. A remarkably accurate circa 1745 map in the Cumberland County Historical Society collection shows that this 713-acre tract had been divided into parcels owned by Jonas, Peter, Frederick and John Hoffman. Several riverfront homes are depicted on the map as well as the Nicholas Hoffman house along the north bank of the Menantico River about one-half mile upstream of its mouth (the approximate location of the present-day Route 47 crossing).

The map also shows the log Swedish Evangelical Lutheran Church on the Peter Hoffman property north of the terminus of the present-day Spring Garden Road, where services were first conducted in June, 1745. It was the first church established in eastern Cumberland County. Sermons were delivered in the Swedish language until at least 1748. Due to its remote location, the church was visited by a Swedish Lutheran pastor only three times in 1749, and was described by Israel Acrelius, provost of the Swedish Lutheran Churches in America, as "a place where the people lived almost as heathens." Evangelists of the German Moravian sect also travelled from Pennsylvania to minister to the congregation on an irregular basis until 1757. By 1770 the last Swedish Lutheran missionary resident in southern New Jersey estimated that only 200 persons remained in South Jersey who could partly speak and understand Swedish. In December, 1772 the Maurice River Church was visited by a Swedish Lutheran pastor for the last time, but records of births and deaths were maintained in the Church Book until October, 1798 (these records were reproduced in Bowen, 1885 and Vanaman, 1936, but the whereabouts of the Book today are unknown). By this time settlers of Swedish descent had been assimilated into the English-speaking population. Methodism had supplanted Lutheranism as the dominant Protestant faith of the Manumuskin drainage basin in 1786, when Cumberland County's first Methodist Church was established at Port

Elizabeth. Swedish names (often Anglicized) still found in the general area include Hoffman, Vanaman, Peterson, Errickson, Camp, Cobb, Jones, Riggin, Henderson and Cox (Elmer, 1869; Acrelius, 1759; Cushing, 1883).

The first loop of the Maurice River north of the mouth of the Manumuskin River is designated on the circa 1745 map as "Hoffman's Banked Meadow." The embankment of tidal wetlands by construction of earthen dikes five feet or more in height was accomplished in order to bring the fertile river floodplains into agricultural production. The "blue mud" bottomland soils were far higher in organic matter, clay and silt than the sandy upland soils of the region, and were particularly valued for raising crops of hay. Until artificial fertilizer and lime first came into use in about 1819, "reclaimed meadowlands" were by far the most valuable farmlands. John Hoffman's embanked plot is believed to be the first reclaimed salt marsh on the Maurice River, and it was still being cultivated as recently as 1936, when only 200 acres of meadow farmland remained along the Maurice River between Muskee Creek and the Menantico River. The high cost of maintaining the dikes in the face of rising sea levels and storm events causing tidal flooding has led to their gradual abandonment (Bowen, 1885; Vanaman, 1936; Elmer, 1869; Acrelius, 1759).

The development of a rudimentary system of local government accompanied settlement of the region. The northernmost portion of the Manumuskin drainage basin came within the limits of Gloucester County after its establishment in 1686. This area later became part of Atlantic County when it was set off from Gloucester County in 1837. The remainder of the drainage basin was within the confines of Cape May County from 1692 to 1710, when it was transferred to Salem County. This area was included within the boundaries of Cumberland County when it was severed from Salem County in 1748. Maurice River Township is first mentioned in the records of Salem County in 1717. Millville and Landis Townships were set off from it in 1801 and 1864, respectively. Landis Township became the City of Vineland in 1952. Buena Vista Township in Atlantic County was set off from Hamilton Township in 1867 (Cushing, 1883; Sheppard, 1883; Snyder, 1968).

The first public road to cross the drainage basin was opened in approximately 1707. Known as the Old Cape Road, it linked the village of Cape May with Greenwich and Salem, roughly following the path of the present-day Route 49 through the basin. This was possibly the thoroughfare described by Thomas Chalkley in 1726: "From Cohansey through the wilderness over Maurice River... a miry, boggy way in which we saw no house for about forty miles." The roads of the day were often former Indian trails, winding, narrow and interspersed with trees. They followed the path of least natural resistance. Overland travel was by horseback rather than carriage until after the Revolutionary War. Relatively few bridges existed during the eighteenth century, and streams were typically crossed at mill dams above the head of tidal influence (Sheppard, 1883; Elmer, 1869).

The Old Cape Road probably crossed the Manumuskin River at the site of a sawmill. These were the first foci of settlement inland from the floodplain of the Maurice River, and thus were the points at which roads converged. Logs and sawn lumber were floated downstream from the swmills or carted to the tidal portion of the river where they could be loaded aboard sailing vessels for shipment to market in Philadelphia, New York and other destinations. Salem County records indicate that a license was granted in 1740 to John Bell to operate a tavern on the east side of the tidal Manumuskin in the vicinity of what is now Port Elizabeth. This area was later referred to as "Board Landing," and it is probably safe to assume that it was the central shipping point for cedar logs and lumber on the Manumuskin (Elmer, 1869; Defebaugh, 1907).

According to Beesley (Cook, 1857), most of the White Cedar stands in neighboring Cape May County had been located by 1750, and it is likely that this was also the case in the Manumuskin drainage basin. An existing survey map clearly depicts several cedar stands in the twin upper forks of the Manumuskin in what is now Buena Vista Township, Atlantic County. The accompanying deed indicates that the stands were sold in 1757 (Bernstein, 1976).

Most of the scattered settlements in the general region during the 1760s were near cedar swamps where lumbering operations were underway (Wacker, 1975). One such village was established at Fries Sawmill above the head of tide on the Manumuskin in about 1770. A tavern that still stands was built prior to 1802 at the western end of the mill dam.

Samuel Smith commented in 1765 that White Cedar stands along the Atlantic Coast were "now much worked out." As early as 1749 the Swedish botanist Peter Kalm had expressed concern that overharvesting might actually lead to extinction of the species. He complained that in their forestry practices the settlers of southern New Jersey were "bent only upon their present advantage, utterly regardless of posterity" (Benson, 1937).

However, the demand for lumber increased after the Revolutionary War, particularly in rapidly growing Philadelphia which was then the largest city in the United States. Cutting and hauling timber to wharves along navigable streams became the leading business activity in Cumberland County. Upland oaks acquired value for use in construction and ship building, and a network of roads gradually developed throughout the basin to carry logs to sawmills and to wharves. Taverns providing food and lodging came into existence in conjunction with the expansion of the wood trade. By the time Doughty's Tavern was established in 1779 at the northernmost extent of the drainage basin in what is now the town of Milmay, the forestry resource of the entire basin was accessible by sand road (Sheppard, 1883).

With the growth in population and development of industry in the

United States after the Revolution, wood also came into increasing demand for use as fuel. A booming trade in cordwood began in Cumberland County that continued for nearly a century. Other wood products also produced in the drainage basin included tar, bark for tanning of hides, and hoops and staves for the manufacture of barrels (Sheppard, 1883; Bowen, 1885). The average value of pine forests in southern New Jersey increased from ten cents to $6 per acre during the period 1790 to 1830, and by the latter date White Cedar stands were worth $100-300 per acre (Gordon, 1834).

In 1778 the New Jersey legislature passed a measure authorizing landowners to form corporations in order to embank and drain tidal wetlands for agricultural use. Before 1782 an earthen dam was erected across the tidal Manumuskin in approximately the same location as the present-day Route 47 highway crossing. The dam blocked the upstream movement of salt water during high tides, and at low tide freshwater passed in a downstream direction through sluice gates installed in the dam. By these means the water level of the river upstream of the dam was lowered by about four feet, permitting several hundred acres of floodplain along a two-mile stretch of the Manumuskin to be farmed. The dam apparently was maintained until 1889, when it was destroyed by tidal flooding (Hartman, 1983; Bowen, 1885).

Another, and probably much more important, consequence of the dam was that it provided a bridge across the tidal section of the river wide enough to accomodate wagons. Bridges capable of bearing heavy loads were rare at the time, and there were even fewer such crossings over navigable (i,e., tidal) streams. Although bridges had been built across the tidal Cohansey and Maurice Rivers as early as 1716 and 1755, respectively, they were designed for foot traffic and were not widened and strengthened until the beginning of the nineteenth century (Elmer, 1869; Sheppard, 1883)..

Construction of the dam focused attention on the area as a center of commerce. Wharves were built (probably by Maurice River Township) on the east bank of the Manumuskin immediately downstream of the new dam. At this bustling location Elizabeth Clark began in 1785 to lay out the streets of a new village and to sell lots subdivided from her 213-acre property. Port Elizabeth (the town was named in honor of its founder) was the first village to spring into existence in eastern Cumberland County (Elmer, 1869; Bowen, 1885).

The Manumuskin drainage basin also became the site of one of Cumberland County's earliest industrial facilities in approximately 1785, when a bloomery-forge for the production of wrought iron smelted from bog ore was built along the river about 5.5 miles north of Port Elizabeth. This was followed in 1799 by the Eagle Glass Works, the third glass factory to be opened in New Jersey. The facility was established at Port Elizabeth and produced window glass and hollow ware (containers). The Cumberland Iron Furnace was erected about 4.5 miles

north of Port Elizabeth in 1810. Pig iron was smelted from iron ore in the furnace and cast into products such as iron stove parts. One year later a glass factory producing hollow ware, the Union Glass Works, was opened at Port Elizabeth (Elmer, 1869; Bowen, 1885; Gordon, 1834; Pepper, 1971).

These facilities made Port Elizabeth the center of industry in Cumberland County and a close rival of Bridgeton in population and commercial importance. The chief factor drawing industry to the Manumuskin drainage basin was the availability of inexpensive fuel in the form of wood. Vast quantities of it had to be burned in order to generate and maintain over long periods of time the intense heat needed to melt, purify and mold glass and iron products into finished form. It was less costly to transport the raw materials to the source of fuel than to attempt the reverse (Elmer, 1869; Pierce, 1957; Davis, 1949).

Although little is known about the bloomery-forge, it probably had a relatively small production capacity. The average forge output in New Jersey in 1802 was about twenty tons of iron per year (Swank, 1892). In a small open hearth furnace probably made of stone, ore was presumably heated with charcoal fuel blown upon by a bellows. The "bloom" or pasty lump of molten pig iron thus smelted was then pounded into wrought iron by mechanically-operated hammers. The final product could have been in the form of bars of wrought iron or finished articles such as tools, horseshoes or wagon tires--objects requiring great strength (Swank, 1892; Pierce, 1957).

The ore from which the iron was smelted is known as bog ore, a type of limonite. It is found in southern New Jersey along stream channels and in swamps where iron is precipitated from groundwater as it discharges at the land surface (see Soils section of this report). Local deposits were soon exhausted, and ore had to be imported from a variety of other locations. The fuel used in the bloomery-forge was charcoal, a refined wood product. Locally cut wood was piled in mounds approximately thirty feet in diameter, covered with clumps of turf, and slowly burned over a two week period. It took from 100 to 300 bushels of charcoal to produce one ton of iron (Starkey, 1962; Elmer, 1869).

Water power was also essential to the production of iron. A dam was constructed across the Manumuskin at Forge Avenue in order to power the bellows (which supplied a forced draft of air to the furnace, greatly intensifying the heat generated within it), and to drive the hammer for crushing ore and pounding pig iron into wrought iron. The forge is identified by the name "Defiance" on William Watson's 1812 map of New Jersey, and its exact location is shown on Thomas Gordon's accurate state map of 1828. Mention is also made of the forge in Gordon's Gazeteer (1834).

Cumberland Furnace was a major industrial facility of an entirely different order than the bloomery-forge. It was undoubtedly capable of

producing hundreds of tons of iron per year. The Furnace was located west of the Manumuskin River on the south side of the present day Route 49. The dam which created Cumberland Pond was constructed in order to provide water power for the Furnace. A survey map of "Eli Budd's Lands" dated 1831 in the collection of the office of the City Engineer of Millville clearly shows both the Furnace and the associated Wesley Budd mansion house (which is still extant), but does not seem to illustrate the bloomery-forge. If the map is accurate, Cumberland Pond in 1831 was more than twice as large as it is today. The head of the Pond is shown as being upstream of White Oak Branch, whereas at present it is found about 0.3 miles downstream of that point.

During its thirty-year period of operation, the Furnace was owned by a succession of wealthy Philadelphians. Stove plates and other items cast in molds were the chief products manufactured. Ore was brought by sailing vessel to Schooner Landing at the head of navigation on the tidal Menantico River, and carried overland in wagons on Schooner Landing Road 3.25 miles to the Furnace site (Elmer, 1869; Beers map of Cumberland County, 1862).

Port Elizabeth's glassworks burned untreated cordwood and were not dependent upon water power (Vanaman, 1965). The chief raw material used in the manufacture of glass is quartz sand high in silica content. The sand found locally is relatively free of impurities coating the surfaces of the grains, and thus can be used in the manufacture of clear glass. The first glass sand deposits worked were apparently along the Maurice River, probably about 0.75 miles northwest of Port Elizabeth. An immense glass sand deposit was discovered along the west bank of the Maurice in about 1804. It extended from the mouth of Buckshutem Creek for several miles in a northernly direction and provided a major impetus for the development of the glass industry throughout southern New Jersey (Elmer, 1869; Pepper, 1971).

Beginning in the early nineteenth century, the cylinder method of producing "window light" (clear glass window panes) was used at the Eagle Glass Works. The procedure involved the hand blowing of a 50-70 pound mass of molten glass into a six foot balloon. When the ends were cracked off, a glass cylinder remained, which was then split down the middle into two curving sheets. These were reheated and flattened, and finally cut into panes (Pepper, 1971).

The characteristics of the local sand imparted a slightly aquamarine color to the thin sheets of window glass produced at the Eagle Works, a color which was intensified when the blowers produced hollow ware. These pieces were "free blown" rather than formed in molds, and today are highly prized as an American folk art form. Adeline Pepper (1971) suggests that the Port Elizabeth glassworks "must have exerted as much influence in shaping American glass as did Wistarberg and the early Stanger works at Glassboro."

Some surviving tableware from Port Elizabeth was made from a canary-colored glass, and red and emerald glass slag have also been found at the Eagle Works site. A wine glass of clear amber color from Port Elizabeth is shown in George and Helen McKearin's book, American Glass (1965), and a charming oil lamp is illustrated in Adeline Pepper's book (1971). Quite a number of local pieces were displayed at the Port Elizabeth Centennial Celebration of 1885 (Bowen, 1885).

Although many of the individuals involved in the management of the glassworks were Quakers, nearly all of the blowers were German, most of whom had previously worked in Glassboro in Gloucester County. They carried on their work in the German language, and after years of holding services in private homes, established Cumberland County's first Roman Catholic Church in Port Elizabeth in 1845. The Rev. Walter Leahy in his history of the Catholic diocese of Trenton remarked that St. Elizabeth's Church had "one of the best choirs in the state" (Leahy, 1905; Gordon, 1834).

Port Elizabeth was a flourishing commercial center for over half a century after its founding. There is record of a school having been established as early as 1783, and the community's first church (Methodist) was erected in 1786. Two years later a small hotel was built in town. In 1789 Port Elizabeth was designated the port of delivery for the Maurice River region by act of the United States Congress. The first public road linking the community with another town--Tuckahoe to the east in Cape May County--was opened in 1796 (Elmer, 1869; Bowen, 1885).

In 1779, the same year that the Eagle Glass Works commenced production, a tannery and a Quaker meeting house (the second in Cumberland County) were erected on the west side of the Manumuskin. Port Elizabeth was selected as one of five communities to have post offices on the weekly Woodbury to Cape May stage coach mail route established in 1802. By 1812 the Brick and Lee shipyard was producing wooden sailing vessels for the coasting trade at Port Elizabeth, and in the same year a Baptist Church was built. A ferry across the Maurice River went into operation in 1813, shuttling between the Spring Garden Roads on opposite sides of the River. In 1818 a public road was laid out connecting Port Elizabeth with the new town of Millville, which had been founded in 1801. The first bridge across the tidal Menantico River was built along this road (now Route 47). The bridge was equipped with a draw so as to enable masted sailing vessels to pass upriver to Schooner Landing. A bridge was also placed across the Manumuskin in 1812, but because the dam blocked passage of vessels upstream, no draw was thought necessary. Finally, in 1827, while Port Elizabeth was at the acme of its prosperity, the community's beloved red brick Methodist Church was erected. (Elmer, 1869; Sheppard, 1883; Bowen, 1885).

The U.S. Census of 1830 revealed that Maurice River Township had become the most populous of Cumberland County's eight municipalities

with 2,724 inhabitants, nearly one of every five citizens then living in the County. Port Elizabeth had four stores, two tanneries, a tavern, a mortuary, a "commodious" academy, 80 to 100 dwellings, two hotels and its own resident physicians and attorneys in 1834 (Gordon, 1834). The trade in wood was probably at its historic peak. Bowen (1885) recalled that, "In the early morning the first line of teams on their way to the wharves would measure half a mile in length." Some ship building was still being done in Port Elizabeth in 1834, and the embanked meadowlands were said to be worth $100 per acre (Gordon, 1834).

Yet by 1865 Elmer would describe Port Elizabeth as a "decayed village." Virtually all of its major industries had foundered. Port Elizabeth's German colony moved to Millville and Bridgeton in the 1850s (with the exception of a few families in the Port Elizabeth and Hesstown areas), and numerous homes, stores and churches were abandoned (Sheppard, 1883; Leahy, 1905).

The Union Glass Works was a casualty of the finacial depression following the war of 1812. After the Treaty of Ghent in 1814 American manufacturers suffered severely from competition with Great Britain, which dumped glass products in vast quantities into the American market. Although a tariff was introduced in 1816, the Glass Works went out of business in 1817 (Bowen, 1885; Pepper, 1971).

Cumberland Furnace was abandoned in 1840 when, according to Elmer, the supply of charcoal from a 15,000 acre tract of woodland connected with the factory was "entirely consumed." It is highly likely that other factors contributed to the Furnace's demise as well. New Jersey's largest and purest deposits of bog ore were found along the Atsion and Wading Rivers. After having been mined for nearly eighty years, they were severely depleted by 1830. Thereafter furnaces throughout southern New Jersey experienced great difficulties in obtaining ore, and were forced to import rock ore at substantial additional expense (Pierce, 1957; Pearse, 1876; Gordon, 1834; Cook, 1868).

At the same time, coal was replacing wood as the industrial fuel of choice in metallurgy. Bituminous coal from the Richmond, Virginia fields was available in Philadelphia by 1789 (Swank, 1892). Its first use in Cumberland County was at the Reeves and Whitaker iron foundry in Bridgeton after 1822. By 1834 two vessels were employed in transporting coal to the foundry, which produced 250 tons of iron castings per year (Gordon, 1834).

By 1833 the "hot blast" technique which had revolutionized iron production in Great Britain had been adapted for use with inexpensive Pennsylvannia anthracite coal. Heating the draft of air before it was introduced into the iron furnace made it possible to smelt iron with untreated coal for the first time. By 1841 there were already fifteen hot blast furnaces operating in northeastern Pennsylvania and northern

New Jersey in close proximity to anthracite coal deposits and plentiful hard rock iron ore reserves of purer grade than southern New Jersey bog ore. For each ton of iron produced at the hot blast furnaces, only two tons of coal were burned, whereas the cold blast furnaces consumed five tons of charcoal per ton of iron smelted (Swank, 1892; Johnson, 1841).

Cumberland Furnace was not only of an outmoded design, but its location more than three miles inland from a navigable waterway placed it under an irredeemably severe transport handicap. It proved to be prohibitively expensive to transport overland not only the ore but also the fuel needed for iron smelting. Competition from hot blast furnaces forced all of the cold blast furnaces in southern New Jersey out of business by 1854 (Swank, 1892).

The Eagle Glass Works fell victim to some of the same economic forces. Wood eventually became a factor of high cost in glass production too, and after 1855 the glass factories in New Jersey began to use anthracite coal. Again, reliance on the new fuel heavily favored factory sites fronting on navigable streams since water transport by vessel or barge was by far the most economical method of bulk shipment (Weeks, 1883; Pepper, 1971). Unfortunately, the dam across the Manumuskin blocked access of vessels to the Glass Works site. The factory closed in 1857 after nearly 60 years of operation, and although it reopened later and functioned spasmodically for a number of years, Port Elizabeth's days as a leading manufacturing town were over (Leahy, 1905; Bowen, 1885; Sheppard, 1883).

Another community had eclipsed Port Elizabeth as the dominant trade center of the tidal Maurice River region. Like Port Elizabeth, Millville began its existence as a shipping point for lumber. The town was founded in 1801, but it was not until 1814 that Millville actually had its first mill. In that year the Union Mill Pond was created by the damming of the freshwater Maurice River about 2.75 miles upstream of the present-day Route 49 bridge. Its water power drove the machinery of a cold blast iron furnace built in the same year which was quite similar in design to Cumberland Furnace. About 600 tons of iron castings--primarily parts for cast iron stoves--were produced annually from bog ore smelted at the factory. Window glassworks were also erected in 1806 and 1832 (Elmer, 1869; Sheppard, 1883; 1824 survey map of Millville).

Millville's factories were different from those found in Maurice River Township in one crucial respect: all three were sited on the waterfront of a navigable stream. When an improved bridge was built across the Maurice River in 1807, it was equipped with a hoisting draw so that sailing vessels could continue to reach the two plants upstream of it (Sheppard, 1883; survey map of Millville by E.B. Foster dated 1826 in the Wheaton Historical Association collection, Millville).

Millville's blast furnace ceased operations in 1849, but unlike Cumberland Furnace it was replaced in the following year and on the same

site by two new coal-burning foundries. Their combined annual production of four to five thousand tons of iron castings dwarfed that of their predecessor. Iron was no longer smelted directly from ore. Instead pig iron was purchased (probably from the new hot blast furnaces in Pennsylvania and northern New Jersey), remelted, and cast into an entirely new product then in great demand: water- and gas-pipe. The foundries employed 125 workers and produced goods valued at $350,000 per year at the time of Sheppard's History of Cumberland County in 1883.

Millville's glassworks demonstrated the same kind of ability to adapt to changing economic circumstances. Not only did both survive the conversion to coal fuel in the early 1860s, but they also shifted from window glass to hollow ware production. Glass bottles are still being manufactured today at the site of the South Millville works established in 1832 (Elmer, 1869; Sheppard, 1883; Pepper, 1971).

As coal superseded wood as the industrial fuel of choice in the middle of the nineteenth century, severe repercussions were felt in the cordwood trade. As early as 1857 Beesley noted the "failure in some measure of wood and lumber" in neighboring Cape May County. By the mid-1860s Sheppard recorded that "the small saw-mills which were situated on nearly every branch of the Maurice River had been left idle, and most of them have been destroyed, and the ponds have mostly disappeared by the going down of the dams." The draw on the bridge across the Menantico River was seldom used by 1873, Sheppard observed, "owing to Schooner Landing having fallen into decay, and the wood trade having almost entirely ceased." Ten years later he described the condition of the Cumberland County forests east of the Maurice River as follows:

"...there are still large tracts of unimproved land, pine constituting a much larger proportion of the timber than in the western (part of the County). Most of this has been cut off for lumber and firewood several times since the settlement of the county. Along the upper portions of the different streams were formerly tracts of cedar swamp, many of them quite extensive and of great value; most of these have been cut off and the cedar timber converted into shingles, siding, rails, etc."

The furnaces and glassworks which once depended on wood had consolidated huge tracts of undeveloped forest. The Eagle Glass Works held title to at least 2,900 acres of timberland in 1815, but this was a small holding in comparison with the 20,000 acres owned by the heirs of Richard D. Wood in the early 1880s. The Wood property included the lands formerly attached to Cumberland Furnace. It extended six miles in a north-south direction from south of the Cumberland Furnace site to the Atlantic County border. At its widest point it stretched from the Menantico across to the Tuckahoe River, taking in an entire section of the Manumuskin drainage basin lying between the two streams. The boundaries of the Wood property are shown on the 1862 Beers map of Cumberland County (identified as "Sharp Tract" and "R.D. Woods Tract").

With the advent of coal, such remote timberlands depreciated in value to only a few dollars an acre (Vanaman, 1965; Sheppard, 1883).

Charles K. Landis, an enterprising young real estate developer, conceived the idea of purchasing a number of the large forested properties and establishing a new community. Beginning in 1861 he assembled a 28,000 acre tract which came to be known as Vineland, and which encompassed the northwestern portion of the Manumuskin drainage basin. Landis vividly described his forested property and its 200 inhabitants at the time of purchase:

"The whole tract was a wilderness of a forbidding aspect; no beautiful parks, but oak of second or third growth, pine and brush, all of which had been swept by fires. The lay of the land was graced by no pleasing diversity of the surface; it was level, with sufficient roll for drainage--about nine feet to the mile--but many miles were covered by small streams and swamps that needed to be drained. That it had no population was a positive advantage, as it lessened the opposition I would meet with in my plans. Yet there was a population to a certain extent, of wood choppers and charcoal burners who lived around in log cabins with clay floors, a people as simple, and almost as barbarous in their habits as though they lived a thousand miles from Philadelphia... These people worked for only fifty cents a day, paid in orders on the stores at Millville. Their supplies usually consisted of pork, whisky, and tobacco and an occasional calico dress for wife or daughter. They owned no land" (Landis, 1903).

Landis began an aggressive and effective advertising campaign by which, in Elmer's wry words, "the real and supposed advantages of the location for a prosperous settlement were made known throughout the Northern and Eastern States." In only nine years the new community had a population in excess of 7,000, making it Cumberland County's largest municipality (Sheppard, 1883).

Land sales began to slack off in the early 1870s, however, forcing Landis to develop a new strategy. He began an advertising campaign directed at attracting Italian immigrants to Vineland, a plan which proved extra- ordinarily successful. By 1873 new settlers were streaming into Vineland from northern Italy. They established farms along Landis and Genoa Avenues in an area that later came to be known as East Vineland, but which was originally called the "Italian Colony." The community extended across the northern perimeter of the Manumuskin drainage basin (Biondi, 1961; Quairoli, 1911).

The farmers of the Italian Colony specialized in raising fruits and vegetables. They were Roman Catholics, and by 1885 had established the second Italian Mission chapel in New Jersey in East Vineland. In a few years this became St. Mary's parish with a resident priest. In 1908 Our Lady of Pompeii parish was formed in nearby New Italy. The congregation in 1976 was composed of about 70 families, primarily

"Tyrolese of Trento, Venetians and Sicilians--all farmers," in the words of an historical pamphlet privately published by the parish (De Marco, 1976). With the help of his parishioners, Father Eugene Fiteni erected the stone Grotto of Our Lady of Lourdes in 1938, and between 1945 and 1947 completed the "Calvario," a masonry replica of Mount Calvary. The church's 50th annual Our Lady of Lourdes Festival will be held on the first Sunday after Labor Day in 1988 in thanksgiving for a successful harvest.

Italian farmers also settled at a later date along the northeastern portion of the Manumuskin drainage basin. They were joined by an influx of Polish immigrants after 1890, and the two groups formed a small community that came to be known as Milmay for its location midway between Millville and Mays Landing. The Philadelphia and Sea Shore Railroad was routed through the town before 1894, and a post office was established in 1897. A factory, sawmill and hotel are said to have been established in the community at about that time (Anonymous, 1967).

In about 1905 the Waldeck Company, a firm headquartered in the South, purchased a substantial tract of land in the vicinity of Waldeck Avenue and Cannon Range Road in Buena Vista Township, and attempted to raise tobacco. A land office, 30-40 workers' houses, tobacco curing barns, a cafeteria, and a machine shop were built on the site, but unexpected difficulties were experienced in curing the crop in the New Jersey climate. The Company apparently attempted to lower the water table beneath its land by digging a network of drainage ditches. A licorice crop was also reportedly tried before the community was abandoned some ten to fifteen years after its establishment (Anonymous, 1967).

Beginning in about 1915, sand mining corporations discovered extensive deposits of sand, gravel and clay in the drainage basin. There are no active mining operations on the west side of the Manumuskin at present, but land holdings totalling in the thousands of acres are maintained by the New Jersey Silica Sand Corporation in Maurice River Township, and by the Morie Company and U.S. Silica in Vineland. On the east side of the Manumuskin two concerns are currently excavating sand deposits north of Port Elizabeth, George F. Pettinos, Inc. and WHIBCO. The sand is shipped to market both by truck and by rail.

The Manumuskin drainage basin is rich in history, and because of the relatively slow rate of change in the southern two-thirds of the basin since the time of the Civil War, many of its historic features have not yet been destroyed.

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INVENTORY OF HISTORIC SITES AND STRUCTURES WITHIN THE MANUMUSKIN DRAINAGE BASIN

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INVENTORY OF HISTORIC SITES AND STRUCTURES WITHIN THE MANUMUSKIN DRAINAGE BASIN

by Jean Jones

1. SAWMILLS

1A Bennett's Mill. Located on the upper Manumuskin, southwest of Milmay. Date of construction not established but it is shown on an 1831 map (Fig. 1-a) as Hall & Buzby sawmill, owned by Clement Hall and Nathaniel Buzby. This mill could be much older, since cedar logging is known as early as 1758 on the upper Manumuskin. Not acknowledged on Stewart's 1876 atlas maps and possibly had ceased operation by that time. The area presently is owned by the Department of Environmental Protection, Division of Fish, Game and Wildlife.

Two dams have been built at Bennett's Mill. The original earthen dam is about a quarter-mile south of a more recent dam on Old Mays Landing Road. A road leading across the original dam led to Doughty's Tavern to the east and connected with Union Road to the west. This road does not exist as such in 1987 but Samuel DeRosa, a lifelong resident of Milmay, says the road was passable as a trail and was used by hunters in the first quarter of the 20th century and possibly longer.

The 1831 map (Fig. 1-a) locates the sawmill at the east end of the dam and places a dwelling on the west side of the creek and slightly north of the dam. An undated composite map (Fig. 1-b) drawn by surveyor Charles S. Hartman spanning the time period 1770-1900 located a sawmill and raceway west of the creek and downstream of the dam. No dwelling is indicated on this map.

A mound of sandstone was found at the eastern end of this dam in 1987 and may be the sawmill foundation. Two long timbers are visible on the bottom of the creek and may have been part of the water control system.

Because of a very dense overgrowth of briars, no attempt was made to locate a possible raceway or mill foundations on the west side of the creek, as shown on Hartman's map, in 1987.

No house foundations were found on the west side of the creek, but DeRosa says there were sandstone foundations on a grassy knoll which were dismantled and removed by area residents for other use.

The upper dam was constructed more recently, probably when Old Mays Landing Road was built after 1884, leaving the lower portion of the millpond a bog. See also 3A, 4A, 4B, 5H and 6B.

1B Eli Budd's sawmill (Fig. 2-e). Located on the south side of Route 49, below Cumberland Pond. Probably first built ca. 1800 or shortly thereafter following construction of the iron furnace. There probably were two mills, the last operated by Sam Cameron until 1915.

Early maps (Fig. 2 a-c), ca. 1820-1830, show three raceways at this location, although an 1831 map of Eli Budd's Lands indicates only one. There is no question that the westernmost raceway served the furnace but maps differ on where the saw and grist mills were located.

Cumberland resident William Otto recalls the ruins of a sawmill on the west bank of the creek, rather than any raceway. He says a large turbine was salvaged from the mill and sold by a junk man for scrap around 1936. Otto describes the turbine as having a shaft about six feet long, straight up, and a rotor about 4-1/2 to 5 feet in diameter. This would indicate a mill of more recent construction that the old Budd mill.

A ca. 1820 map (Fig. 2-a) shows the furnace and an unidentified structure on the westernmost raceway. Two ca. 1830 maps (Fig. 2-b & 2-c) show the furnace and unidentified structures on the two other raceways. The 1831 Budd map (Fig. 3) depicts the furnace and an unidentified structure west of a single raceway. An insert from the 1862 Pomeroy map of Cumberland County (Fig. 2-d) is even more vague. The furnace, gristmill and a store are west of the one raceway but too far away for the locations to be accurate. An 1876 Stewart's Atlas insert (Fig. 2-e) shows one raceway with a store and sawmill on the west side of the creek itself and an unidentified structure on the east side of the single raceway.

The furnace and grist mill ceased to operate about 1840 and it is possible that by 1862 the raceways had started to fill and were dry. A possible explanation of the differing map information may be that the grist mill was closed but still standing in 1862 and an early sawmill, probably on the first raceway, had closed in 1862 but another was operating by 1876.

An undated newpaper clipping published by the Vineland Historical Society, a sales pitch to sell land in the Cumberland area, mentions a grist mill already erected on the lower dam and a saw mill, with machinery for planing and matching, soon to be running. It does not say the grist mill is operating, merely that it is there. Other statements in the advertisement place its publication at ca. 1870.

Both Otto and Cumberland resident Tom Brown recall that water for the Cameron sawmill was channeled through a cedar trough under the old iron bridge on Route 49. The bridge was replaced and the sites of the sawmill and a small store were obliterated when the highway was widened about 1930, they say.

1C Fries sawmill. Located downstream from Budd's sawmill. Another case where two locations are given for the mill. Early maps place the mill on the west side of the creek but later maps locate it on the east side. It seems probable there were two mills at different periods.

The creek was dammed at this point by Jonathan Smith in 1770 and saw and grist mills built. A C.S. Hartman map (Fig. 4-a), based on early surveys, shows a channel running from the grist mill raceway to the creek but if this is intended to indicate another raceway it is too far south of the sawmill site. There is another channel through the swamp but its

course meanders and a 1911 map of the area indicates that this is an older creek course. The new course also was shown on this map. It was not stated when the course changed or whether the change was due to human intervention.

Maps of 1895 and 1911 place the sawmill on the east side of the creek as do maps of 1862 and 1876.

Remains of sawmills on either bank of the creek would have been destroyed when beaches were created for the camp Hollybrook YMCA camp in the 20th century. Trees were removed, considerable bulldozing done and white sand deposited on the beaches, which was periodically renewed. Any remains of foundations or water control systems would have been destroyed or buried.

Fries sawmill probably operated until near the end of the 19th century. The pond and dam apparently were intact in 1894 when its waterpower capacity was recorded by the state (see 4-F).

Owners of the mill complex, called Friendship Mills in 1780, were Jonathan Smith, William Furniss, Daniel Heisler, Benjamin Reeves and John Fries.

A pen and ink sketch of the sawmill by Phil Nutt of Vineland (Fig.5) shows the sawmill which stood on the east bank. The drawing (originally published in the Vineland Historical Society Magazine) appears to have been made from a photograph and should be accurate.

2. GRIST MILLS

2-A Budd's grist mill (Fig. 2-d). Said to have been built at about the same time as the furance, ca. 1800, south of present Route 49 and Cumberland Pond. The mill was built by Eli Budd and reportedly shut down at approximately the same time as the furnace, about 1840.

Two millstones from this mill were kept in the yard of the large, old house east of the creek and south of Route 49. This house is shown on an 1831 map (Fig. 3) as being the home of Wesley Budd, son of Eli. The stones were purchased by the Fox family in the 1940s and are in the possession of Carolyn Fox in 1987. There may be subsurface remains of the mill if they were not destroyed by highway reconstruction.

2-B Fries grist mill (Fig. 4 a-b). Located on the west side of the creek, between the swamp and a road running south on the upland. This road connected with Barth Road in Port Elizabeth. The grist mill may have been the original mill, built ca. 1770, when the pond was created.

There are extant foundations which extend above the surface for much of the perimeter. There also are parts of foundations and scattered rubble indicating other, smaller buildings around the mill. A pen and ink sketch by Phil Nutt of Vineland depicts the mill with a three-sided shelter in the foreground (Fig.5-b). This shelter was found intact, near the Simon Shaw house, where it had been moved. In 1987 it is covered with red tarpaper on the exterior. Vertical board sides are of random width, some quite wide, and show deep circular saw marks.

The mill foundation is approximately 25 by 50 feet, with a central dividing wall. It is constructed of granite and some sandstone, with some common brick among the rubble. What may have been a wide doorway in the foundation faces the raceway.

2-C Possible grist mill (Fig. 9) on Lawrens Branch, a tributary of the Manumuskin, just north of Route 49, on the east side of Cumberland Pond.

No map has been located showing a mill at this site but William Otto dug a millstone from the bank of the creek in recent years. There is a low earthen dam east of the confluence of Lawrens Branch and Cumberland Pond. The branch is shallow and water movement sluggish in 1987 but longtime local residents say the branch used to be much deeper and the current more swift.

Otto said the stone was about 18 inches beneath the surface. He did not probe for a second stone. The stone is in his possession in 1987. It measures 47-1/2 inches in diameter and about 10 inches thick, except where a piece has broken off, leaving the edge thinner.

3. RACEWAYS

3-A Bennett's Mill (Fig. 1-a). What may be the eroded remnants of a millrace on the eastern side of the creek may be found north of the stone foundation of the sawmill, but this could be merely erosion. There may be remains of a raceway on the west side of the creek if maps showing a mill at that location are accurate.

3-B Budd's sawmill (Fig. 2 a-c). Probably the easternmost raceway shown on the old maps depicting three raceways at Cumberland furnace. This also probably is the dry raceway which still can be found west of the creek.

3-C Budd's grist mill (Fig. 2-c). If this raceway is extant, it would lie within the swamp between the present creek course and the iron furnace raceway, west of the creek.

3-D Eli Budd's iron furnace raceway (Fig. 2 a-c; Fig. 3). The westernmost raceway of the three. Although all maps show this raceway leaving Cumberland Pond at the western end of the dam, longtime area residents all say that the very slight depression west of the pond is the course of the raceway and that it left the pond at a point to the north, where the bank curves westward toward Union Road, and was easily discernable 50 years ago. A catch basin has been dug where this raceway crossed present Route 49. It is located approximately 318 feet east of the Union Road intersection and about 16 feet east of a concrete marker north of the highway. In August 1987, after an extended drought, the course of the raceway could be seen as an area where the grass was noticeably greener. It probably was deliberately filled, as the raceway outside the disturbed area south of Route 49 is still fairly deep.

H. W. Vanaman has suggested that a better surge of water might have been obtained by tapping into the pond above the point where the creek channel and two other raceways drew water from it. This raceway can be

found south of the disturbed area along Route 49 and followed to the furnace ruins.

3-E Fries sawmill (Fig. 4-a). No trace of a raceway was found east of the creek. Remains of part of a raceway might exist within the swamp on the west side of the Manumuskin but it appears more likely that the mill, or mills, might have operated directly from the creek.

3-F Fries grist mill (Fig. 4-a). Raceway is intact, though dry, from south of the dam to the mill site. At this point there is standing water, which had no movement in August 1987. The raceway begins to curve toward the creek at this point, passing through a swamp area. Located west of the creek and passes through upland for much of its southward course. Parallels the old dirt road leading south toward Barth Road.

4. DAMS

4-A Bennett's Mill. South of Old Mays Landing Road. An earth berm can be followed around the lower edge of the former millpond. This mill is shown on an 1831 map (Fig. 1-a) but the actual date of construction has not been determined.

4-B Bennett's Mill upper dam (Fig. 1-b). Probably built when Old Mays Landing Road was constructed, after the 1886 N.J. Topographic Atlas. Construction of this dam left the lower portion of the millpond a bog. There is a considerable growth of spaghnum and cranberries but it could not be learned whether cranberries were cultivated here. A family named Wilks lived on the north side of Old Mays Landing Road, east of the upper dam, and was harvesting cranberries here, according to Tom Brown, who used to trap mink in this area. Brown says the family did not cultivate the berries, merely harvested what was already there during the 1950s. Cranberries also were growing in parts of the upper millpond.

4-C Wesley Budd's forge dam (Fig. 3). About one mile above the Cumberland furnace dam. Forge Avenue crossed this dam. An earthen dam, it provided pondage for an iron forge built here ca. 1810. The road crossing the dam and other roads in the area are built of slag from the iron furnace.

4-D Cumberland furnace dam (Fig. 3). Route 49 crosses this dam. Probably built ca. 1800 or earlier to provide power for the iron furnace and saw and grist mills. The 1894 Geological Survey of New Jersey reports a nine-foot fall, giving 3.16 horsepower per foot fall for nine months of the year. Only the sawmill was operating here at that time.

4-E Lawrens Branch dam. A low earthen dam crossing the branch east of its confluence with Cumberland Pond. This stream was said to be deeper and more swift at one time and may have powered a grist mill. See 2-C. Date undetermined.

4-F Fries Mills (Fig. 4-a). Built in 1770 by Jonathan Smith. Dam is intact but there is no water control system and the pond is dry. The old Bridgeton to Cape Point (Cape May) Road crossed this dam. In the 1894 state geological survey, the millpond was reported as having an

eight-foot fall, generating 3.54 horsepower per foot fall for nine months of the year.

4-G Port Elizabeth dam (Fig. 7). Bowen says this dam was built prior to 1782 when the state legislature authorized the creation of the Manumuskin Meadow Company. The dam was on the downstream side of the present Port Elizabeth bridge and continued northward to block a large meander in the creek course. This channeled the creek through a man-made canal which is the present creek course. While this dam and its system of flood gates and sluices was intact, the water level upstream of the dam was four feet lower than previously, according to C.S. Hartman, and the lowlands above the dam could be farmed without diking. Since the Manumuskin is tidal at this point, mean high tide probably was used as a comparison.

The water control system was washed out in a storm which occurred between 1889 and 1890, according to various reports. The approaches to present Route 47 today serve to keep the water within the boundaries of the channel. According to H.W. Vanaman, more than 50,000 yards of gravel were needed to fill the new approaches when the present bridge was built in 1930. Several thousands of tons of mud were displaced by the settling gravel and forced up onto the meadows on either side of the creek.

5. BRIDGES

5-A At Port Elizabeth (Fig. 7), across the 18th century dam, three bridges were built at the same location and a fourth was built adjacent to the earlier three.

A wooden bridge was built across the dam in 1821, 132 feet long, 20 feet wide and 18 inches above all tides. It was replaced in 1838 by a covered bridge built on the truss plan, 60 feet long, 20 feet wide and with stone parapets flanking the approaches at each end. When the covered bridge was replaced by a steel bridge in 1908, it was sold and the lumber used to construct sluices on the Commercial Township side of the Maurice River.

The 1908 steel bridge soon was found to have insufficient width and load-bearing capacity for the increasing traffic and it was replaced in 1930 by the present concrete bridge. The steel bridge was cut up and sold for scrap. The present concrete bridge was built next to the steel bridge upstream.

The base of one stone parapet from the 1838 covered bridge is extant. It can be found at the edge of the creek, southwest of the southern approach to the present bridge. The remains of the other parapet on this side of the creek might be present under the bridge approach. All remnants of the covered bridge on the north side of the creek, west of Route 47, were said to have been removed when Henderson's Boatyard was constructed here and a launching ramp installed at that location after 1930.

Stubs of pilings visible at low tide may be related to the covered bridge or to the sluices or flood gates. The present concrete bridge on

Route 47 is being treated as part of the site of the previous bridges, since the location overlaps.

5-B Stage Coach Road bridge (Fig. 9), called on an early map Abraham Reeves's bridge. This bridge crossed the Manumuskin at Port Elizabeth along the route of the old Millville-Port Elizabeth-Cape Island Road. It crossed from Abraham Reeve's property on the west bank to the portion of the old stage road which recently was named Reeve's Road in Port Elizabeth, on the east bank. There are timbers in the bank on the west side of the creek near the Dr. James Rosenthal House which may be part of this bridge.

5-C Railroad bridge near Manumuskin Station (Fig. 9). Built in 1862 and still in use.

5-D Bridge across the dam at Fries Mills (Fig. 4-a). The first bridge probably was built in 1770 at the time the dam was built. Replaced several times, most recently by a foot bridge, since the land on both sides now is privately owned and this is not a through road. The foot bridge now is closed and barred at each end to deter passage.

5-E Bridge across the dam at Route 49, Cumberland Road (Fig.2-e). The present bridge replaces an earlier steel bridge, which probably was successor to a series of wooden bridges. The steel bridge was replaced when Route 49 was widened to accomodate traffic about 1929.

5-F Lawrens Branch bridge (Fig. 2-e). A small wooden bridge which crosses over the dam east of Cumberland Pond and west of the Cumberland Pond trailer park. Before 1876.

5-G Forge Avenue bridge (Fig. 9). Several bridges have been built here, the earliest to accomodate wagons and later automobiles. The last two bridges have been for pedestrian use only. The present bridge consists of two telephone poles with pallets nailed across them. The pallets have been removed from the western end of the bridge.

5-H Original crossing over the old Bennett's Mill dam (Fig. 1-a). A thicket of briars now where this bridge would have crossed. There may be remains but they were not found.

5-I Bridge on Old Mays Landing Road, at the new dam (Fig. 9). This is an old concrete bridge but no date was found on it.

5-J Concrete bridge (Fig. 9) on present Mays Landing Road, Route 552. Built about 1930.

5-K Wooden bridge across the Manumuskin on the old road to Doughty's Tavern (Fig. 9).

5-L Log bridge across the Manumuskin on old Bloomingdale Avenue (Fig. 9).

Wooden or log bridges can be assumed on the Manumuskin and its tributaries at other locations where roads crossed and the water was too deep to ford.

6. SLUICES AND FLOOD GATES

6-A A set of flood gates (Fig. 7) were located in the old dam at Port Elizabeth flanked by sluices on either side. The dam was located west of the present concrete bridge and at the end of a man-made canal which replaced the original creek course.

The first flood gate was two feet high, eight feet wide and 55 feet long. It was to be buried two feet below the low water mark, according to C.S. Hartman, surveyor and longtime collector of old maps and records. It lasted only a few years before it was replaced. The flood gate could be closed to prevent incoming tides from passing the dam.

The next water control system consisted of a larger set of gates, four feet high, 10 feet wide and 55 feet long, with sluices on either side measuring two by three feet. Hinged gates which worked in only one direction allowed water to flow downstream but prevented incoming tides from entering. This system washed out in a storm and never was replaced. See 4-G.

6-B A simple type of water gate is installed at the new bridge (see 5-I on Fig. 9) at Bennett's Mill. Metal channels attached to the side of the bridge allow boards to be dropped into them against the sides of the bridge. Boards may be removed or added to raise the height of the gate and control the water level. There are cranberries in parts of the upper millpond where the water level varies and also in a bog south of the new dam. This water control system could have been used in conjunction with cranberry farming if such farming were done here.

Various types of water control mechanisms would have been used at the mills, the forge, and the iron furnace, but remains where they exist at all, are only fragmentary and give little information as to what their purpose was. Some wooden structure can be seen in the bottom of the creek where Forge Avenue bridge crosses but it cannot be identified.

7. WHARVES (See Fig. 7)

7-A Union Glass Works wharf. A small wharf on the western half of the old meander which was the original creek course. The glass works ceased to operate before the road to Millville was built and the water here was deeper at that time. The glass works was established ca. 1810 and last operated in 1817.

7-B Located at the end of Broadway, behind where Joshua Brick's store once stood. Said by H.W. Vanaman to have been a stone-faced wharf but today either covered or replaced by a steel bulkhead. Stones can be seen in the creek bed at low tide.

7-C Located just south of 7-B. Wooden bulkhead today but said to have been stone at one time.

7-D Long, curving wharf used by Francis Lee and called Lee's Wharf on some maps. South of 7-C and north of Boxwood Manor on Route 47, which was Lee's home.

The latter three wharves, along with the deep-water wharf at Bricksboro on the Maurice River, were used for local commerce. They have no commercial use today but 7-B is used as the station for drafting water by the Port Elizabeth Fire Company. Although Port Elizabeth was declared a port of delivery for the Bridgeton customs district in 1785 and Elmer says there was trading out of the Maurice River with the West Indies, that trade had ceased by about 1835. Bowen blames the greater advantages of New York and Philadelphia for the decline.

8. DIKES

8-A The meadow (Fig. 9) along the Maurice River, at the confluence with Manumuskin Creek and on the west side of the creek, was said to be the first banked meadow on the Maurice River. This meadow was owned by John Hoffman and was sold to Hezekiah Lore in 1750. It was said to be banked before this time.

8-B Above Port Elizabeth bridge and on the bank which is north or west, depending on the various meanders, the meadow was said to be banked in the early 20th century (Fig. 7). H.W. Vanaman said the dikes were built within his memory by a man named Ed Key for landowners on that side of the creek. Vanaman says the dikes were expensive and difficult to maintain and were kept up for only a short time. Although Vanaman thought this diking occurred in the 1920s, the dikes are shown on a 1917 state topographical map so they must have been earlier.

9. POST OFFICES

9-A A post office (Fig. 9) was established in 1864 at Manumuskin Station and was located in a house on the west side of Port Elizabeth Cumberland Road. Date of closure of this post office was not determined but it was after 1935. Building later moved one-half mile north. Partially burned in recent years.

A post office was established at Port Elizabeth in 1802 but the location has chaged frequently. The present Port Elizabeth post office is outside the study area.

10. RAILROADS AND TRAIN STATIONS

10-A The West Jersey Railroad built its Camden to Cape May line a short distance below Fries Mills in 1862. A station (Fig. 9) was located east of Port Elizabeth-Cumberland Road providing both passenger and freight service. Although the station is called Manumuskin Station on maps, a photograph of the station in possession of H.W. Vanaman, has a sign with the spelling "Manamuskin".

10-B Maurice River Branch (Fig. 9). This branch was built in 1887 and extended from Manumuskin Station to the community of Maurice River near Heislerville. There was a station at Port Elizabeth, as well as stations further down the line. The Port Elizabeth station was one block east of Second Street and extended from Broadway to Quaker Street. Passenger service on this line was discontinued in 1932 and again following an oyster blight in the late 1950s. Tracks subsequently were removed below Leesburg and still later the tracks between Leesburg and

Dorchester were taken up. The remaining portion is used for shipping sand from the area mining operations. The Maurice River branch connected to the main line of the West Jersey Railroad by means of a wye, a Y-shaped section of curving track which allowed trains to be backed and turned.

A station was located within and at the western end of the wye but was removed at an undetermined time and taken to Cape May Court House where it was used by a riding academy. The concrete foundations of the station remain including a 17 by 26-1/2 foot station building, and the boarding platform is extant.

According to H.W. Vanaman, the Port Elizabeth station was razed. No date could be provided.

11. SURVEY STONES

Only stones of major importance are listed. Some may be in excess of 250 years old. Other stones are shown on some of the maps included with the inventory. Unless they are known to be extant in 1987 or in recent years, their continued existence needs to be confirmed.

11-A Port Elizabeth, northeast of Route 47 (Fig. 9). A stone marked "D.L". This is a marker for "Hoffman's back line" and is initialed for David Lore, a later owner. Extant in 1987. Hoffman property surveyed before 1750 (see Post-settlement History section).

11-B Cumberland, west of Port Elizabeth-Cumberland Road south of Route 49, a Society corner (Fig. 9). Also called Quarry Hill corner on some maps. This is a corner marker for the West Jersey Society of Proprietors.

11-C North of Cumberland and east of Union Road, on Cedar Branch, southwest of Milmay (Fig. 9). A Society corner.

11-D Near the confluence of the Manumuskin and Canute Branch, also called Hoffman's Branch, on the west side of the creek, a Society corner (Fig. 9). This is a tall granite monument, extant in recent years.

11-E East of Union Road and south of Trento Avenue (Fig. 9). A Society corner.

11-F East of Milmay, in Atlantic County, a Society stone (Fig.9). Marks the division of Buena Vista, Hamilton and Weymouth Townships.

12. ROADS (with the exception of 12-J, not shown on figures).

12-A Port Elizabeth-Estell Manor Road. Before 1862. Also called Mays Landing Road locally. A portion was closed during World War II when munitions testing was being done by du Pont. Reopened after World War II, then the portion from the railroad to the DeCarlo tract two miles east of the railroad bridge vacated permanently.

12-B Port Elizabeth-Tuckahoe Road. Laid out in 1794. Renamed Weatherby Road after it was improved for vehicular traffic in 1916.

12-C Port Elizabeth-Cumberland Road. Also called at various times the Road to Budd's Mill, Road to Budd's Furnace and, where it passed near the Eagle Glass Works, Glasstown Road. Built in 1800.

12-D Port Elizabeth to Millville Road. Laid out in 1818. Formerly Route 15, now part of Route 47.

12-E Spring Garden Road. 1810. Led from Port Elizabeth to Spring Garden Ferry and joined Buckshutem Road on the west side of the Maurice River.

12-F Lore's Hill Road. In 1987, Fralinger Road. Leads from Route 47 west to the Hezekiah Lore property. Date of construction not established. Several generations of Lores lived here. A public road for part of its length. Recently paved. A cul-de-sac now defines the end of the public portion of this road.

12-G Road across the dam at Fries Mills. Old 18th century stage road from Bridgeton to Cape May Point, via Hunter's Mill.

12-H Old stage road from Port Elizabeth to Millville and from Port Elizabeth to Cape Island (Cape May). Crossed the Manumuskin at Abraham Reeves's bridge (see 5-B). A mile-long segment west of Barth Road is still used.

12-I Road from Fries Mills to Daniel Carroll's. Connected with the end of Abraham Reeves's Road, in 1987 called Barth Road.

12-J Old Gloucester to Cape Point (Cape May Point) Road, also called Old Cape Road or Old King's Road (Fig. 2-b). 1707. Crossed the Manumuskin at Cumberland, south of present Route 49 and north of the electric line. After 1800, or when the dam was built, this road was moved north to take advantage of the dam crossing. Now part of Route 49.

12-K Union Road. Roughly follows the courses of old Blue Anchor or old Union Road. Also called the road to Budd's Furnace from William Vanamans, Mattox's Road and other local names. Probably ca. 1800 or earlier.

12-L Hesstown Road. Also called Dorothy Road. The portion from Port Elizabeth-Cumberland Road to Route 49 has been renamed Ormond Road, probably ca. 1890. Hesstown Road was built prior to 1862.

12-M Forge Avenue. Crossed the forge dam and joined other roads east of the creek at Budd's forge. Also extended a short distance west of Union Road. Ca. 1810.

12-N Schooner Landing Road (1). Led from Cumberland Furnace to Schooner Landing south of Clarks Pond on Menantico Creek, where ore was brought in for the Cumberland blast furnace and iron and possibly wood shipped out. The road was probably built at about the same time as the furnace, ca. 1800.

12-O Schooner Landing Road (2). Led from Fries Mills to Schooner Landing. Date not established.

12-P Mays Landing Road. The western end of this road started in Millville as part of the old road to Doughty's Tavern. The section which branched off toward Milmay is not on the 1886 N.J. Topographic Atlas so, was built after that time. The original course of Old Mays Landing Road dipped south at Bennett's Mill then turned north again. Mays Landing Road was rebuilt after the first quarter of the 20th century and rerouted north of Bennett's Mill. This was said to be a WPA project so probably was in the 1930s. Now Route 552.

12-Q New Union Road. After 1876. Connects Old Union Road with East Vineland area.

12-R Harding Highway. Also called Philadelphia to Tuckahoe Road. In 1987, Route 557. Date not determined.

Landis and Chestnut Avenues in East Vineland were laid out before 1862. The majority of the other East Vineland roads were laid out and built during the last quarter of the 19th century. Such street names as Genoa, Dante, Piacenzia, Trento and Italia avenues reflect the Italian heritage of the immigrants who settled this area between 1865 and 1900.

The Milmay area has few major roads, although Routes 552 and 557 intersect here. A number of secondary roads were laid out as part of a DeCarlo housing development in the 1960s but were not improved and some exist only on paper. Except for a few sections taken over by Maurice River Township, these roads are considered private and no building permits can be issued for lots fronting on them.

Cannon Range Road and Waldeck Avenue were reportedly built in the 20th century. According to local resident Samuel DeRosa, Waldeck was a company based in the South which briefly attempted tobacco culture here. DeRosa said the Waldeck Company built 30 or 40 temporary workers houses, large curing barns, and a machine shop to construct machinery for ditching the area to promote drainage and for the farming of the tobacco. Although DeRosa says all these facilities have disappeared, there may be foundations in the area where Cannon Range Road and Waldeck Avenue intersect.

The watershed is criss-crossed with old sand roads, some of which had no names and others which were used only for relatively short periods such as roads made by woodcutters. Some are passable in 1987. Others can be walked and still others have been obliterated by development or sand mining.

13. GLASS FACTORIES

13-A Eagle Glass Works (Fig. 8). Built on what is now Port Elizabeth-Cumberland Road prior to 1799 by James Lee. This factory manufactured window glass by the cylinder method until about 1870. Some container manufacture then was initiated and eventually window glass discontinued.

Lee sold the factory in 1813 to James Josiah, Samuel Parrish and Joseph L. Lewis Co. but retained a quarter interest and continued as

manager. By 1817, Lee had sold his interest to Joseph Lewis and Jacob C. Wyckoff and Joshua Brick had acquired an eighth interest. The firm was called J. Josiah, Harrison & Company.

In 1818 the glass works was sold to Samuel Wetherill who leased the factory to Joseph, Johann and Christopher Getsinger, John Welser and Francis Langstaff, a company of Germans. In 1831, Joseph and Johann Getsinger purchased the glass works. A number of other German glass workers moved into Port Elizabeth to work at the factory. The U.S. Census lists the birth places of some as Prussia, Hanover, Saxony and Bohemia.

The Getsingers deeded 36 tracts of land, including the glass works and the tract of more than five acres on which it stood, to George B. Cooper and Charles Townsend in 1846. Large amounts of wood were needed to fuel the glass furnaces and company owners acquired wooded tracts throughout the area to provide this fuel. No estimate was found of how many acres would have been needed to assure a continuous supply or the acreage held by the owners at any specific point in time.

Cooper retired from the firm and Townsend continued to operate with various partners until 1852, when the property was mortgaged to Dr. E.L.B. Wales. Wales sold the mortgage to Samuel Townsend who foreclosed. The property was sold at sheriff's sale in 1862 and Townsend purchased it.

Townsend rented the works to Mitchell & Irwin for an unspecified time, after which the works closed until 1881 when the factory was purchased by the Whitney Company. The Whitney Company operated sporadically until the winter of 1883-1884, then the company closed. According to H.W. Vanaman, the factory was briefly re-opened by a Mr. Berry for about six months for the manufacture of glass caskets. Vanaman says the discarded iron moulds were used by some local farmers as watering troughs for their stock.

An 1872 insurance map of the Eagle Glass Works shows two furnaces; a complex of joined structures which included the roller house, flattening house, sear house and cutting room, a blacksmith shop, pot house, tempering house, mill house, engine house, two box shops, a sand and lime house, a counting room and storehouses.

In 1987, the five-acre property has been subdivided and two dwellings have been built. Mounds at the rear of the two properties are said to represent ruins of the glass works, probably the furnaces. Glass, brick and stone are found in the soil. Eagle Glass Works is known to have manufactured ink wells and panel bottles. Whitney also manufactured early canning jars here.

In addition to the wooded tracts in outlying districts, the Eagle Glass Company owned numerous lots and structures within the town, most in the vicinity of the factory. Some of the lots were sold to private citizens but seven houses are included in the 1872 insurance inventory. Two of these, two duplexes which were located immediately south of the factory, are extant. The large house said to be the Eagle Glass

Company Hotel across the road from the duplexes, and the Ackley home on the north side of the hotel, also once were glass factory properties but were privately owned in 1872.

13-B Union Glass Works (Fig. 8). Built ca. 1810 west of present Route 47 and along the curve of the original creek bed northeast of the bridge. A map of the division of this property in 1814 when the first partnership dissolved, shows a building about 80-1/2 feet long and approximately 26 feet wide at its widest point. The business ceased to operate in 1817 one year before the Millville road was built. The original partners were Jacob Stanger, William Shough, Frederick Stanger and, soon after, Randall Marshall. The journal of glassblower Samuel Huffsey (Vanaman, 1965) notes that Jacob Stanger and Shough retained part of the factory after the division and built a small furnace of two pots in the fall of 1814. By 1815, six pots, or stations for glass-blowing, were operating in the factory and in 1816 there were two furnaces, both six pots, operating under one roof.

A new company formed in the summer of 1817 and was called the Eagle Glass Factory but there was no apparent connection with the factory on Glasstown Road (Port Elizabeth-Cumberland Road). This operation broke up by September 1817, Huffsey writes.

Because of the various partnerships, there may have been structures on the property other than the main building shown in the division. The factories manufactured small hollow ware, mostly vials. After the tariff on imported glassware was lifted, it no longer was economical to continue production and the factory closed. It is reported that there later was a fire in the abandoned building and what remained subsequently fell down. Glass shard can be found on the site and there may be subsurface foundations.

It is interesting to note that Ann Marshall Stanger, the daughter of Randall Marshall and wife of Frederick Stanger, has a ceramic tombstone. Ann died in 1815, while Union Glass Works was operating, and was buried in the Quaker cemetery nearby. The stone is made of clay similar to that used for making the pots for the hand furnaces and it is possible that this stone, and another similar stone marking the grave of her sister, Hannah, were made and fired at Union Glass Works.

14. IRON WORKS

14-A Eli Budd's iron furnace (Fig. 2). Located south of Route 49 between old Schooner Landing Road and the west bank of the Manumuskin.

Eli Budd moved to this area from Burlington in 1785 and, ca. 1810 built a blast furnace for the manufacture of iron from bog ore. Although the Budd family lost the iron works in 1819 after financial problems, the furnace continued to be operated by a succession of owners until about 1840. By this time, all the wood had been cut from the large tracts affiliated with the furnace cutting off the cheap supply of charcoal. There also was competition with other areas where anthracite coal had come into use and there was a supply of better quality ore. The Budds at one time owned 22,000 acres of land in

conjunction with the furnace and an iron forge built at an earlier date.

The ruins of the furnace can be found by following the remains of the old raceway south from Route 49 (see 3-D). In the 1940s, the stack was said to be standing and the ruins were estimated to be from 12 to 15 feet high. The ruins later were salvaged by vandals for brick and sandstone and in 1987 there remains only a mound about 25 feet in diameter and about seven feet high. The mound contains fire brick, sandstone, granite and some common brick.

Immediately west of the furnace mound is a ramp about 12 feet high widening at its high end to 40 or 50 feet and about 150 feet long to the point where it reaches ground level. There is a concrete monument marked ACE (Atlantic City Electric) at the base of the low end of the ramp. The ramp has a gradual slope along the north side but the south edge drops more sharply. The ramp consists of fine charcoal and intact oyster shells to a depth of about 18 inches. No digging was done to determine whether the core of the ramp consists of slag. H. W. Vanaman says this was the ramp leading to the stack's charging point where ore, charcoal and flux were added periodically while the furnace was in blast. Lime flux in the form of oyster shells was used at Cumberland Furnace to draw off impurities in the form of slag. No identifiable slag pile was found, but, numerous roads in the area are constructed of slag and it may have been removed almost as fast as it was produced.

East of the furnace and along the raceway is another mound, also about 25 feet in diameter but much lower. The content is the same as the furnace mound. The second mound may be the foundation of a building housing the bellows, which was operated by water power. No record was found of the type of bellows employed here.

No remains of a building between this foundation and the furnace were found but the air pipe could have crossed the area between the raceway and the furnace without a housing. Fire brick was found in this and other mounds which appear to be foundations. This could be due to the fact that the furnace had to be rebuilt frequently and the resulting rubble may have been recycled. Some distance south of the ramp is a concentration of stone underground which may represent the remains of a building shown as a square on one early map (Fig.2-b). Other areas where rubble is found may be indications of auxiliary buildings or the results of scattering through vandalism.

Subsurface remains might still be found of the casting floor, the area where charcoal was stockpiled, the oyster shell stockpile and additional buildings. Once this site is brought to the attention of the public, there is certain to be further vandalism by souvenir hunters.

It is reported that large amounts of iron debris were removed for scrap during World War II and owners of metal detectors have done additional collecting since that time. There is a report of cannon balls having been found on this site but it has not been substantiated. If such items were found they would have been made for the War of 1812

since the furnace operated after the Revolutionary War and closed before the Civil War.

14-B Wesley Budd's forge (Fig. 3). Located about one mile upstream from the furnace. Twenty years ago it was easily accessible but in 1987 part of the bridge has been removed on the east side of the creek and the forge site is accessible from the west only by way of sand roads of very poor quality.

About 1967 there were mounds of sandstone and brick on the site and standing water had a thick, rusty film. One of these mounds was pointed out by H.W. Vanaman, a descendant of Eli Budd, as the ruins of the forge. Trapper and hunter, Tom Brown, recalls that there used to be considerable iron debris in the area and some of it consisted of recognizable iron stove lids and parts of stoves which he believed to be products of the forge.

H.W. Vanaman says the Quaker Meeting House at Hancocks bridge has a stove made at Cumberland Furnace. Either a stove or fireback made at the Cumberland works was rumored to have been installed in Independence Hall but the latter report cannot be substantiated.

Boyer (1931) reports a second forge across the dam from the blast furnace at Cumberland Pond citing an 1831 map as his source. An 1831 map of Eli Budd's lands, filed in the City of Millville Engineering Department, shows no forge at that location although such details as the homes of Eli and Wesley Budd and the home of Eli Budd's son, John, west of the creek at the forge dam, are shown (Fig. 3).

There are no visible indications of foundations and artifact hunters with metal detectors have reported no finds at this location which would indicate a forge. The forge and furnace have been called Budd's Iron Works, Cumberland Forge and Furnace and the forge only was once called Old Concord Forge.

It would have taken a large number of workers to cut and haul the wood, colliers to convert it to charcoal and then haul the charcoal to the iron works. Moulders and other workmen would have been required for the forge and furnace but no information as to the output of either facility or the number of workers required has been found. In spite of the number of people who must have been employed in conjunction with the iron works, the settlement at Cumberland never was large. In addition to the forge and furnace, there was a church, at least two stores, one operated by the Budds on the east side of Schooner Landing Road just south of Route 49, and saw and grist mills.

Several area residents have said they recall large cleared areas in the woods with some charcoal present which may have been colliery sites but none could be specific about locations. Charcoal could have been produced here, as in other areas, by piling the wood where it was cut, stripping sod to cover the pile, and burning the charcoal on site; the site moving with the location of the wood being cut.

15. CHURCHES AND CEMETERIES

15-A Cumberland Methodist Episcopal Church (Fig. 2-e). Present church built in 1947, replacing a frame church built in 1862. The original church at this location was Budd's Chapel. The congregation was established as early as 1786 and the church was built and being used as both a church and school as early as 1810. Walter Hawn of Cumberland has ink wells which were found behind the church and which probably date to the period during which it was used also as a school. A church history states that the church was depicted on an 1817 map and was similar in appearance to Head of the River Church. A pen and ink sketch of the old church by Phil Nutt may be based on this early representation.

The original church was built by Eli Budd. Budd's son, Wesley, became a Methodist preacher and was a circuit rider on the Salem cirucit in 1799. Wesley also was involved in the iron furnace business with his father and, with some partners from Philadelphia, built the forge. Some accounts say Wesley Budd built the church but H.W. Vanaman, an Eli Budd descendant, says the church was built by Eli. Wesley was a poor business man and is blamed for the loss of the iron works which were sold at Sheriff's sale in 1819. Wesley subsequently left the area and apparently did not keep in touch with the family.

A large Bible, kept in a glass case in the present church, was presented to the church by Eli Budd's wife, Ann, in 1812 and bears an inscription in the front commemorating the occasion. It refers to the church as "Methodist Ebenezer Episcopal". This church is located on the north side of Route 49, east of the dam and Cumberland Pond Trailer Park.

The oldest inscribed stone in the cemetery is that of Joshua Bennett who died in March 1811. Several iron markers are found in this cemetery and are said to have been made at the local iron works. None have names or inscriptions though three have initials. Eli and Ann Budd are buried here.

15-B Port Elizabeth Methodist Episcopal Church (Fig. 8). Located on the west side of the road where Second Street becomes Port Elizabeth-Cumberland Road.

The congregation was organized by 1778 and the first church on the site built about 1786. It was replaced by the present brick church in 1827. The church was designed by Dr. Benjamin Fisler who also directed its construction. It has not been substantially changed in exterior appearance except for the addition of a belfry and bell after World War I. In 1894, the interior was renovated and a vestibule added. The previous church was smaller and faced Second Street whereas the present church is oriented to face Port Elizabeth-Cumberland Road. The sites of the two churches overlap slightly.

The earliest legible tombstone in the cemetery is that of John Kendall who died in 1787. Two stones, for Hezekiah Lore who died in 1770, and his wife, Elizabeth, who died in 1761, were moved here from the old Swedish Church on the Maurice River outside the study area. It is not certain whether the remains also were moved.

15-C St. Elizabeth's Roman Catholic Church cemetery (Fig. 8). A Catholic church was established in the former Port Elizabeth Academy, a closed school, after 1843. It was dedicated in 1846. The church served mainly the German glass workers at the Eagle Glass Works but, as the workers moved to other areas following a decline in the local glass industry, the congregation dwindled. Services ceased to be held here around 1860. In 1878 the building was dismantled and moved on a raft down the Maurice River across the Delaware Bay and up Dennis Creek. It was re-erected in Goshen where it stands today as St. Elizabeth's Church.

The Port Elizabeth church was said to be the first Catholic church in Cumberland County. The cemetery remains with about a half dozen stones at the corner of Academy and Church Streets. Local residents say there are more stones which have sunk below ground level. One stone is smashed and lying flat upon the ground. Five, with inscriptions, are erect. The earliest inscription is on the stone of Isabell McLean who died in 1847. The latest is Margaret, wife of John Getsinger, who died in 1862.

15-D Quaker cemetery. The Quaker Meeting House formerly was located on the east side of Route 47 north of the Port Elizabeth bridge. It was built prior to 1799 and meetings were held until 1854 when Port Elizabeth Meeting was "laid down". Meetings were held on special occasions until 1881. The church was sold in 1884 and removed in 1886 for the timber and stone which were used to build a barn on the J.W.B. Vanaman property on Ferry Lane in Port Elizabeth. The barn later blew down in a hurricane in the 1960s.

The cemetery is surrounded by a masonry wall with an iron gate. Town founder Elizabeth Bodly is buried here, until 1985 with only a sandstone marker with E. B. to mark her grave. A granite monument was placed on the grave in time for the town's 200th anniversary in 1985. The oldest inscribed stone is that of Margaret Cowarden who died in 1807. Two unusual ceramic stones mark the graves of Ann Stanger and Hannah Marshall (See 13-B).

15-E Baptist church and cemetery (Fig. 8). On Baptist Lane, a street which no longer exists, at the end of Church Street.

Land was given by James and Hannah Lee in 1807 for a one-acre cemetery to be used for burying strangers without cost and a quarter-acre lot for a church for which $37.50 was paid. The church usually is shown being on the same lot as the cemetery but a C.S. Hartman map of Port Elizabeth dated 1950 (H.W. Vanaman Collection) shows the cemetery on the north side of Baptist Lane and the church on the south side across the street from the adjacent African one.

The Baptist Association was organized in 1810 and a church begun but never completed. It nevertheless was used for services and was used to quarter troops during the War of 1812. From 1832 to 1842 there were only about a dozen members and in December 1842 the remaining congregation joined with others in forming the Millville Church. The church building stood vacant and occasionally was used for sheltering sheep until it finally fell down.

In 1885 the only inscribed stone remaining in the cemetery was that of Elemuel Edwards who died in June 1811, aged 75 years. The stone was removed for "safekeeping" in the 1920s and was lost. A number of burials remain in the cemetery but are marked only by rough chunks of stone. The majority of these markers probably are below the surface in 1987.

15-F Mt. Zion African M.E. Church (Fig. 8). Located adjacent to the Baptist cemetery to the east. The congregation organized in 1836 and in 1838 moved a building to this site to be used for services until a later edifice was erected. The land was deeded to the church in 1861 and the new church was said to have been built after that time. The building was standing in 1908 but is no longer extant. Foundations remained in the 1960s.

The African cemetery is located some distance from the church east of the old stage road to Muskee Island and west of the railroad between the courses of Stable Street and Quaker Street although these streets do not extend this far. The cemetery is the burial place of Civil War veterans William Wallace and Wesley Downs. There were three large stones with inscriptions in the 1960s including Wallace, Downs and a Tillman. In 1987 all the stones have been smashed and the pieces burned in campfires. The area is littered with beer bottles and one grave has been excavated. The vandalism was done by partying teenagers according to local residents.

The cemetery is adjacent to the stage road, also called Mitchell's Lane locally. The path has been blocked by construction at K. ShawAssociates, a manufacturer of sand mining machinery, but access to the cemetery can be gained by walking the railroad tracks to the point where they meet the road.

15-G Church of the Nazarene. Located in Port Elizabeth at Second Street and Weatherby Road. The congregation dates to 1913 but the building is more recent. Services currently are held here and the congregation is active.

St. Mary's (established 1884) and Our Lady of Pompeii Roman Catholic Churches are outside the study area in East Vineland. St. Mary's is the older congregation. Our Lady of Pompeii parish was formed in 1907 and is noted for its grotto (1938) and Stations of the Cross (1945-1947). East Vineland resident James Bertonazzi says his grandfather, Marco Smaniotto, gave the land for Our Lady of Pompeii and had a cross and relics of the Crucifixion installed. Later stonework was added by the Rev. Eugene Fiteni.

A church was erected by the Moravians for the early Swedish settlers on the Maurice River above Spring Garden Road and outside the study area. It was built in 1743 and used for a limited time. It long ago fell down and the cemetery is said to have washed into the river.

16. SCHOOLS

16-A Hesstown School (Fig. 9). Located on Ormond Road south of the intersection with Route 49. Ann Budd Vanaman, in her autobiography in the possession of H.W. Vanaman, writes of moving from Tuckahoe to Cumberland when a child, going to school at Budd's Chapel, adding that later a school was built. She does not indicate how much later or where. Hesstown School

closed in the 1950s. Local residents do not think this school dates to the early 1800s when Ann Vanaman, born in 1803, would have attended. Kenneth Low says he believes an older school was located on the northwest corner of the intersection of Hesstown Road and Route 49. This has not been verified.

16-B Former public school built in Port Elizabeth in 1854 (Fig. 8). Moved to its present location north of the Port Elizabeth M.E. Church after a new school was built to replace it. Converted to a Sunday School and renamed John Boggs Hall. An addition has been built on the rear in recent years.

16-C Former Little Port School. Built in 1958 at the corner of Second Street and Weatherby Road to replace the 1854 school. Closed in recent years as a school and now converted to a Senior Center and medical clinic. Extensively renovated.

School lots were indicated on maps in Port Elizabeth and near Fries Mill but there is no evidence that schools were built on them. There was an Eagle Glass Works school lot in Port Elizabeth on Christian Street one block east of Port Elizabeth-Cumberland Road and a short distance south of the junction with Estell Manor Road. A school was located at the end of "Jones School Road" in Port Elizabeth at a place called Board Landing before 1785. A school lot at Friendship Mills (Fries Mill) was located on Port Elizabeth-Cumberland Road, on the west side of the road and south of the road leading into Fries Mill. One map (Fig. 4-a) shows a drawing of a school here but it may have been merely symbolic. The school was to be called "Friendship School". Land was deeded for this lot in 1802.

17. SPECIAL USE BUILDINGS

17-A Port Elizabeth Library/Lee's Hall/storehouse (Fig. 8). Second and Broadway, Port Elizabeth. Benjamin Fisler built this stucture in 1810 as a store, later operated by Joseph Brown, Issac Townsend, Cooper & Townsend and in connection with the Eagle Glass Works. Later used by Francis Lee for a storehouse. In 1883 named Lee Hall and used for community gatherings and performances. After Lee's death, it was turned over to the community with M.E. Church as trustee. The church used the building as a Sunday School until after the 1854 school was acquired and renovated for that purpose, then turned over to the Library Association. In 1987 a public library.

17-B Dr. Benjamin Fisler's office (Fig. 8). Southwest corner of Second and Broadway. Used by Dr. Benjamin Fisler as an office. Later a feed store, oyster bar, ice cream parlor and barber shop, before becoming the first townlibrary. Early 1800s. Extant but deteriorated.

17-C Col. J. Howard Willets office (Fig. 8). Northeast corner of Broadway and Route 47. There formerly was a store on this site destroyed by fire in 1857. Willet's office was built after 1862 and before 1876. Now converted to a private residence. The back room once was used as a post office. Because this was an office, there are no unique interior features. The two bay windows are said to be shown in an 1880s photo and are believed to be original. Present owner, Thomas Savarese.

17-D Japhet Fox store (Fig. 8). Not extant but included because the store was reported to have been pushed into its cellar with merchandise on the shelves and a large safe inside. Located on the southwest corner of Second and Broadway in Port Elizabeth next to the Fisler office. Razed in the 1930s. Built by Stephen Willis, ca. 1800. Later operated by the Lee family then Japhet Fox.

17-E Former mortuary (Fig. 8). Stable Lane east of Second Street in Port Elizabeth. Also used as a storehouse. Operated as a mortuary by Samuel Mayhew in 1876, not 1862. Reported to have also been used as a school at one time. In 1987 has been converted to a garage. Large doors installed and an addition built on back.

17-F Another site, not extant, the Randall Marshall store (Fig. 8). Located on the east side of Route 47 north of Port Elizabeth bridge. Marked by a depression in the ground which may indicate a cellar. Very early, ca. 1810, may have been operated in conjunction with the Union Glass Works.

17-G Heisler House Tavern/Simon Shaw house (Fig. 9). Fries Mills at the west end of the dam. Could date to 1770 when the dam was built. Operating as a tavern by ca. 1805. The Simon Shaw house in 1896 when Shaw killed Stultz Carlisle on the porch and gave the place some notoriety. The house is extant and was occupied until recently. It has been badly vandalized since it was vacated.

Hand-hewn ceiling beams are in the one-room oldest section. There is a large brick fireplace with two iron rings for cranes and an area in the upper left corner where it looks as if there was an oven. Corners on the fireplace wall are rounded to accomodate large corner timbers. The windows have been moved and changed, a fact revealed when vandals smashed out some of the walls. The original windows appear to have been in pairs and had three notches cut into one vertical frame on each window, possibly to accomodate hinges for casement windows.

The half-story above the kitchen is plastered. Some of the rafters are hewn and some sawn. The house has a corrugated tin roof at present. An old drawing shows a dormer in the front which has been removed. A dormer in the back was built in recent years to accomodate a bathroom.

The newer section of the house was moved here and attached as shown by two sets of weatherboards within the joining wall. It is two steps up from the old section and has one room with a fireplace on the first floor and two smaller rooms, one with a fireplace, on the second floor. The upstairs fireplace is small, about 24 inches square and shallow. The newer section has weatherboards under the newer cedar shakes. It also has a plastered attic. The rafters once were pegged but the pegs are missing. Possibly a salvage operation since all interior doors appear to have been carefully removed with their hardware rather than smashed by vandals. The weatherboards of the older section are 3/4 of an inch thick, untapered and with a 5/8 inch bead on the lower edge. A rose-headed nail was removed from one board. All the nails appear to be square and handmade. The weatherboards taper to narrower widths above the windows.

This house could be saved if immediate action is taken.

18. DWELLINGS (Numbers 1-4 and 6-40 shown on Figure 8)

Because of the large number of dwellings listed, numerical rather than alphabetical designations have been assigned. All but two of the dwellings listed date to at least 1876 and nearly all to 1862. Some have been extensively remodeled and retain little historical integrity. Others have been paneled inside and had siding applied outside but the original construction is intact within the walls.

Firm dates of construction were not available for most of these houses. Unless otherwise stated, they were built before 1862. Unless the original owner is known, the names given on Stewart's 1876 Atlas maps are used. Where other owners were given on Pomeroy's 1862 map, they are listed.

1. F.S. Simmons house. West side of Route 47 north of the bridge. 2-1/2 stories, new siding and interior reportedly remodeled.

2. T.M. Reeves house. West side of Route 47 north of the bridge and south of the Simmons house. 2-1/2 stories, new siding and the interior is being remodeled in 1987.

3. S. Mayhew house. Corner of Route 47 and Doughty Lane. Has been moved back from its original location, being extensively remodeled in 1987.

4. S. Mayhew. Shaw in 1862. West side of Route 47, south side of Doughty Lane. Sits some distance from the highway. Five bays across the front with center door, however, the door appears to have been moved to accomodate the later addition of a stained glass window. Rear two-story wing. Two end chimneys. Present owner Agnes Whilden.

5. Doughty house (Fig. 9). First thought to be the house designated Townsend on the 1862 map. Located at the end of Doughty Lane west of Route 47, north of Manumuskin Creek and east of Maurice River. The 1876 map locates a residence in this area also but closer to the river, designated Birdsall. Neither map is very accurate when compared to current topographical maps and these houses may be intended to be the Doughty house. This house appears old but has been extensively remodeled. The west end of the house is new. The old section has had floors replaced. There are no fireplaces in the old section. The house had no cellar and in the middle 1900s was jacked up, a cellar dug and a foundation constructed of sandstone salvaged from another house. Present owner Victor Vurganov.

6. Mrs. S. Townsend house. C. Townsend in 1862. East side of Route 47 south of Barth Road and north of the Quaker cemetery. Possibly the oldest house remaining on the north side of the bridge. Appears to have been built in two stages with an off-center chimney in the south section. 2-1/2 story. Root cellar at north end. End chimney on north section. Five bays first floor, four bays second floor.

7. David Lore house. Francis Oglee in 1862 and 1876. Built 1853-54 by Lore. Located east side of Route 47, first house north of the bridge. Five bays with center door. 2-1/2 story with internal end chimneys. Being restored by present owner Edward Griner. 2-1/2 story rear wing.

8. J. H. Willets house. North side of Broadway east of the Col.J. Howard Willets office. House said to have been built by Joshua Brick. Built in at least two and possibly three, stages. Oldest section torn down several years ago and remainder may all date to the Willets occupancy. 2-1/2 stories, new siding, new entrance, 6/1 windows. Present owner Elmer Beebe.

9. B. F. Lee house. North side of Broadway east of Willets. A large house with a rear wing. Front has three bays with side entrance. 2-1/2 stories. Front section has 9/6 windows on first floor, 6/6 second floor. Rear section has 6/6 windows also but smaller. Large center chimney on front section, end chimney at rear.

10. Murphy house. Radcliff in 1862. North side of Broadway, east of B. F. Lee. 2-1/2 stories. Three bays wide, two-story addition at rear. Enclosed porch across front.

11. Thomas Lee house. B. F. Lee in 1862 and 1876. Dated as 1805 although present owner believes there may have been one section built earlier. North side of Broadway east of the Murphy house. Built in three stages each with a large chimney. Five working fireplaces. Front door surround and one interior fireplace facing are not original. Some 9/6 windows. Spring house in rear yard. Present owner Thomas Timmons.

12. D. Harris house. North side of Broadway east of Lee house. 2-1/2 stories with rear wing, one-story lean-to. Five bays first floor with center door. Four bays second floor. Non-functional shutters installed in recent years. Two dormers.

13. Pancoast house. North side of broadway east of the D. Harris house and west of the library. 2-1/2 story saltbox. Exterior siding and interior walls all paneled. Enclosed porch with louvres across front. Fireplace does not have original facing. Present owner, Pangburn.

14. Large Victorian house with cross-gable roof. South side of Broadway. 2-1/2 stories with large rear wing and lean-to additions. Post 1876. Present owner Elwood Savage.

15. Burdsall house. T. Garron in 1862. Has been converted to five or six apartments. Some windows changed in location and size. Rear wing. Reportedly used to have numbers on bedroom doors and rooms rented to railbird hunters in season though not a hotel at that time. Kept as a hotel at one period by Ingate Stanford. Main entrance door has side panels with three lights and a three-light transom.

16. W.G. Harris house. South side of Broadway east of the Burdsall house. 2-1/2 storeis with three bays on both levels. Off-center door. Updated with siding but retains much of what must have been the original appearance. Full-width front porch with wooden scrollwork. Present owner Ellsworth Riley. This house was Fortiner in 1862.

17. A. Sheppard house. East side of Second Street south of Stable Lane. 2-1/2 stories. Two-bay second floor. First floor has two windows with the door squeezed between one window and the end wall as though added later. Dated at 1790. One-story lean-to addition. Beaded weatherboards.

18. S. Mayhew house. Weiser in 1862. East side of Second Street south of the Sheppard house. 2-1/2 stories. Three bays with side door. Present owner Neal VanGilder is restoring this house and plans to remove the porch and siding which are not original.

19. Leach house. Built in 1862. North side of Quaker Street. 2-1/2 stories with rear wing. Lean-to addition. Three bays first floor and two on the second floor. Porch semi-enclosed.

20. Gray house. North side of Quaker Street west of the Leach house. 2-1/2 stories with rear wing. Five-bay first floor with center door and four-bay second story. One-story lean-to addition.

21. Gilliland house. Murphy in 1862. North side of Quaker Street. Said to have been built in 1780 by Margaret Furness (Furnass), "marital sister" of Elizabeth Bodly, the town founder. This structure consists of two houses joined together. At one time had very large old fireplace in west end and other original features. Two recent fires and extensive rebuilding and remodeling have left little historical integrity. At one time operated as the Quaker Tea Room and later as the Colonial Rest Home.

22. D. Loper house. Northeast corner of Route 47 and Quaker Street. 2-1/2 story. Owner believes construction date is 1810. Has an Aetna Furnace fireback in one fireplace. Three fireplaces on one chimney but no longer used due to deterioration of chimney interior. Once owned by a daughter of Elizabeth Bodly . Upstairs windows said to be glazed with cylinder glass. Wide, beaded weatherboards. Has "meal room" for storage at one end. Present owner Lewis Fitzgerald.

23. Southeast corner of Stable Lane and Route 47. No owner designated on earlier maps. Four bays wide but picture window has been installed on Route 47 side. Asbestos siding.

24. Boxwood Manor. Francis Lee house. 2-1/2 story. May have been built by Samuel Townsend. West side of Route 47. Said to have been built ca. 1780 and remodeled when Lee acquired it. Kept as a hotel by Ingate Stanford in 1847 but primarily a private residence. Two major sections with lean-to additions. Has had some alteration but still a fine house.

25. S. Townsend house. Operated as the Windmill Inn at one time but was a restaurant, not a residential inn. One of the homes which would accomodate railbird hunters in season and reportedly had numbered doors at one time. Built in at least two stages. Older portion apears to be the section adjacent to Route 47. Two entrances on Quaker Street. Entrance nearest Route 47 has three-light side panels but no transom. Cross-gable roof on older section. Wing along Quaker Street has roof ridge parallel to street. Arched attic windows. Reported that interior renovation is being done in 1987. Owner J. Bailey.

26. Bozarth house. South side of Quaker street. 2-1/2 story. Built in at least two stages or another house moved here and joined. Converted to three apratments at one time but now a single-family dwelling. Owner says this house has fireplaces but they are closed off. Two entrances on Quaker Street. Door surround on the west end has a three-light transom.

27. Edwards house. South side of Quaker Street. 2-1/2 story saltbox with rear wing and side porch. Three bays with center door on first floor, two-bay second floor.

28. Wilmer Gheen house. 2-1/2 story. Camp in 1862 but this may be another house. H.W. Vanaman says the Gheen house was built around the time of the Civil War by Gheen. A large house with mansard roof and two dormers on each face. Side facing Quaker Street has mansard interrupted by a gable. Dormers are arched. Five-bay first floor with center door. Porch has wooden scrollwork. Two bays second floor. Attached cookhouse also with mansard roof and arched dormers. Present owner Widener.

29. Methodist parsonage. Built ca. 1804. Corner of Second and Quaker Streets on southwest corner. Undergoing drastic remodeling in 1987. Interior walls have been removed and weatherboards torn off. Little left of the original house except the framework.

30. Jonathan Dallas house. 2-1/2 story. Said to be 18th century. Second Street between South and Quaker on east side. According to owner built in three stages. One section Georgian with arched dormers. Has a spiral staircase with plater moldings around the perimeter. Beehive oven and six working fireplaces. Hand-split lath in one portion. Hardware identified by blacksmith Donald Streeter as English import, brass, with unusual doorknobs. Original floors and some original chair rails. Restored. Present owner Leslie Woolford.

31. Jacob Sheppard house. 2-1/2 story. Southwest corner of Second and South Streets. One-story room on northwest corner said to have been used as a school at one time. J. Getsinger in 1862.

32. Victorian farmhouse west side Route 47, south of Boxwood Manor. 2-1/2 story. Post 1876. Appears to have little or no change. Bay windows with paneled surrounds on north side.

33. Oliver house. 2-1/2 story. South side of Broadway east of Second Street. Large central chimney. One-story lean-to addition. Has siding and is patched on one corner where it was struck by a car. Poor condition.

34. Stephen Murphy house. Across from the Methodist Church north of the present Senior Center on Port Elizabeth-Cumberland Road. Present owner Clarissa Bradford is building a new house adjacent to this dwelling and it will be demolished as soon as the occupancy permit is issued for the new home. Built in at least two stages, 6/9 windows facing the road. 8/8 windows in rear section. Three-light transom over entrance which is on the side facing the Senior center. It once faced School Lane which no longer exists. One-story lean-to addition on northeast corner. Interior said to have been extensively renovated.

35. Lee house. Hand in 1862. 1-1/2 story saltbox. Church Street south of the Catholic cemetery. May have originally been a Cape Cod with a later rear addition. Three bays with off-center door. One-story lean-to addition.

36. Joseph Getsinger house. 2-1/2 story. East side of Port Elizabeth-Cumberland Road north of Academy Street. Three-bay second story.

Enclosed porch covers first floor. Rear wing may be older. Has narrow 4/4 windows. One-story lean-to addition. Large chimney.

37. Eagle Glass Works Hotel. 2-1/2 story. A long-time private residence. Mrs. J. Getsinger in 1862, Hickman in 1876. Operated as early as 1807 by Christian Stanger as a hotel. Three fireplaces including one in the plastered attic. There was a fire in the attic in the 20th century and these features may have been removed in rebuilding. Present owner Kenneth Elwell says attic floor has some boards 22" wide. Three bays with side door. Present porch and fan light new. Large rear wing with one-story lean-to.

38. Glass company house. East side of Port Elizabeth-Cumberland Road north of the hotel. 2-1/2 story. Saltbox shape may be due to rear addition to original house. One-story lean-to on south side. Present owner Lawrence Ackley.

39. Eagle Glass Company duplex. West side of Port Elizabeth-Cumberland Road. One of a pair of duplexes owned by Eagle Glass Company. Each half two bays wide with side door. Porch across entire front. Mapped and described on an 1872 insurance map. Said to be 30 by 30 feet with a 9 x 30-foot shed and cellar in rear, one chimney and two fireplaces.

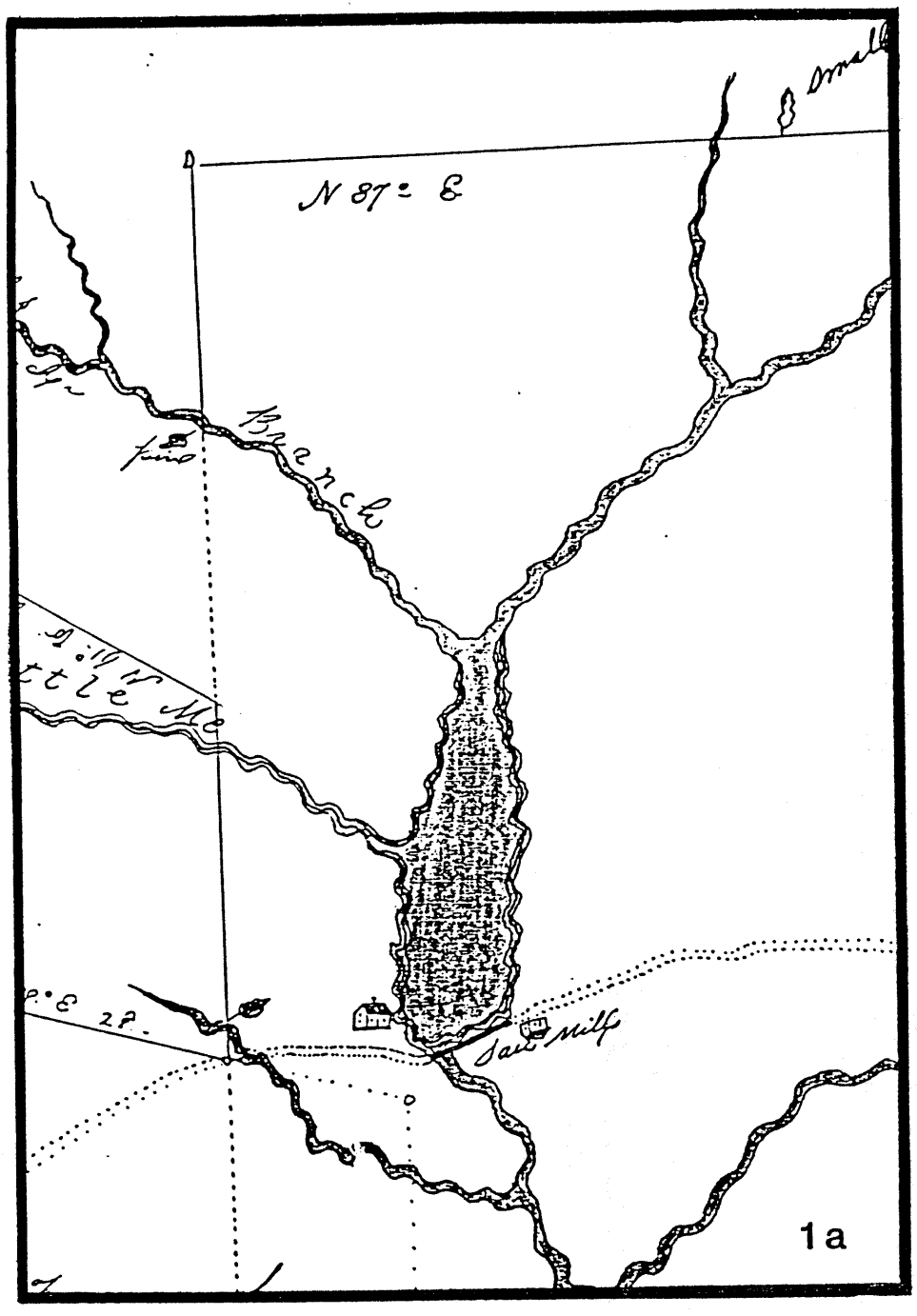
40. Adjacent to and identical to 39. Both houses have been updated and one is undergoing renovation in 1987.

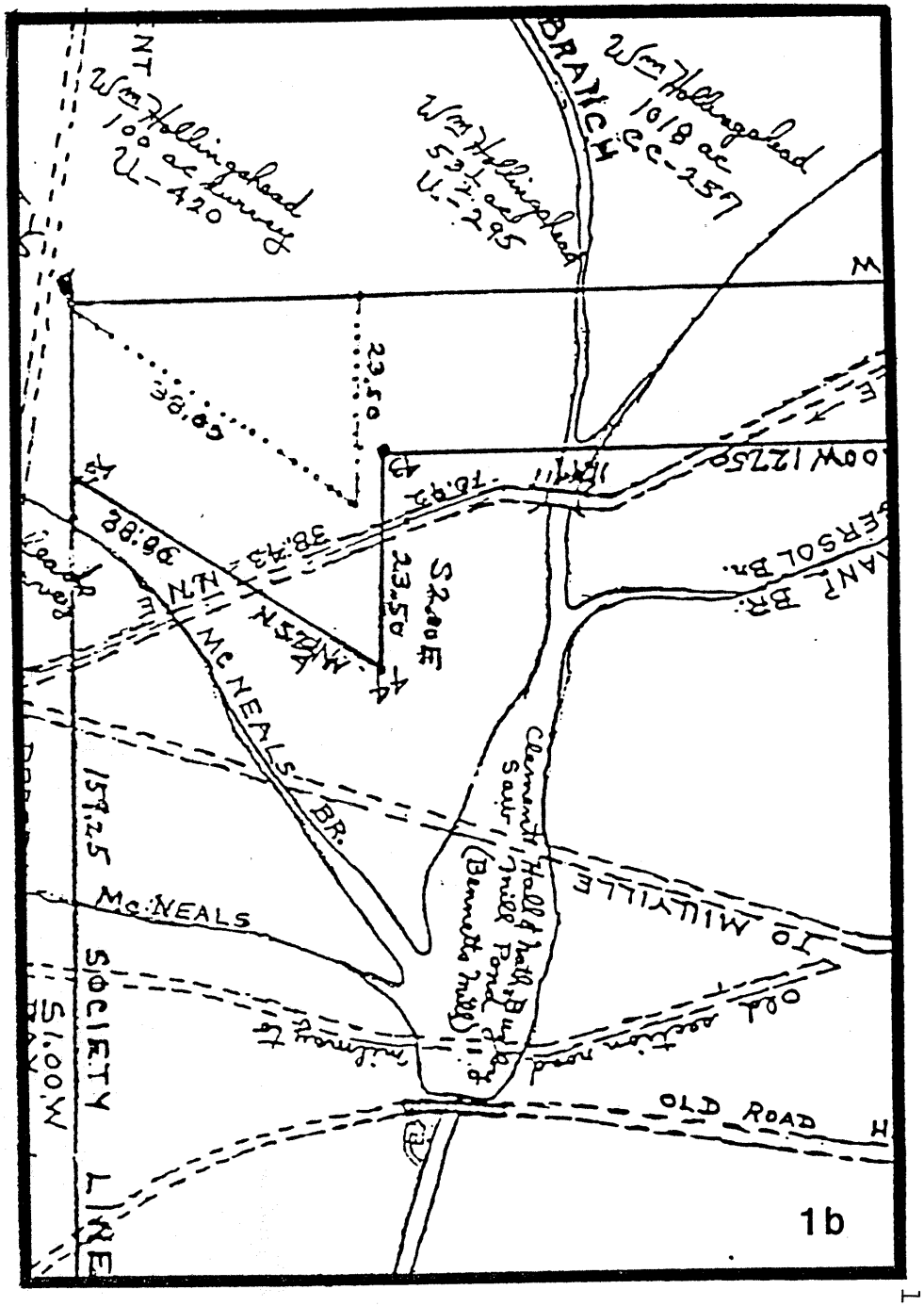
41. S.C. Vanaman house (Fig. 9). West side Port Elizabeth-Cumberland Road across from intersection with Ormond Road. 2-1/2 story. Four bays with enclosed front porch. Large center chimney. One-story addition in rear.

42. Wesley Budd house (Fig. 9). Prior to 1831 and possibly ca. 1800. 2-1/2 story. South side of Route 49 east of Cumberland Pond. Three bays first floor, two bays second floor. Center door. 2-1/2 story addition on west end and enclosed porch on east end. Rear wing and lean-to additions. Said to have had either a fireback or stove made at Cumberland iron works at one time. Could not be verified whether it still has these features. Internal end chimneys in main section. Schmeelk in 1987.

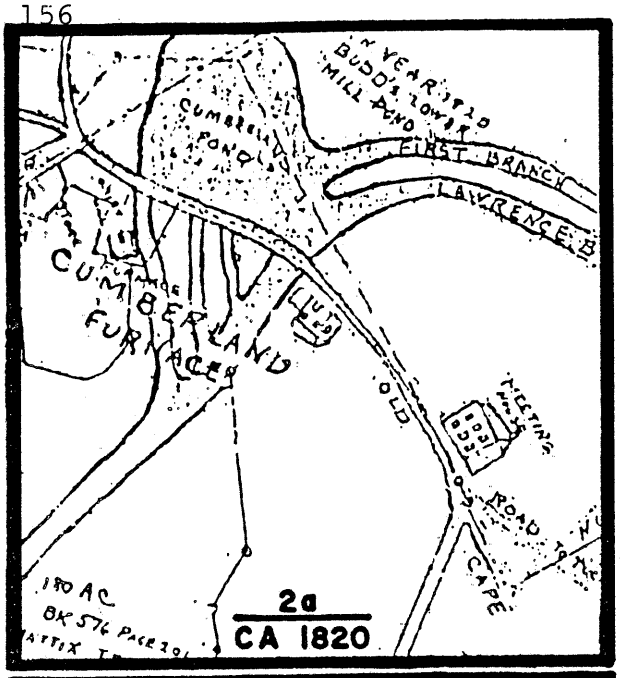
43. Phifer house (Fig. 9). South side Cumberland Road east of Cumberland Pond and west of Ormond Road. 2-1/2 story with a two-story rear wing. Enclosed porch on side extends to an open porch across the full width of the front. Three bays with center door. Internal end chimneys.

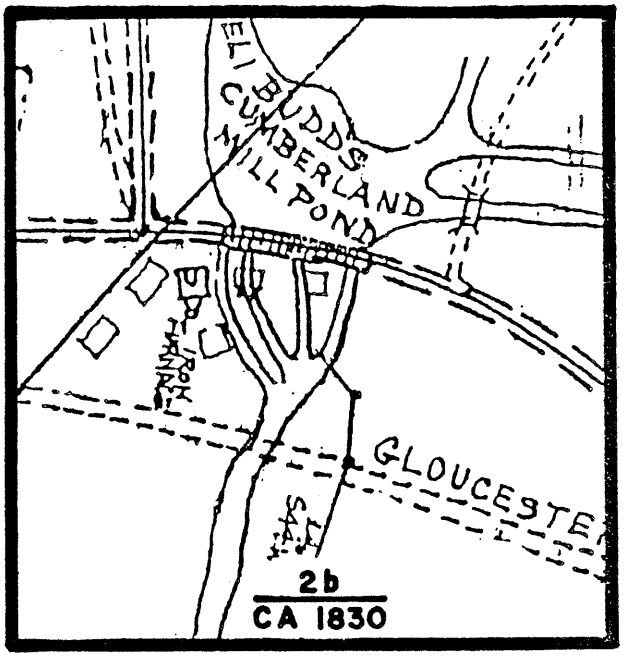
44. Ewing house (Fig. 9). Northwest corner of Hesstown Road and Route 49. 2-1/2 story with 1-1/2 story addition along Hesstown Road. Formerly a store. Smaller one-story addition on west end. Low in 1987. Kenneth Low, who lived in this house, says it is 200 years old and once was an Indian trading post. No verification for either of these statements.

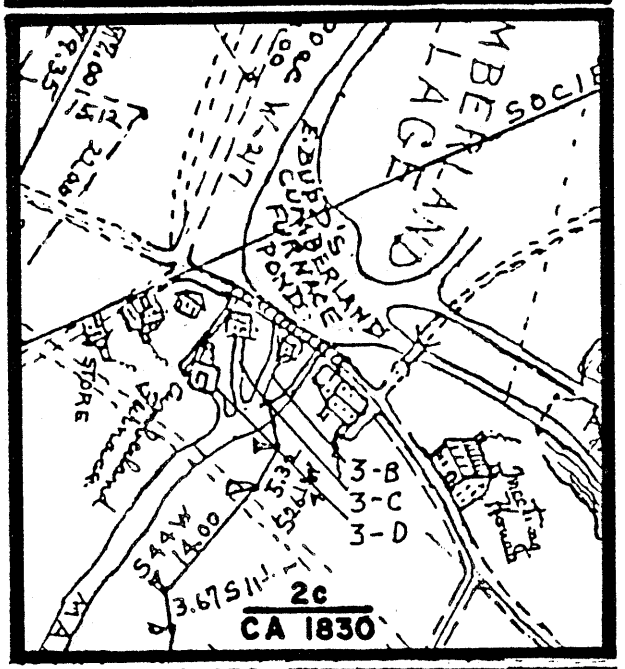




BENNETTS MILL fig. 1



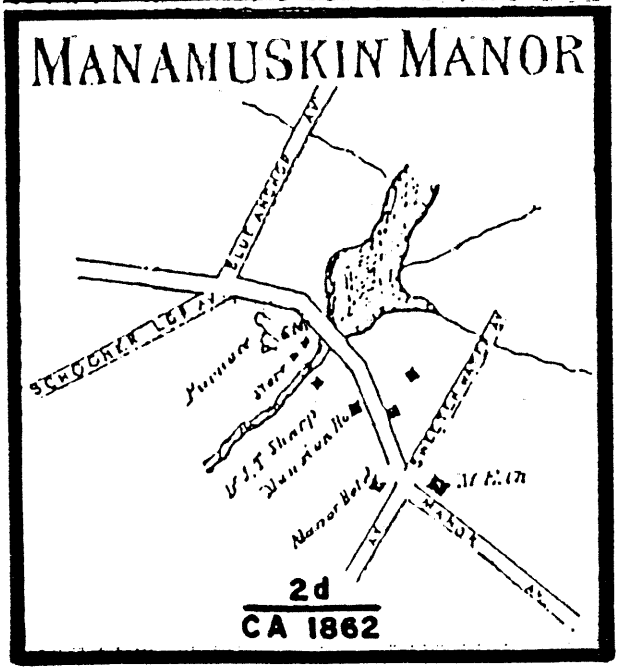


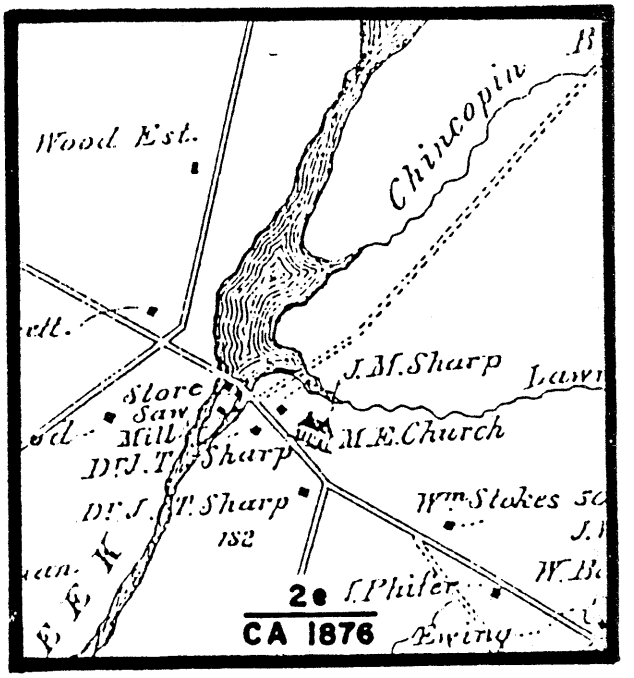


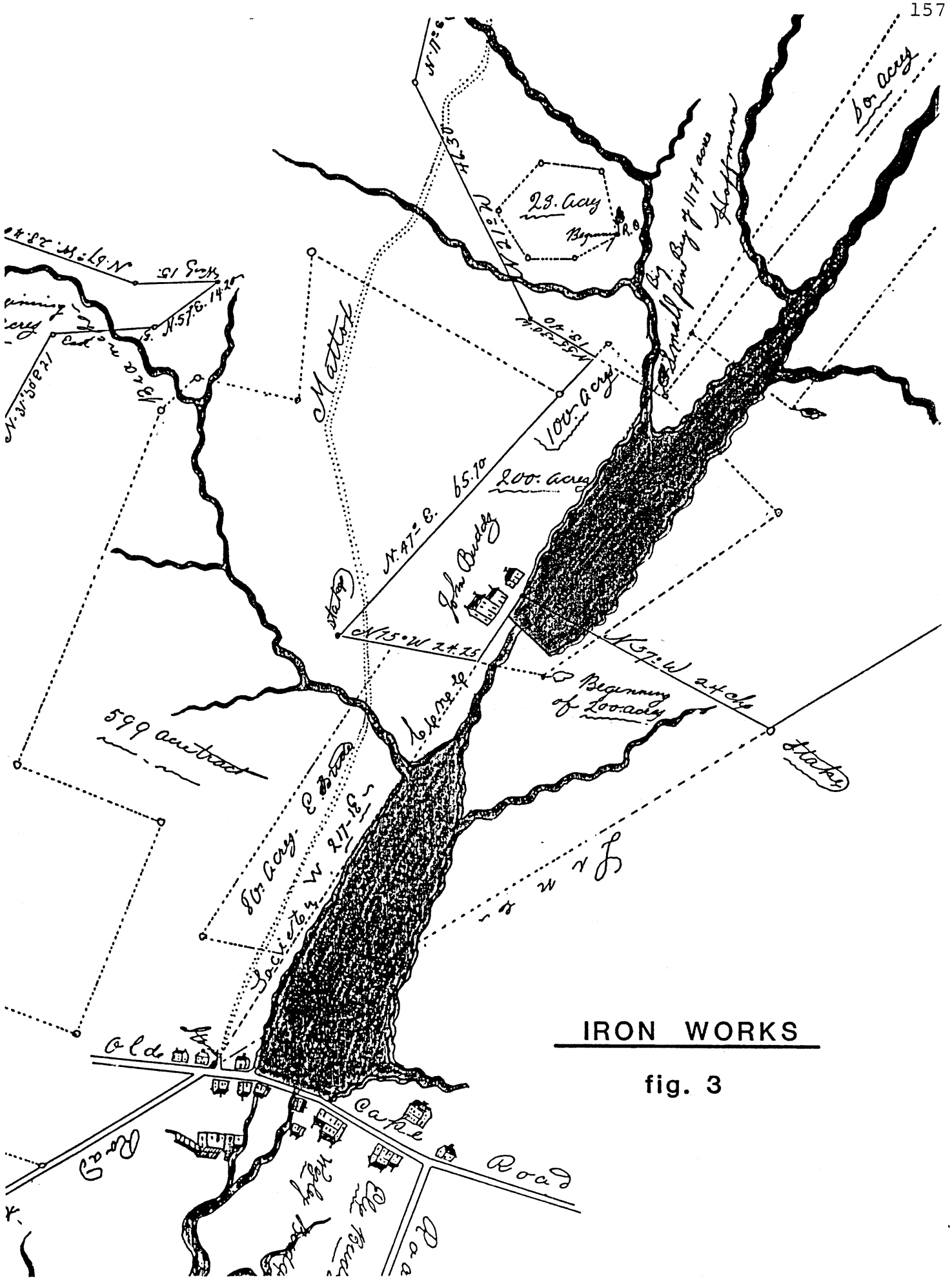
CUMBERLAND

POND

fig. 2

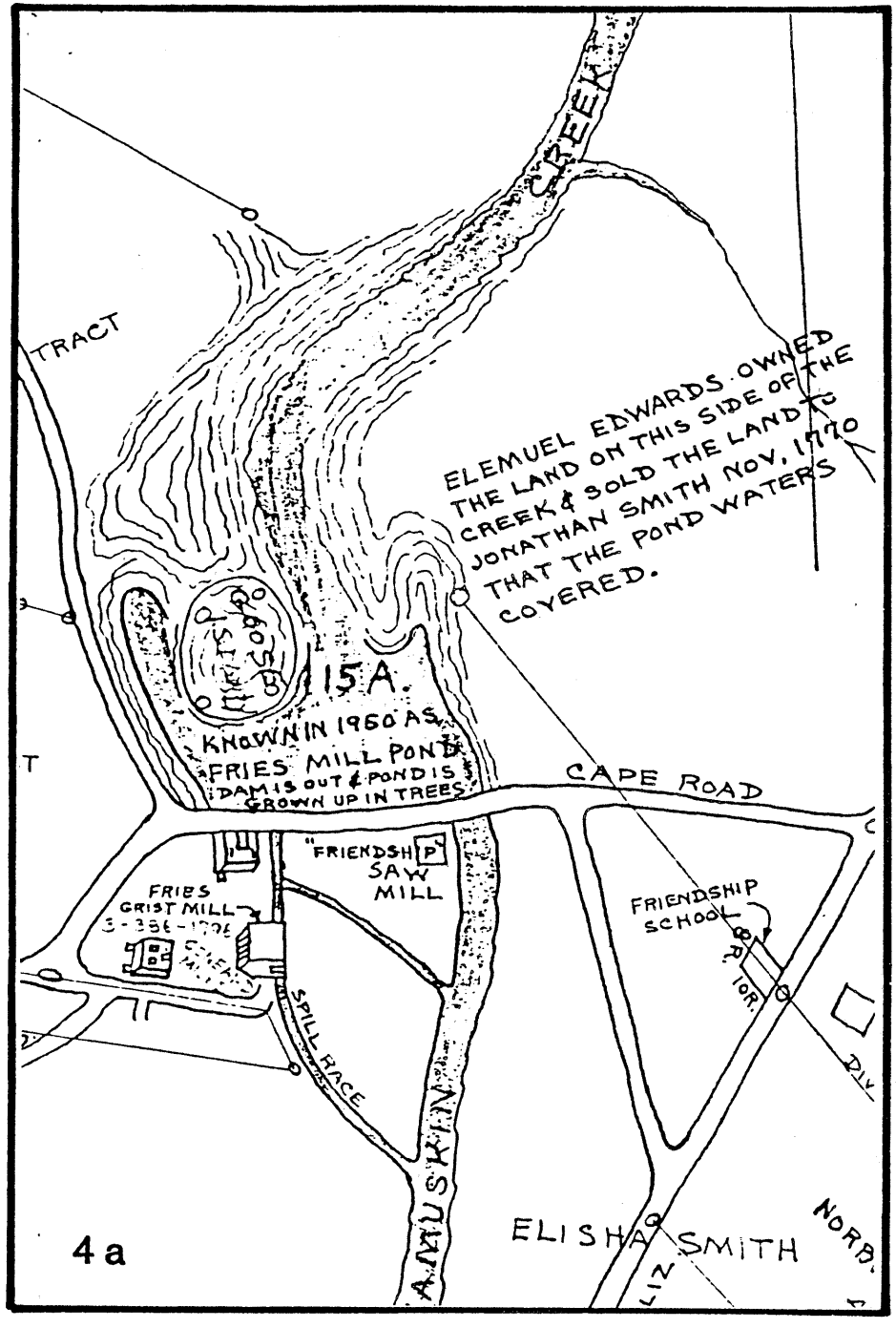


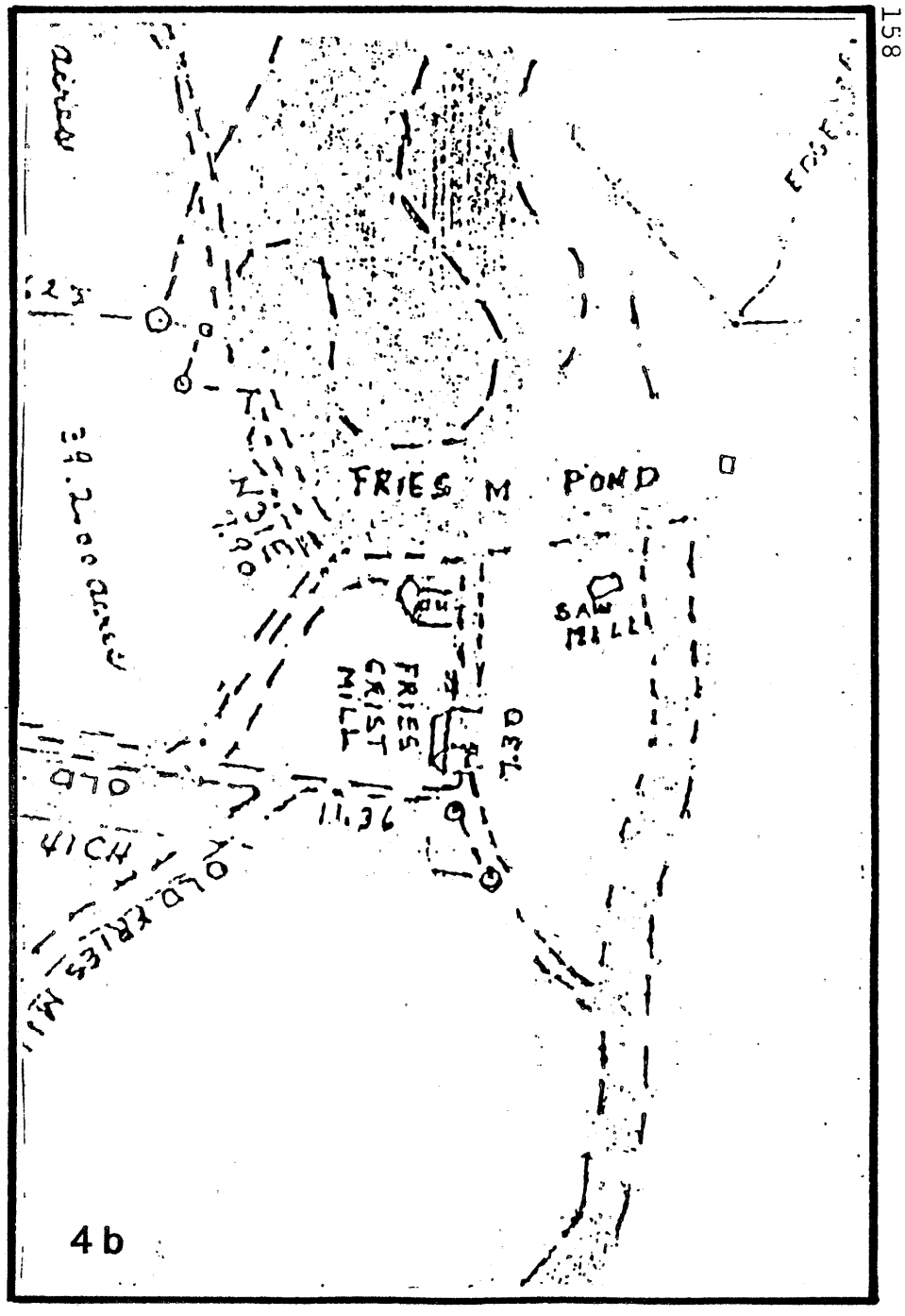




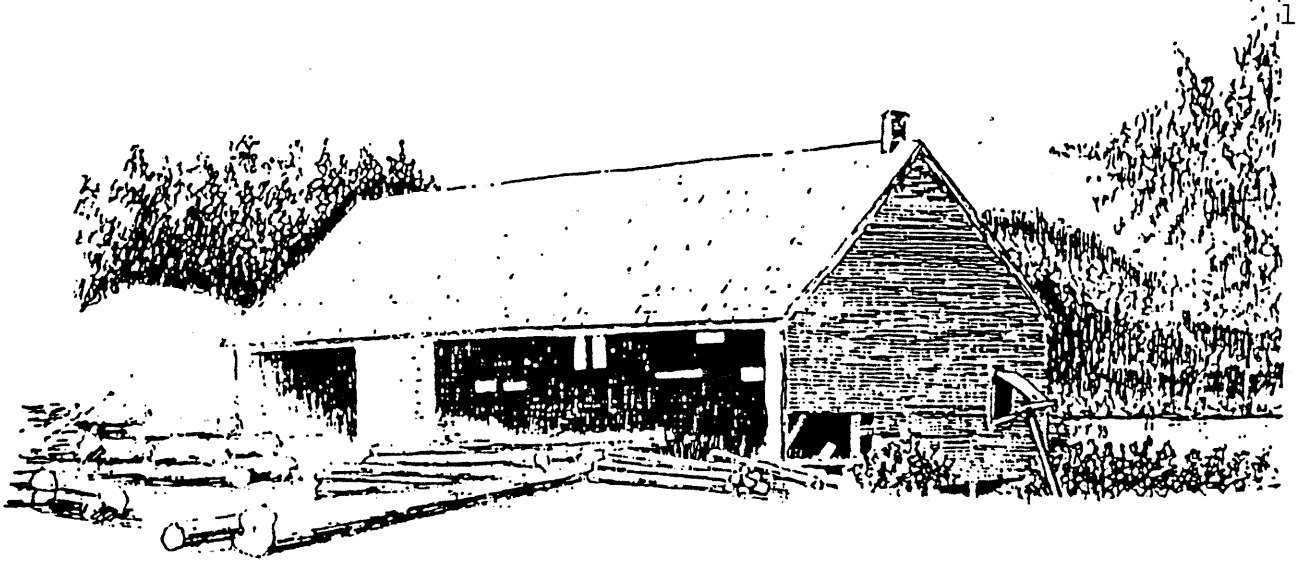
IRON WORKS

fig. 3





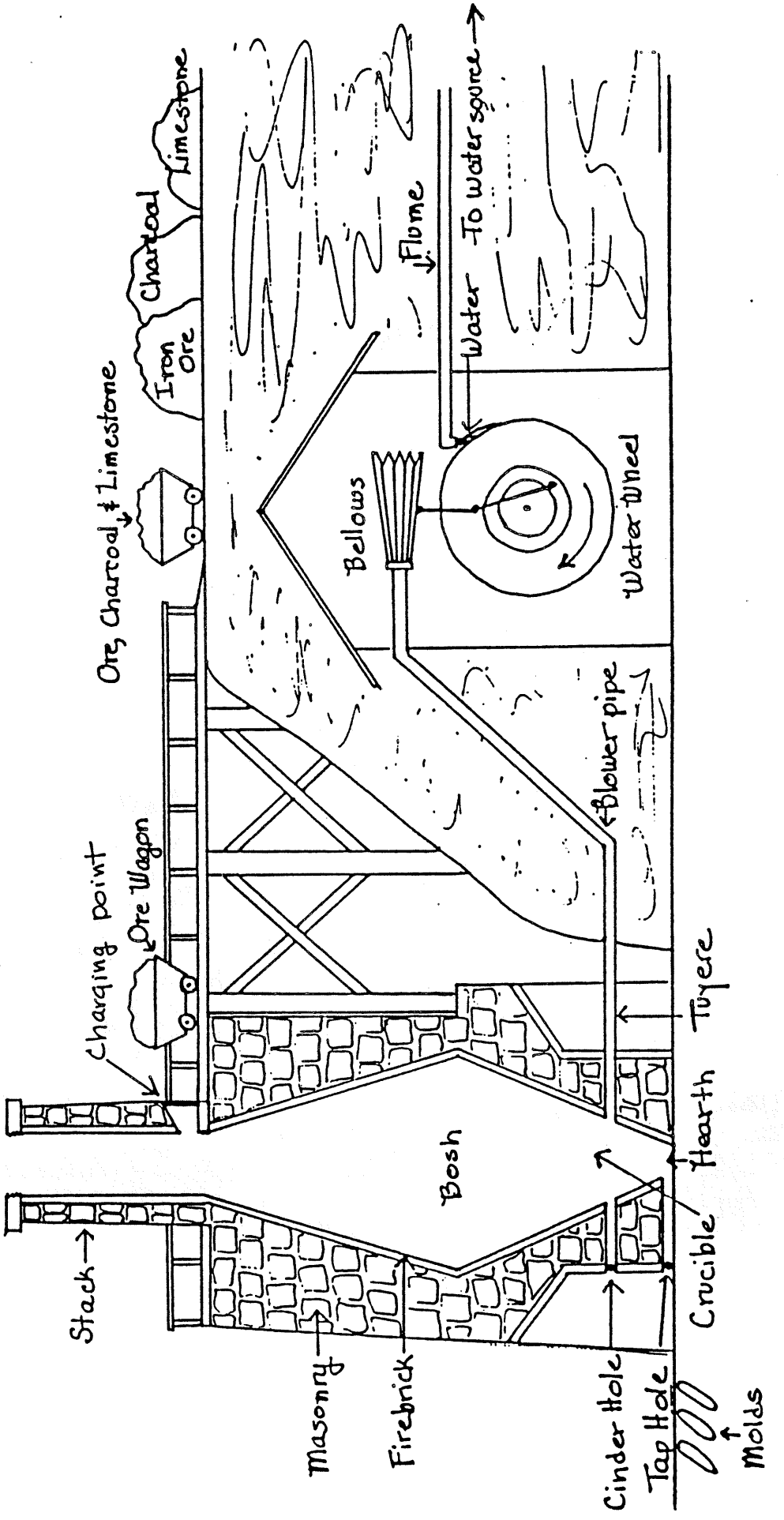
FRIES MILL fig. 4



Old Saw Mill at Frie's Mill, Manumuskin, N.J.

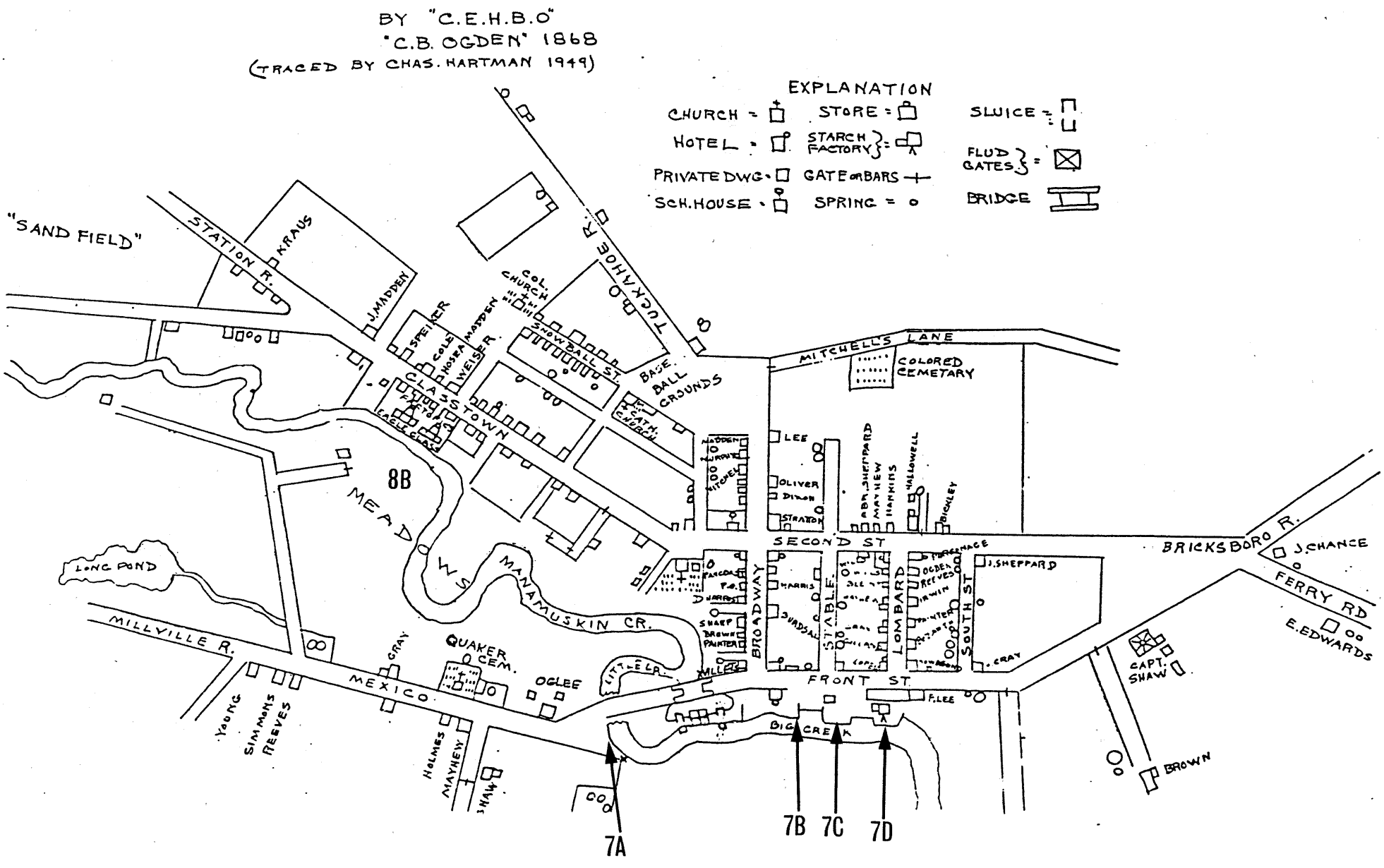
Old Reeve's Grist Mill at Frie's Mill, Manumuskin, N.J. owned by Clara S. Steven's Great Grandfather.

fig. 5



TYPICAL IRON FURNACE

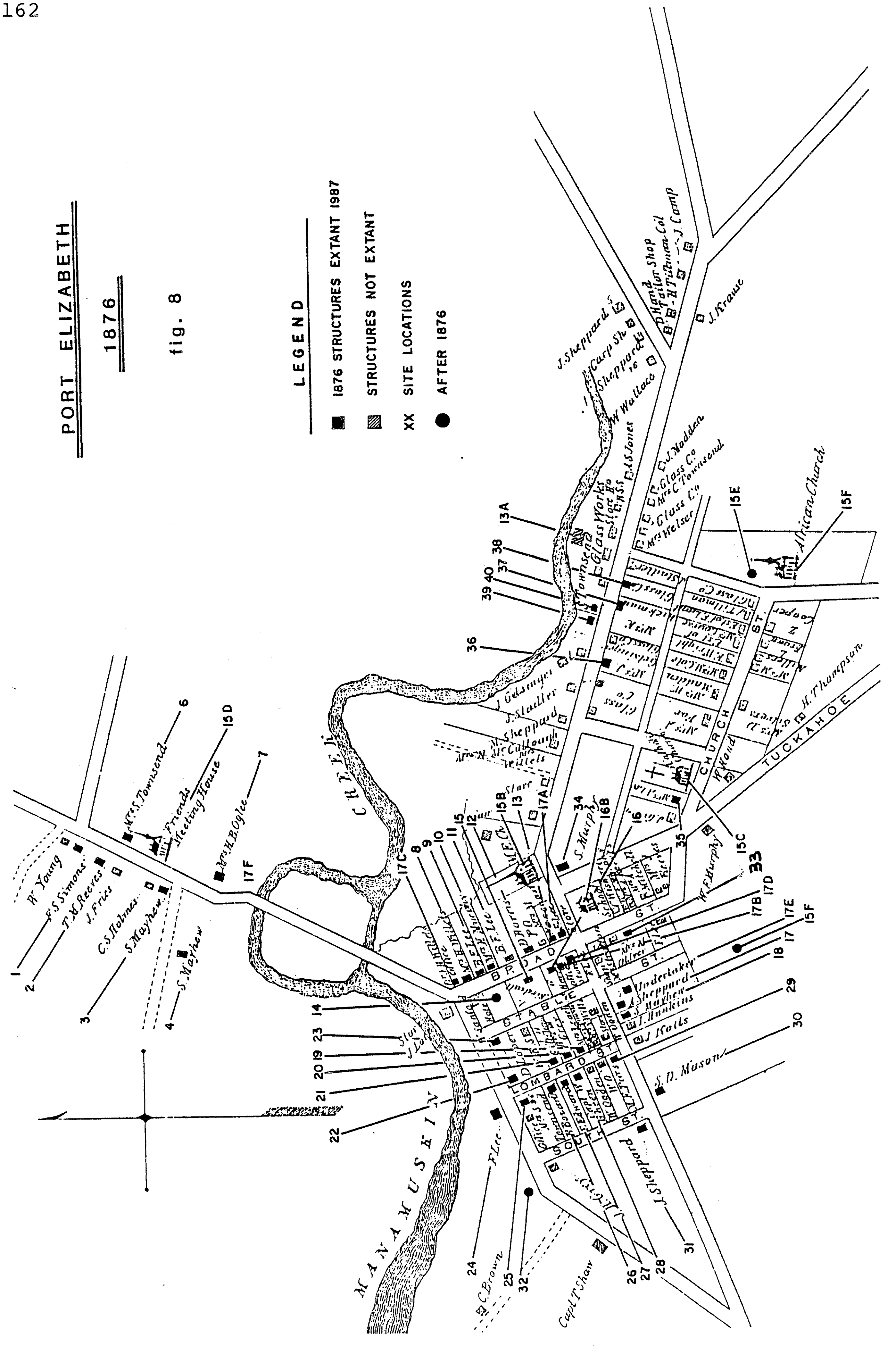
fig. 6

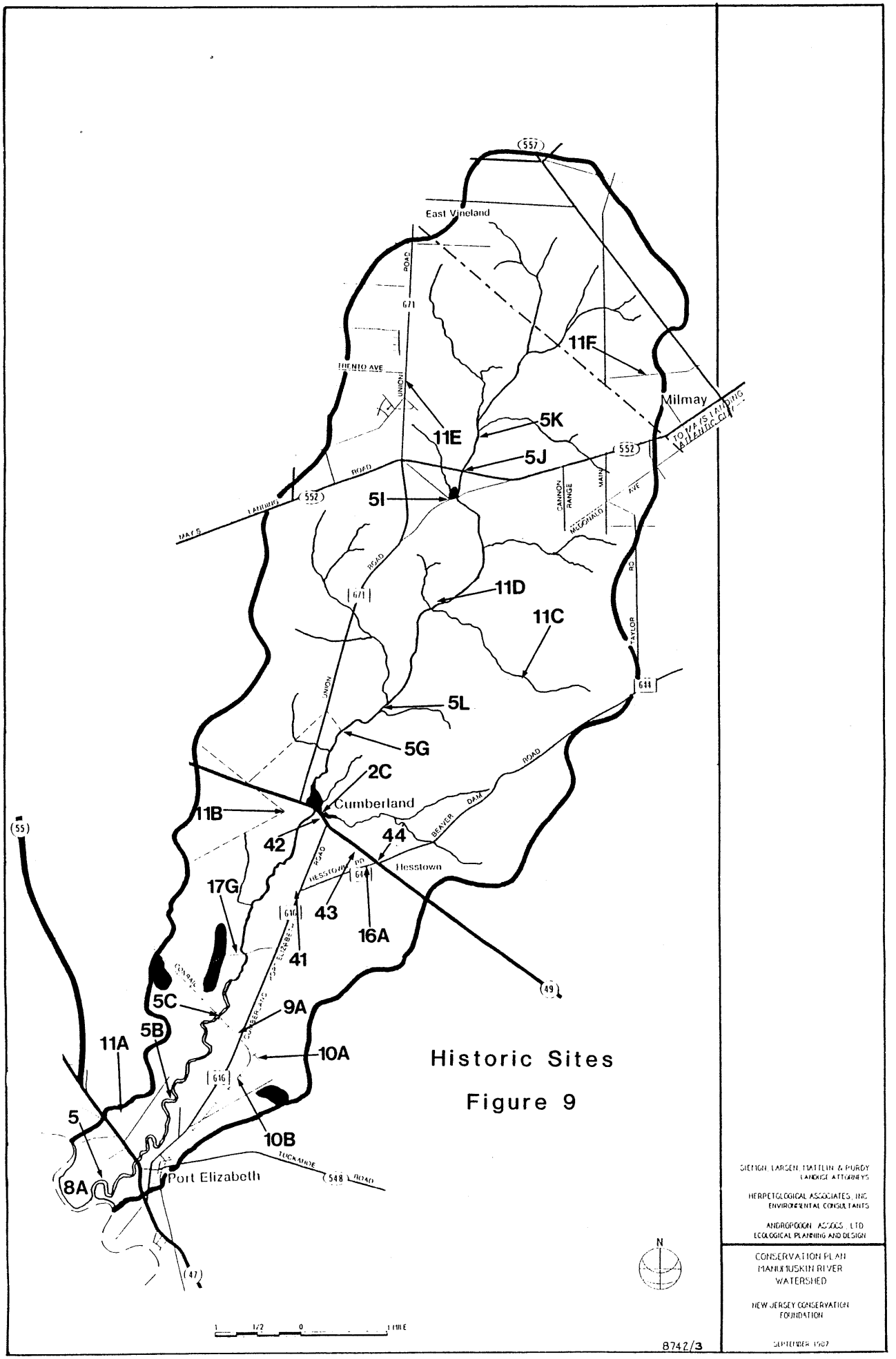


PORT ELIZABETH

1868

fig. 7


PORT ELIZABETH
1876
fig. 8
LEGEND
1876 STRUCTURES EXTANT 1987
STRUCTURES NOT EXTANT
XX SITE LOCATIONS
AFTER 1876
MANAMUSKIN
CREEK
TUCKAHOE
CHURCH
Friends Meeting House
African Church
Glass Works
J. Krause
J. Camp
S. D. Mason
J. Sheppard
Capt T. Shaw
C. Brown
H. Thompson
S. Murphy
W. F. Murphy
Mrs. H. B. Ogle
Mrs. S. Townsend
R. Young
F. S. Simons
T. H. Reeves
J. Fries
C. S. Holmes
S. Mayhew
W. Wallace
J. Madden
A. S. Jones
Underlaker
J. Kalls
T. Hankins



Historic Sites

Figure 9

8742/3

DIEHL, LARSEN, MATTLIN & PURDY
LANDUSE ATTORNEYS

HERPETOLOGICAL ASSOCIATES, INC.
ENVIRONMENTAL CONSULTANTS

ANDROPOGON ASSOCS., LTD.
ECOLOGICAL PLANNING AND DESIGN

CONSERVATION PLAN
MANUMUSKIN RIVER
WATERSHED

NEW JERSEY CONSERVATION
FOUNDATION

SEPTEMBER 1987

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1868 map of Port Elizbeth by C. B. Ogden, reproduced by C.S. Hartman (in Herbert Vanaman Collection, Port Elizabeth, N.J.)

1862 map of Cumberland County, published by A. Pomeroy, Philadelphia, PA (copy at Millville Library).

1895 and 1911 survey maps of Fries Mill. (Millville City Engineer collection).

1831 survey map of Eli Budd's lands. (Millville City Engineer collection).

Several composite maps of Charles S. Hartman, based on surveys spanning the period 1770-1900. (Hartman Collection, Alexander Library, Special Collections Department, Rutgers University, New Brunswick N.J.) Map of Port Elizabeth by Hartman (H.W. Vanaman Collection).

Newspaper article, Vanaman, Herbert W., "Col. J. Howard Willets of Port Elizabeth", Bridgeton Evening News, Jan. 1926. Reprinted in the Vineland Historical Magazine, Vol. 54, No. 1.

1872 insurance map of Eagle Glass Works & 1814 survey map of Union Glass Works (Millvile City Engineer collection).

Informants:

Herbert W. Vanaman, Port Elizabeth.

William Otto, Cumberland.

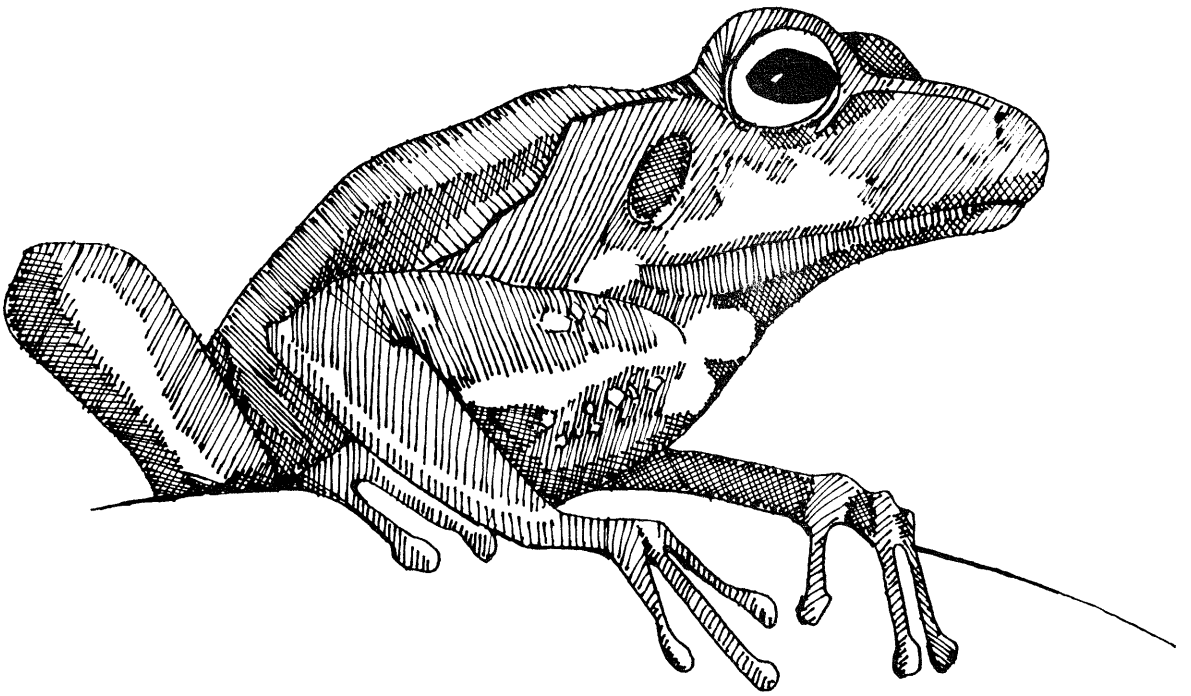
Tom Brown, Cumberland.

Charles E. Hartman, Millville.

James Bertonazzi, Vineland.

Samuel DeRosa, Milmay.

Information also was obtained from numerous documents, record books and manuscripts relating to the Budd and Vanaman families in the possession of Herbert W. Vanaman of Port Elizabeth.



APPENDIX

REVIEW OF ZONING AND LAND USE ORDINANCES: Buena Vista Township, Maurice River Township, City of Vineland, and City of Millville

The zoning and land use ordinances for the local jurisdictions within the watershed were reviewed and analyzed. A large portion of the land area within the Manumuskin River Watershed is within the Pinelands and is subject to minimum standards set forth in the N.J. Pinelands Comprehensive Management Plan (C.M.P.). Land areas outside of the Pinelands -- to the west of the Manumuskin in Vineland, Millville and Maurice River -- are not similarly protected.

Land Areas Inside Watershed and Pinelands

The land in Buena Vista Township and virtually all of the land to the east of the Manumuskin, in Maurice River Township, is in the Pinelands. The area in Vineland west of the Manumuskin and east of Union Road is also in the Pinelands. Table 1 shows that in the Pinelands portions of the Maurice River and Vineland, local zoning provisions regarding residential lot restrictions either meet or exceed the Pinelands requirements. Most of the Pinelands portions of Maurice River and Vineland require low residential densities of 1 dwelling unit (DU) per 20 acres to 1 DU/30 acres. However, there are several areas in Maurice River outside Port Elizabeth that provide for residential development on 5 to 10 acre lots, and in Vineland the "P-R" and "P-A" districts allow residential development to be clustered on 1 acre lots, subject to overall densities of between 1 DU/5 acres to 1 DU/10 acres.

Local regulations in Buena Vista Township are not currently in conformance with Pinelands C.M.P. requirements. Pinelands requirements prevail in Buena Vista, until the local zoning code is brought into conformance with the C.M.P. (Minimum lot restrictions contained in the Pinelands Plan are given in Table 6.)

The Pinelands Commission and Buena Vista have been involved for several years in negotiations concerning land use/zoning designations that would be acceptable to each party for the purpose of conformance. The Pinelands Commission recently presented a written proposal to Buena Vista outlining what it deems to be an acceptable land use/zoning configuration

for the portion of that town within the Manumuskin Watershed. (See copy of Pinelands Commission letter in Appendix C.) If adopted, the proposal would greatly reduce the area designated for "Agricultural Production," greatly expand the "Forest Area" designation and create two "Rural Development" areas.

Land Areas Inside Watershed, Outside Pinelands

On the western side of the Manumuskin, there are several large land areas which are not protected by the minimum Pinelands requirements. Table 2 identifies several zones which allow denser residential development than the Pinelands minimum of 1 DU/3.2 acres.

In Maurice River, single-family residential development is allowed at 1 DU/acre in a small area near Port Elizabeth. Maurice River recently acted to afford greater protection to the area west of the Manumuskin, by rezoning lands that had been designated "General Industry" to "Conservation", which requires 25 acres for each DU.

Adjacent to this area, in the 2% of the watershed (500 acres) which lies within Millville, residential development is permitted at 1 DU/2 acres in a "Land Conservation" zone. North of this area, still on the west side of the river, west of Union Road in Vineland, single-family residential development is permitted at 1 DU/40,000 sq. ft. (See tables for regulations regarding other uses in these zones.)

Wetlands Provisions

Two of the four jurisdictions (Maurice River and Vineland) prohibit development within 300 feet of any wetland. As previously mentioned, Buena Vista Township's regulations are currently under revision. Millville has no wetlands provisions. (See Table 3.)

The recently enacted N.J. Freshwater Wetlands Protection Act, which becomes effective in July 1988, will supercede all local wetlands provisions. The Act exempts areas covered by the existing state Coastal Wetlands Act and the Pinelands regulations, however, and would thus only apply to wetlands areas outside of these jurisdictions.

The only wetlands which would gain protection under the new state Act are located in Vineland's "Agriculture" and "Woodland" zones, as these areas are not currently protected under the Vineland Pinelands wetlands

provisions referenced in Table 3, and the relatively small area of wetlands located in the Millville portion of the Watershed. Freshwater wetlands in Maurice River are currently protected by a wetlands provision of general application. Beginning in July 1988 local regulation of Maurice River Township freshwater wetlands, located outside the Pinelands, will be superceded by the new state Act.

Floodplain Provisions

Table 4 lists and references the various flood management regulations. Considering the array of local and state regulatory provisions which apply to this watershed, especially those related to wetlands and wetland buffers, it appears that floodplain provisions will not be a primary factor influencing intensity and spatial distribution of future development.

General Development Regulations

Tables 5, 6 and 7 list, by jurisdiction, the zoning districts in the watershed and some of the more important development regulations for each district along with wetland and flood hazard areas.

TABLE 1

DEVELOPMENT RESTRICTIONS PERTAINING TO
LAND AREAS INSIDE WATERSHED AND
INSIDE PINELANDS AREA

ZONING DISTRICT	MINIMUM LOT SIZE (Residential)	MAX. LOT COVERAGE
Buena Vista:*		
Maurice River:		
-Public	No residential development permitted.	
-Conservation	30 acres	2 percent
-Limited Growth	25 acres	2 percent
-Mobile Home	5 acres	20 percent
-R-10 Residence	10 acres (5, if clustered on 100 acres minimum)	10 percent (20, if clustered)
-R-5 Residence	5 acres	20 percent
-R-1 Residence	3.2 acres, without innovative on-site wastewater system; 1 acre with such system or clustered on at least 50 acres without such system.	30 without system; 40 with system
-M-1 Resource Industrial	5 acres if clustered on 100 acres minimum, subject to authority approval	
Millville**	N/A	N/A
Vineland:		
-Pinelands-Agric.	10 acres if accessory to agricultural use; 3.2 acres, subject to certain requirements; 1 acre, subject to certain requirements.	
-Pinelands-Forest	20 acres; 3.2 acres, subject to certain requirements; 1 acre, subject to certain requirements.	
-Pinelands-Rural Development	3.2 acres, subject to certain requirements; 40,000 sq.ft. if clustered, so long as 1 DU/3.2 acres maintained; 1 acre, subject to certain requirements.	

* Local land use plan is currently under complete revision to conform with Pinelands requirements. New zones are likely to be very similar to Pinelands zones in Vineland.

** Millville is entirely outside of the Pinelands area.

TABLE 2

DEVELOPMENT RESTRICTIONS PERTAINING TO
LAND AREAS INSIDE WATERSHED AND
OUTSIDE PINELANDS AREA

ZONING DISTRICT	MINIMUM LOT SIZE (Residential)	MAX. LOT COVERAGE
Buena Vista:*	N/A	N/A
Maurice River:		
-Conservation	25 acres	1 percent
-Limited Growth	10 acres	10 percent
-R-5 Residence	5 acres (3, if clustered on 50 acres minimum)	10 percent
-R-1 Residence	1 acre (20 acres for multi-family dev'ts): 22,000 sq.ft. if clustered on at least 25 acres with an innovative on-site wastewater system.	35 (50, multi-fam.) 40, if clustered with system
-B-1 Neighborhood Business	No residential development permitted.	
-M-3 General Industry	No residential development permitted.	
	5 acres if clustered on 100 acres minimum, subject to authority approval	
Millville:	N/A	N/A
-Land Conservation	2 acres	30 percent
Vineland:		
-Agriculture	40,000 sq.ft.; 2 acres, other uses	10 percent
-Woodlands	40,000 sq.ft.;	10 percent

* The Buena Vista area of the watershed is entirely within the Pinelands area.

TABLE 3

LOCAL WETLANDS PROVISIONS

BUENA VISTA	MAURICE RIVER**	MILLVILLE	VINELAND*
Local development ordinance currently undergoing revision. See N.J. Pinelands C.M.P., Article 6, Part 1, "Wetlands"	No development permitted within 300 feet of any wetland except uses specifically authorized under this section. Development Regulations Ordinance, Section 10.2AH	None	No development permitted within 300 feet of any wetland unless applicant demonstrates no adverse impact will result. Land Use Ordinance Art. 6E "Pinelands" Section 10 "Wetlands

* Only applies to wetlands within the Pinelands.

** Definition of Wetlands: Wetlands are those lands which are inundated or saturated by water at a magnitured, duration and frequency sufficient to support the growth of hydrophytes. Wet-lands include lands with poorly darined or very poorly drained soils as designated by the Natural Cooperative Soils Survey of the Soil Conservation Service of the United States and as defined in N.J.A.C. 7:50-6.3 through 6.5.

TABLE 4

LOCAL FLOODPLAIN PROVISIONS

BUENA VISTA	MAURICE RIVER	MILLVILLE	VINELANDS
Local development ordinance currently undergoing revision. There are no floodplain management provisions in the Pinelands Plan.	No development permitted in floodways. 2 acre min. lot size and 5 percent max. lot coverage applies to all other portions of floodplain areas. First floor of any structure must be at elevation 10 feet above elevation of nearest stream or watercourse within 500 feet. For other restrictions, see Development Reglations Ordinance, Section 10.2K, "Flood Plain Management"	None	No development or substantial improvements in floodway unless no adverse impact will result. In flood hazard areas, the lowest floor of any structure must be at or above base flood elevation. Land Use Ordinance Article 6A, Sec. 1, "Flood Damage Prevention"

TABLE 5

PERMITTED AND PROVISIONAL USES
MANUMUSKIN RIVER WATERSHED DEVELOPMENT RESTRICTIONS

JURISDICTION	LAND USE or ZONING DISTRICT	PERMITTED USES	PROVISIONAL USES
Buena Vista Twp.*	Pinelands Wetlands	-Dev't prohibited except for:	
	N.J. Pinelands C.M.P Article 6, Part 1	-Horticulture -Beekeeping -Forestry -Fish & wildlife -Low-intensity & water-dependent recreation -Public improvemnts	
	Pinelands Agricult Production Area ** N.J. Pinelands C.M.P Section 5-304	-Residential DUs -Agriculture -Ag. employee hsg. -Forestry -Low-intensity recr. -Intensive recreat'n -Ag. commercial establishments -Ag. products processing -Public service infrastructure -Signs -Accessory uses	-Institutional uses -Resource-related industries -Airports & heliport related to agric. or public service -Compatible light industrial -Fish & wildlife management -Campgrounds -Resource extraction -Landfills
	Pinelands Forestry Area N.J. Pinelands C.M.P Section 5-303	-Residential DUs -Agriculture -Ag. employee hsg. -Forestry -Low-intensity recr. -Intensive recreat'n -Public service infrastructure -Signs -Accessory uses	-Institutional uses -Resource-related industries -Airports serving Pinelands Town -Compatible light industrial -Ag. commercial establishments -Roadside retail sales & service

			-Resource extraction -Landfills
	Pinelands Rural Development Areas N.J. Pinelands C.M.P Section 5-306	-Residential DUs	-Agriculture -Ag. employee hsg. -Ag. products sales & processing -other light indust. -Roadside retail -Resource extraction -Landfills -Public infrastruct. -Institutional -Signs -Accessory uses
Township of Maurice River	Floodway Development Regulation Ordinance Section 10.2K	-Pasture and grazing -Recreation (excl. covered structures) -Game farm or fish hatchery -Hunting or fishing preserve -Wildlife sanctuary -Woodland preserve -Arboretum -Open yard areas or area for any other permitted use	N/A
	Remaining portions of floodplain		-All permitted uses above plus uses permitted in zoning districts subject to floodplain restrictions.
	Wetlands Development Regulation Ordinance Section 10.2AH	-Beekeeping	-Horticulture -Forestry -Fish & wildlife management -Low-intensity recr. -Docks, piers, moorings, boat launches -Bridges, roads, trails, utilities -Agriculture
	Pinelands Residence		

	Dev.Reg.Ord Sec.9.11 Zoning districts abutting on the Manumuskin R.: C Conservation R-1 Residence R-5 Residence M-3 General Industry LG Limited Growth R-10 Residence MH Mobile Home P Public	Refer directly to Maurice River Township Development Ordinance	Refer directly to Maurice River Township Development Ordinance
City of Millville	LC Land Conservation (zone nearest the Manumuskin River)	Refer directly to City of Millville Development Ordinance	Refer directly to City of Millville Development Ordinance
City of Vineland	Wetlands Land Use Ordinance Art. 6E, sec. 10 Zoning Districts: P-A Pinelands Agricultural Production Land Use Ordinance Art. 6E, sec. 4	-Horticulture -Berry culture -Beekeeping -Forestry -Agriculture -Ag. Products Processing Facilities -Fish & wildlife management -Public services & infrastructure -Resource extraction -Signs	-Forestry -Fish & wildlife management -Low-intensity recr. -Docks, piers, moorings, boat launches -Public improvements -Residential DUs -Campsites -Resource-related industries -Low-intensity recr. -Intensive recreat'n -Airport facilites & related light indus -Institutional uses -Agricultural: -goods sales -employee hsg. -air- or heliport

P-F Pinelands Forest Land Use Ordinance Art. 6E, sec. 5	-Forestry -Agriculture -Public Service infrastructure -Resource extraction -Signs	-Residential DUs -Campsites -Resource-related industries -Low-intensity recr. -Intensive recreat'n -Airport facilites & related light indus -Institutional uses -Agric./commercial -Roadside retail
P-R Pinelands Rural Development Land Use Ordinance Art. 6E, sec. 6	-Agriculture -Forestry -Public service uses -Resource extraction -Institutions -Signs	-Residential DUs -Ag. employee hsg. -Ag. products processing facilities -Roadside produce -Agric./commercial
A Agriculture Land Use Ordinance Art. 8, sec. 41	-Farms -One-family dwelling -Farm tenant housing -Horticulture -Veternary hospitals & kennels -Livestock keeping -Riding academies -Radio/TV studios -Airports	-Schools -Churches -Hospitals, homes, med. centers -Municipal facilitie -Public utilities -Non-profit recr. -Elderly housing -Group homes -Nurseries, daycare -Golf courses -Cemeteries -Heliports
W Woodlands Land Use Ordinance Art. 8, sec. 42	-All uses in A zone -Seasonal camps	-Schools -Churches -Hospitals, homes, med. centers -Municipal facilitie -Public utilities -Non-profit recr. -Golf courses -Cemeteries -Planned development -Campgrounds

* It is assumed that the minimum standards contained within the Pinelands C.M.P. govern development in Buena Vista Twp. until the Township's master plan and land use ordinances are certified by the Pinelands Commission.

** Portions of the land area surrounding the Manumuskin River which are currently designated as Agricultural in the C.M.P may be redesignated for Rural Development (per the Twp.'s request) or for Forestry (per the Commission's recommendation).

TABLE 6

LOT RESTRICTIONS
MANUMUSKIN RIVER WATERSHED

LAND USE or ZONING DISTRICT	PERMITTED or PROVISIONAL USE	DENSITY and MINIMUM LOT AREA	MAXIMUM LOT COVERAGE
Buena Vista Twp.			
Pinelands Wetlands N.J. Pinelands C.M.P Article 6, Part 1	Residential DUs	Not authorized within 300 feet of any wetland.	N/A
Pinelands Agricult. Production Area N.J. Pinelands C.M.P Section 5-304	Residential DUs	3.2 acres (min. lot) if certain tests met	
	Residential DUs accessory to agric.	1 DU/10 acres (max. density)	
	Low-intensity recr.	50 acre min. parcel	1 percent maximum impermeable surface
	Agric. commercial establishments	5000 sq. ft. (max. sales area)	
	Pinelands resource-related industrial	5 acre (min. parcel)	
	Campsites	1 site/gross acre; 10 sites/acre if clustered	
Pinelands Forestry Area N.J. Pinelands C.M.P Section 5-303	Residential DUs	3.2 acres (min. lot) if certain tests met Density designated by municpality, so long as total # of DUs does not exceed 163 in Buena Vista	

Pinelands Residence Dev.Reg.Ord Sec.9.11 Zoning districts abutting on the Manumuskin R.:	-Residential DU	3.2 acre parcels provided certain tests are met. 1 acre parcels when other tests are met.		
C Conservation R-1 Residence R-5 Residence M-3 General Industry LG Limited Growth R-10 Residence MH Mobile Home P Public	Refer directly to Maurice River Township Development Ordinance	Refer directly to Maurice River Township Development Ordinance	Refer directly to Maurice River Township Development Ordinance	
City of Millville				
LC Land Conservation (zone nearest the Manumuskin River)	Refer directly to City of Millville Development Ordinance	Refer directly to City of Millville Development Ordinance	Refer directly to City of Millville Development Ordinance	
City of Vineland				
Wetlands Land Use Ordinance Art. 6E, sec. 10	No development permitted within 300 feet of any wetland unless no adverse impact will result.	N/A	N/A	
Zoning Districts: P-A Pinelands Agricultural Production Land Use Ordinance Art. 6E, sec. 4	Residential DUs accessory to agric. Residential DUs	1 DU/10 acres 3.2 acre parcels provided certain tests are met. 1 acre parcels when other tests are met.		

		Township.	
	Low-intensity recr.	50 acre min. parcel	1 percent maximum impermeable surface
	Agric. commercial establishments	5000 sq. ft. (max. sales area)	
	Pinelands resource-related industrial	5 acre (min. parcel)	
	Campsites	6 site/gross acre; 10 sites/acre if clustered	
Pinelands Rural Development Areas N.J. Pinelands C.M.P Section 5-306	Residential	3.2 acres (min. lot) Density designated by municpality, so long as total # of DUs per square mile does not exceed 200, for private, non-wetland, undeveloped land.	
Township of Maurice River			
Floodway Development Regulation Ordinance Section 10.2K	N/A	N/A	N/A
Remaining portions of floodplain	-All uses permitted under Section 10.2K or pertaining to the zoning district.	2 acres (min. lot)	5 percent
Wetlands Development Regulation Ordinance Section 10.2AH	N/A	N/A	N/A

	Campsites	1 site/gross acre; 10 sites/acre if clustered	
	Pinelands resource-related industries	5 acre (min. parcel)	
	Low-intensity recr.	50 acre min. parcel	1 percent max. impervious surface
	Agric. commercial establishments	5000 sq. ft. (max. sales area)	
P-F Pinelands Forest Land Use Ordinance Art. 6E, sec. 5	Residential DUs	20 acre parcels 3.2 acre parcels provided certain tests are met. 1 acre parcels when other tests are met.	
	Campsites	6 sites/gross acre; 10 sites/acre if clustered	
	Pinelands resource-related industries	5 acre (min. parcel)	
	Low-intensity recr.	50 acre min. parcel	1 percent max. impervious surface
	Agric. commercial establishments	5000 sq. ft. (max. sales area)	
P-R Pinelands Rural Development Land Use Ordinance Art. 6E, sec. 6	Residential DUs	3.2 acre parcels provided certain tests are met; 40,000 sq. ft. if clustered, so long as 1 DU/3.2 acres is maintained. 1 acre parcels when other tests are met.	
	Agric. commercial establishments	5000 sq. ft. (max. sales area)	
A Agriculture Land Use Ordinance Art. 8, sec. 41	S-F Residential Other Uses Farms	40,000 sq. ft. (min. lot area) 2 acre (min. lot) 5 acre (min. lot)	10 percent 10 percent 10 percent
W Woodlands Land Use Ordinance Art. 8, sec. 42	S-F Residential Other Uses	40,000 sq. ft. (min. lot area) 3 acre (min. lot)	10 percent 10 percent
	Farms	5 acre (min. lot)	10 percent

TABLE 7

SETBACK AND HEIGHT LIMITATIONS
MANUMUSKIN RIVER WATERSHED

JURISDICTION	LAND USE or ZONING DISTRICT	SETBACK or BUFFER REQUIREMENTS	BUILDING HEIGHT LIMITATIONS
Buena Vista Twp.	Pinelands Wetlands N.J. Pinelands C.M.P Section 6-114	No development within 300 feet of any wetland, except uses specifically authorized under this section.	Height limitation all Pinelands areas is 35 feet, except for: silos, barns, church spires, cupolas, domes, monuments, water towers, fire observation towers, transmission towers, windmills, chimneys, flag poles, and other similar structures.
	Pinelands Forestry Use N.J. Pinelands C.M.P Section 6-404	Harvesting standards -25-ft. vegetated buffer along streams, marshes,etc -no skidding within 25 feet of streams -no accessways for forestry activities within 100 feet of streams, marshes,et -no landings within 200 feet of ponds, lakes, marshes	
	Pinelands Low-intensity recreational use N.J. Pinelands C.M.P Sections 5-303,-304 and -306	Access to bodies of water is limited to no more than 15 feet of frontage per 1000 feet of water body frontage.	
	Roadside retail use N.J. Pinelands C.M.P Sections 5-303,-304 and -306	New structures must be within 300 feet of existing structures.	

Township of Maurice River	Floodplain Development Regulation Ordinance Section 10.2K	First floor elevations of any structure must be 10 feet above the elevation of the nearest stream within 500 feet of the building. Zoning district regs apply if less than 20 percent of an existing lot is in the floodplain and no structures are in floodplain.	
	Wetlands Development Regulation Ordinance Section 10.2AH	No development within 300 feet of any wetland unless no adverse impact will result.	
	Scenic Corridors Development Regulation Ordinance Section 10.2X	200 feet from center line of all navigable streams, lakes and ponds in Pinelands Area, excl. Villages.	
	Zoning districts abutting on the Manumuskin R.: C Conservation R-1 Residence R-5 Residence M-3 General Industry LG Limited Growth R-10 Residence MH Mobile Home P Public	Refer directly to Maurice River Township Development Ordinance	Refer directly to Maurice River Township Development Ordinance

City of Millville	LC Land Conservation (zone nearest the Manumuskin River)	Refer directly to City of Millville Development Ordinance	Refer directly to City of Millville Development Ordinance
City of Vineland	Wetlands Land Use Ordinance Art. 6E, sec. 10	300 feet, unless no adverse impact will result.	
	Flood Hazard Areas Land Use Ordinance Art. 6A, sec. 1	The lowest floor must be at or above base flood elevation No development or substantial improvements in floodway, unless no adverse impact will result.	
	Zoning Districts:		
	Pinelands areas	see Pinelands regs above	see Pinelands regs above
	A Agriculture Land Use Ordinance Art. 8, sec. 41		25 feet (single-family residential 35 feet (all other uses)
	W Woodlands Land Use Ordinance Art. 8, sec. 42		25 feet (single-family residential 35 feet (all other uses) (subtract 10 feet from each for accessory uses)

Pinelands Commission letter to Buena Vista Township

The Pinelands Commission

P.O. Box 7, New Lisbon, N. J. 08064 (609) 894-9342

September 3, 1987

Honorable John Krokos
Mayor, Buena Vista Township
P.O. Box 605, Route 40
Buena, New Jersey 08310

Dear Mayor Krokos:

Following the Appellate Division decision which disallowed a 280 acre management area change in Berkeley Township, our staff reviewed all pending municipal land use proposals in an effort to identify and resolve any apparent inconsistencies with the Court's decision. As a result of that review, we recommended that a Rural Development Area identified in our July, 1986 proposal to Buena Vista Township be redesignated as a Forest Area. The area in question is highlighted on the enclosed map.

The intent of the recommendation was to increase the level of protection afforded to this area, which is drained by the Manumuskin River, one of the Pinelands least disturbed watersheds. At a meeting with Commission staff on July 9, 1987, the township's planning consultant opposed the recommended change and requested that we reconsider the redesignation. Our staff subsequently re-examined the 1986 land use scheme and prepared an amended proposal which we believe may satisfy the Township's concerns as well as the Court's direction.

The amended land use scheme accepts the July, 1986 land use designations unchanged, on the condition that:

1. the Rural Development Area southwest of Route 557 be zoned for residential development on lots not less than 5 acres in size;

2. non-residential land uses in this Rural Development Area be limited to those otherwise permitted in Forest Areas; and

3. the residential density permitted in the Forest Area southwest of Route 557 be determined independent of other Forest Areas in the township.

This land use proposal retains the previously proposed designations, permits the Township to zone for residential

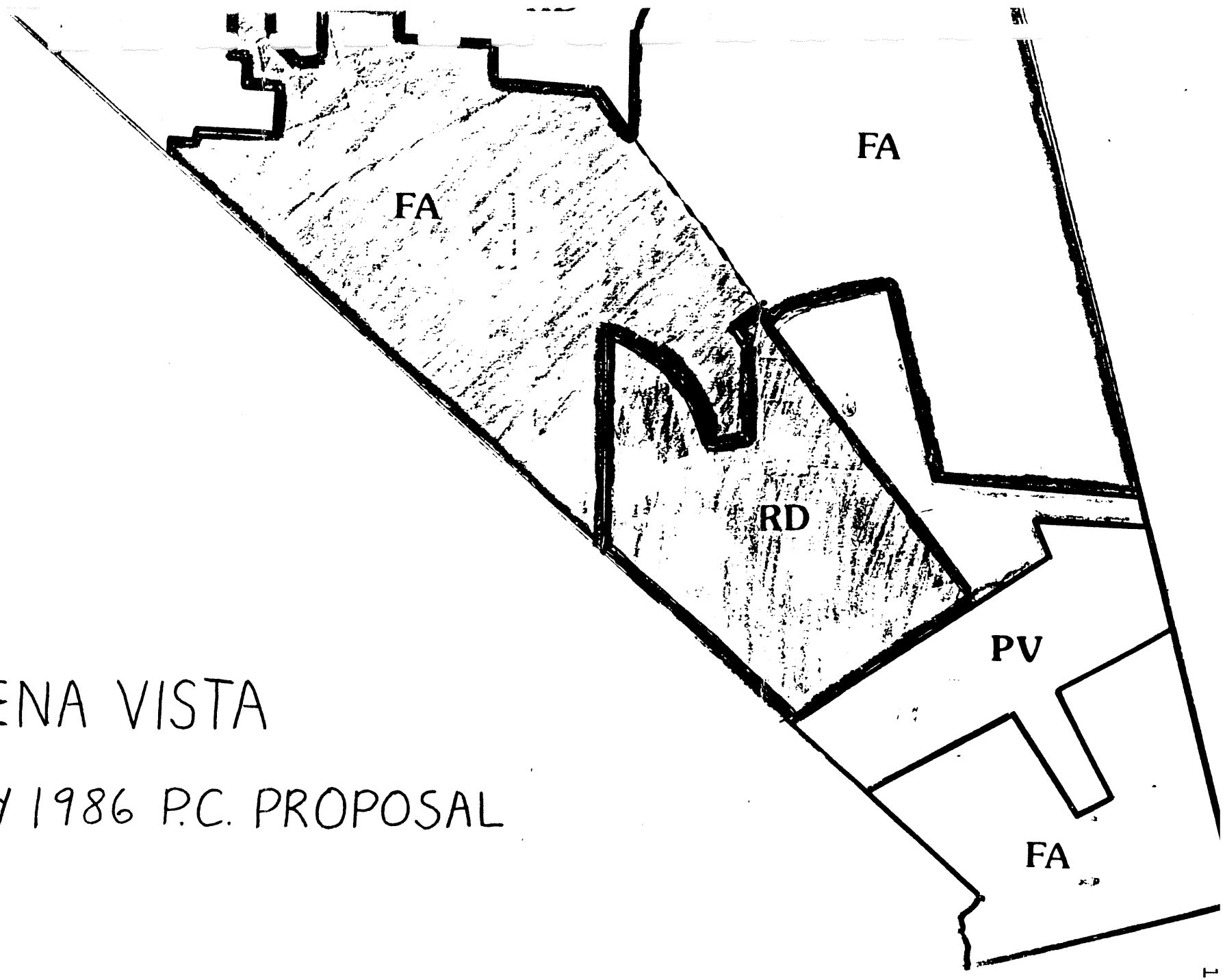
development in the Rural Development Area while limiting the overall impact to the Manumuskin watershed, and is generally consistent with existing zoning in the Maurice River portion of the watershed. We have reviewed this with the Commission's Conformance Subcommittee on two occasions and no objections were expressed. I am, therefore, submitting this to you for the Township's consideration.

If you have any questions or comments, please do not hesitate to contact Ms. Suzanne Low, Resource Planner.

Sincerely,

Terrence D. Moore
Executive Director

TDM/SL/scb/CBV
Attach.
cc: Mr. John Holland,
Township Planner
Commissioner Brian Lefke
(without attachments)



BUENA VISTA

JULY 1986 P.C. PROPOSAL

8/28/87

Herpetological Associates Recommendations

to Cumberland County

HA FILE NO. 87.01-B

Fish Studies in the Manumuskin River Drainage Basin - and Portions of the Maurice River and Manantico Creek, Maurice River Township, Cumberland County, New Jersey

Submitted - October 13, 1987

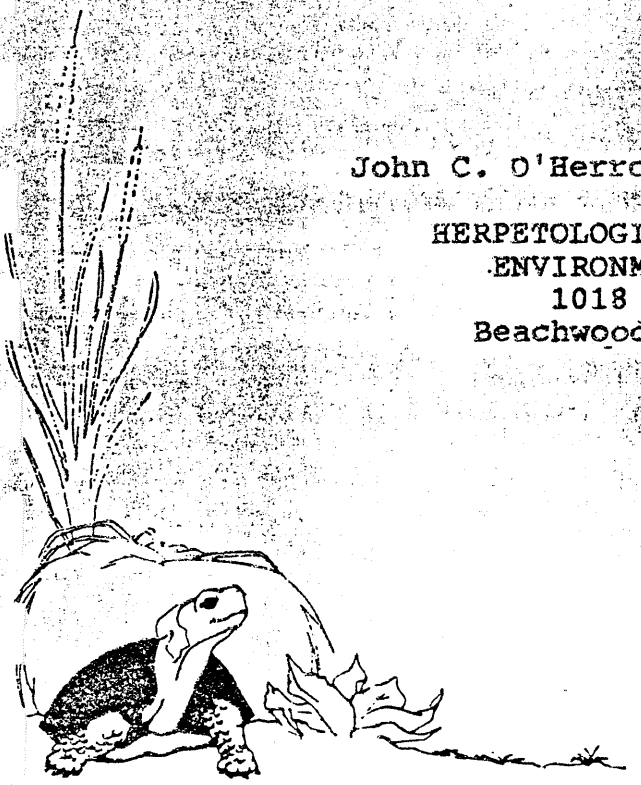
to

Stephen L. Kehs
Executive Director
Department of Planning and Development
County of Cumberland
800 East Commerce Street
Bridgeton, New Jersey 08302

by

John C. O'Herron, II and Rudolf G. Arndt

HERPETOLOGICAL ASSOCIATES, INC.
ENVIRONMENTAL CONSULTANTS
1018 Berkeley Avenue
Beachwood, New Jersey 08722



RECOMMENDATIONS:

Sensitivity to environmental issues is increasing and earlier practices which has their time and place now no longer acceptable. The maintenance of good quality fish habitat in the Maurice River, Manumuskin River and Manantico Creek in the Port Elizabeth vicinity is dependent, not only upon ambient conditions, but also upon the environmental quality of the upper watershed. There are three subjects of particular concern in this area: 1). potential loss of the restricted characteristic Pine Barrens fish fauna, 2). excess nutrient enrichment, and 3). Contamination of fish and the environment with toxic substances. The recommendations here have biological basis, are in practice, and are increasingly becoming part of the law of the land.

1. Nutrient enrichment can be partially controlled. Sewage should receive tertiary treatment to remove nutrients from effluent before it is discharged. Existing septic systems should be monitored for functional and structural integrity to ensure that undigested wastes are not entering the environment and increasing the biochemical oxygen demand. The old type septic systems do not reduce nutrient discharge. New placement or replacement of septic systems should utilize the recent denitrification technology to reduce nitrogen enrichment of ground waters.

2. Control of land development (agricultural, industrial, and residential), especially in the upper watershed. Development disturbance results in the chronic release of excess nutrients to the river system. Agricultural land use is usually the major contributor of excess nutrients because of fertilization and plowing practice necessary to that enterprise. The carrying capacity of areas within the watershed of a particular land use should be carefully considered before new development is permitted.

3. Fish, marsh plants, and marsh surface and river bottom sediments should be periodically monitored to evaluate the extent and trends in toxic substance (heavy metals, pesticides, and exotic chemicals) contamination. Inquiry should be made to NJDEP regarding the potential spread of arsenic from Union Lake sediments as a result of water drawdown to facilitate repair of the dam.

4. Waterfront development should be discouraged, as it places septic systems at the water's edge. Mere physical disturbance along the shore can alter nearby aquatic habitat. Waterfront lots tend to be contained by bulkheads and frequently have permanent boat ramps. These reduce nursery habitat for fish and the available area for vegetation. The aesthetic ambiance of a relatively undisturbed environment is lost when development is a persistent feature.

5. Periodic surveys of the fish fauna would be desirable. Trends in occurrence patterns and species composition are diagnostic of water quality conditions. The stocking of non-native fishes to these waters should be resisted unless they are not able to establish reproducing populations or there is appropriate evidence that they will not significantly alter the existing fish fauna, i.e., in waters so modified that the native faunal assemblage cannot persist.

STATEMENT:

The New Jersey Pine Barrens lay in the midst of the Washington, D.C., Philadelphia, New York City megalopolis and in recent years, has been subjected to tremendous development pressure. The Pine Barrens is a brittle ecosystem incapable of absorbing much environmental impact. Land disturbances here readily alter the water quality and the Maurice River watershed is a Pine Barrens drainage. Aquatic habitat alteration is now an apparent feature. The extent to which it occurs will be decided by the quantity and quality of environmental changes.

The Maurice River estuary has tremendous aesthetic, recreational, and fisheries potential. Occasional native American artifacts give evidence that man has been present in the region for centuries. The presence of modern Americans since the late 1700's to present has changed much of the landscape of the Maurice River watershed. Roads were built, homes erected, and lumbering, agriculture, and other industries established. Tidal marshes were bulkheaded, ditched, and drained to produce salt hay. Streams were dammed for mill races and their flowing waters carried away the by-products of civilization.

HA FILE NO. 87.01-A

An Inventory and Habitat Assessment of the Birds of the Manumuskin River Drainage System and Portions of the Adjacent Maurice River in Cumberland County, New Jersey

Submitted October 13, 1987

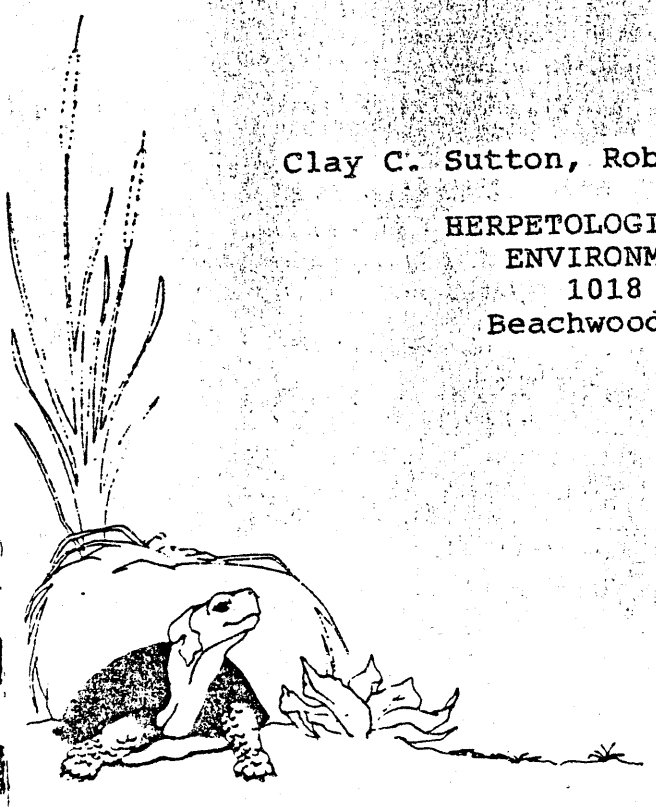
to

Stephen L. Kehs
Executive Director
Department of Planning and Development
County of Cumberland
800 East Commerce Street
Bridgeton, New Jersey 08302

by

Clay C. Sutton, Robert Barber and James Dowdell

HERPETOLOGICAL ASSOCIATES, INC.
ENVIRONMENTAL CONSULTANTS
1018 Berkeley Avenue
Beachwood, New Jersey 08722



Recommendation of a study to determine if parts of the Maurice and Manumuskin River system should be designated as a National Wildlife Refuge:

The waterfowl concentrations of the Manumuskin and adjacent Maurice River are dramatic, spectacular, and highly significant to New Jersey. Particularly significant are the Black Duck numbers certainly a species of special concern. Recommendations: Because this is probably the largest concentration of waterfowl in New Jersey not currently under Federal or State ownership, it is recommended that Federal USF&W biologists conduct a systematic aerial census of this region with an eye towards possible creation of a National Wildlife Refuge along the Maurice and Manumuskin Rivers. This would be the surest form of protection from overhunting, disruption, by boat traffic or changing land-use patterns along the rivers. (Pg. 19)

Recommendation concerning rail birds:

1. Waterfowl protection methods (acquisition) will protect rail habitat as well. 2. That the status of the Sora in the northeast and in New Jersey become a subject of study, and that current federal bag limits and seasons (Sora: 25 daily, September through November 8 in 1986) be considered for revision by responsible agencies and conservation organizations. (Pg. 21)

Recommendation concerning Bald Eagles:

Recommendation: It was believed, and then confirmed, that potential eagle roosting along the Manumuskin is deterred by constant (daily) activity by "dirt bikes", ATV's, and snowmobiles along trails directly adjacent to the western bank of the river from Barth Road to Fries Mill, directly below potential "roost trees". Road closure and curtailment of this activity in this specific area will enhance and increase Bald Eagle use of the Manumuskin. In addition, an end to these activities around the (New Jersey Silica Sand) sand mine lakes will lead to increased Bald Eagle use of these areas as well. The closure of eagle-use areas on the Maurice River to boat traffic, if possible, would lead to less disturbance and greater and wider seasonal eagle-use of the river. Also, the provision of artificial perches on remote areas of the rivers might well increase eagle-use. Particularly needed are perches in the center of the rivers - away from the riverbanks and disturbance. (Pg. 23)

Recommendation concerning Osprey:

Recommendation: The provision of artificial nest poles on the wetlands of the Nature Conservancy Tract, or elsewhere, might attract additional Osprey to the river, birds perhaps currently deterred by the aforementioned off-road vehicle use, houses on the east bank, or predators. Osprey are very much a part of the Manumuskin summer, and their presence can be encouraged and enhanced. (Pg. 23)

Recommendation concerning Barred Owl:

Recommendation: As Barred Owl habitat appears to have been severely depleted along sections of the middle Manumuskin by clear-cutting of both cedar and adjacent hardwoods, any future cutting should avoid clear-cutting, and particularly attempt to leave both the dead and old-growth trees required by these owls as nesting sites. Such an attempt to protect the freshwater wetlands present should in turn protect the Barred Owls present and allow for the establishment of new territories as well. (Pg. 25)

Recommendation concerning Least Terns:

In the summer of 1985 and 1986, a small breeding colony of Least Terns was found on the sandy spoils from the sand mining operation just northwest of the railroad bridge. Feeding was primarily in the Manumuskin River. Approximately 12 birds were in the area; three or four pairs nested, and at least one fledged young was seen in 1985. In 1987, no nesting attempt was noted and only three birds were seen at the site. Recommendation: This colony may well have been disrupted by "dirt bike" and ATV activity in both 1986 and 1987. The colony is solidly criss-crossed with hundreds of tracks. This potential colony should be fenced and patrolled if there is to be any hope of successful nesting. Also, a pack of wild dogs repeatedly seen at this site should be eliminated. (Pg. 26)

New Jersey Conservation Foundation
300 Mendham Road
Morristown NJ 07960
201-539-7540