COASTAL STORM HAZARD MITIGATION

A Handbook on Coastal Planning and Legal Issues

New Jersey Department of Environmental Protection – Division of Coastal Resources

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A Handbook On Coastal Planning And Legal Issues

Prepared By:

New Jersey Department of Environmental Protection
Division of Coastal Resources
Bureau of Planning and Project Review

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PREFACE

In an attempt to address the ever increasing demand for shore protection and storm recovery funding, the Federal Emergency Management Agency (FEMA) contracted with the New Jersey State Police and the New Jersey Department of Environmental Protection (NJDEP) in 1983 to evaluate storm hazard mitigation strategies which could be implemented in New Jersey municipalities and prepare a handbook on their implementation. This Coastal Storm Hazard Mitigation Handbook has been prepared by DEP's Division of Coastal Resources.

Hazard mitigation is a positive approach which works to minimize the potential loss of life and property resulting from coastal storms. The general techniques of storm hazard mitigation are land use management, construction practices and shore protection. The land use management approach seeks to either avoid future storm losses through land management programs or to minimize the social and economic costs incurred by shorefront communities where erosion and storm damages occur. Improved land use management can be accomplished through land acquisition, zoning control, and wise expenditures of public funds for infrastructure siting and repair.

Although the concept of hazard mitigation is relatively new, its potential for reducing storm damages along the coast is very high. Many of the recommended hazard mitigation techniques, particularly downzoning, oceanfront setbacks and acquiring oceanfront property, directly contrast with existing development practices along the New Jersey coast. The ideas discussed in this report, however, have been successfully applied at coastal locations in several other states.

Comprehensive development plans which incorporate coastal storm hazard mitigation are increasingly needed in New Jersey's densely developed coastal municipalities. Hopefully this report will serve as a catalyst for redefining planning objectives at the local level in response to the inherent danger of increased development along the Atlantic Ocean.

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A. INTRODUCTION

The New Jersey coast faces the constant threat of damage from hurricanes and northeast storms. While there has been a marked lull in the number of severe storms that have struck the Jersey shore in the past 20 years, coastal scientists and residents generally agree that another major storm is inevitable. At the same time, development along the coast has continued despite recent downturns in construction activity elsewhere. The population and property now at risk far exceed that which existed at the time of the most destructive storm in recent memory, the March 1962 northeast storm. Furthermore, due to the sometimes imperceptible retreat of the shoreline, accelerated by increasing sea level rise, the beaches afford less natural protection today than in the past.

Coastal erosion continually threatens the densely developed New Jersey barrier islands. This problem, first recognized in the mid-1800's, has required large capital expenditures to complete shore protection projects, including groins, jetties, bulkheads, seawalls and beachfill. The need for high cost shore protection has increased significantly over the past twenty years, primarily as a result of increased coastal development. From 1959 to 1974, $49 million in State, Federal, municipal and county funds were spent on shore protection projects in New Jersey. In 1977, voters approved a Beaches and Harbors Bond Issue, which appropriated $20 million for shore protection purposes. In 1983, a $50 million Shore Protection Bond Issue was approved. This provided $40 million in grant funds and $10 million in loans.

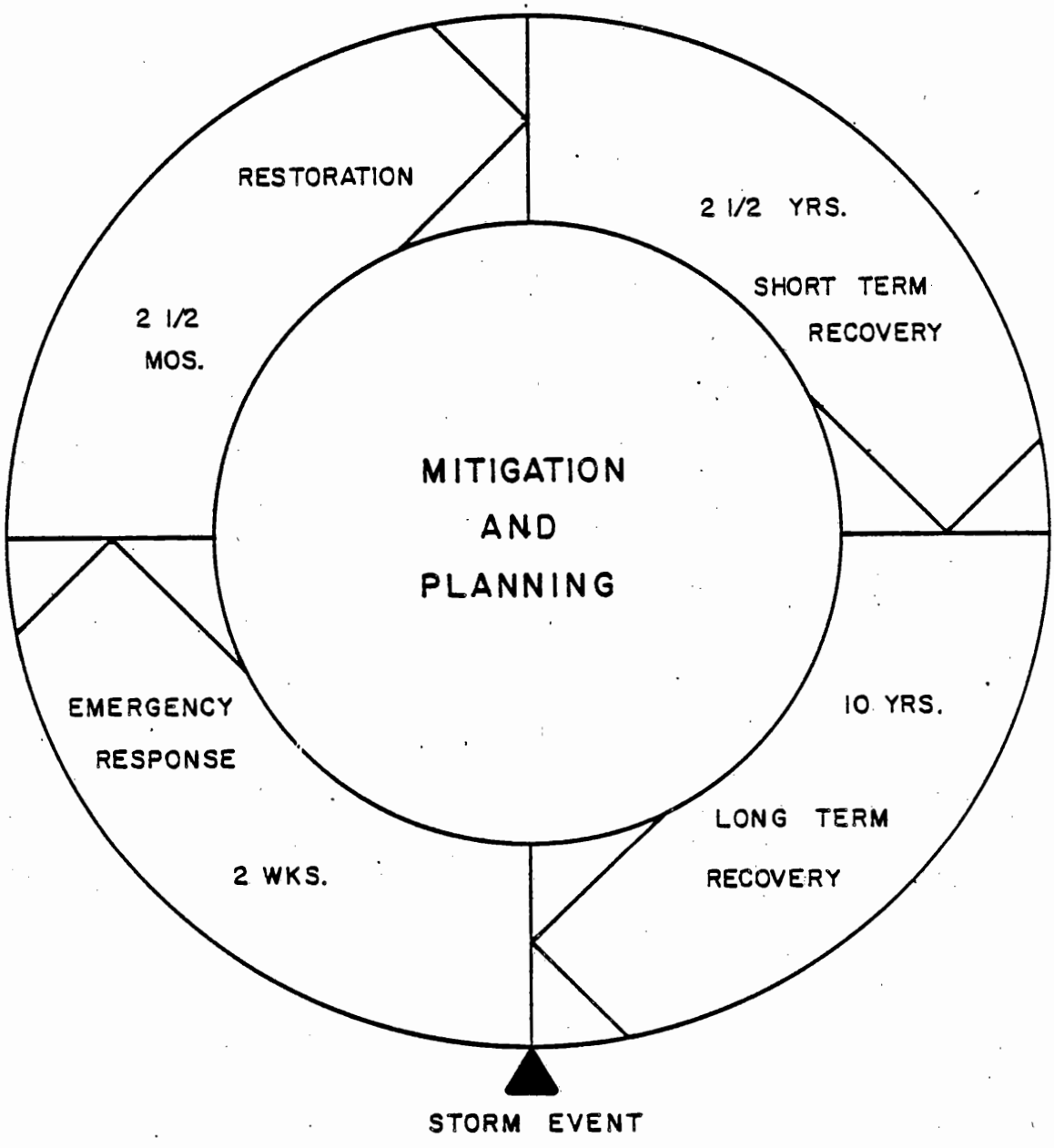
With the prospect of continued erosion and increasing shore protection costs, the State and federal governments are examining various alternatives. One of these alternatives is hazard mitigation through land use controls. Because erosion cannot be completely controlled, the damaging effects of erosion should be mitigated to the maximum extent possible. The increasing cost of erosion control and shore protection can be moderated through comprehensive storm hazard mitigation techniques involving land management. Land management is a more cost effective long range solution to the erosion problem than many of the current structural shore protection methods.

In an effort to mitigate the hazard of inhabiting coastal areas, the Federal Emergency Management Agency contracted with the New Jersey State Police and New Jersey Department of Environmental Protection to prepare this handbook for use by local officials and planners. The handbook outlines coastal processes and shoreline response, with particular emphasis on the effects of coastal storms. It also includes a discussion of hazard mitigation techniques and legal issues involving their implementation.

Comprehensive storm preparedness can be viewed as a series of six related activities as adapted from McElyea et al., 1982 and Haas et al., 1977 (see Figure 1).

1. Mitigation involves activities which reduce the potential damage and loss of life caused by a major storm; these activities are not tied to a specific disaster, but arise from a long-term concern for avoiding damage.

FIGURE 1: HAZARD MITIGATION ACTIVITIES



ADAPTED FROM RECONSTRUCTION FOLLOWING DISASTER (1977) AND BEFORE THE STORM : MANAGING DEVELOPMENT TO REDUCE HURRICANE DAMAGES (1982)

2. Planning, for each of the following post-storm activities, entails anticipating key problems and needs arising from a major storm, identifying methods and resources to ameliorate them and generally preparing, well in advance of a storm, for the quick and rational mobilization and deployment of available resources.

3. Emergency Response activities immediately precede a particular disaster in the form of evacuation and, following the disaster, include search and rescue operations and provision of emergency housing and medical care.

4. Restoration involves repairs to damaged infrastructure, debris removal and other quick remedies and improvements to essential services that enable the community to function, however marginally.

5. Short-term Recovery encompasses the period of several years after a storm during which the full range of repair and reconstruction activities is completed to return the community to pre-storm levels of social and economic vitality (i.e., "normalcy").

6. Long-term Recovery constitutes those projects that better the community often by commemorating the storm event, educating the public, and providing added protection from future storms.

The principal objectives of storm preparedness planning are to enhance New Jersey's capability to respond in an integrated, planned manner to major storms and, where possible, minimize the potential loss of life and property in the State's densely populated coastal zone.

A municipality preparing a Coastal Storm Preparedness Plan should first analyze its vulnerability, identifying hazard areas and the degree of potential loss of life and property damage that may be incurred from a 100-year storm. Shore protection structures should be mapped and their ability to withstand an onslaught of wind, water and waves should be examined, seasonal and non-seasonal (year-round) populations on the barrier islands should be estimated, and the value of structures in particularly vulnerable portions of the municipality should be tabulated.

The vulnerability analysis should be used to evaluate the municipality's zoning and present and proposed development, in light of the hazard mitigation strategies discussed in this handbook. Appropriate zoning changes should be made, including the adoption of a post-storm redevelopment plan which would enable a municipality to more quickly recover from a major coastal storm and incur less damages and costs in future storms. Furthermore, it would facilitate the response of various state and federal agencies to a disaster declaration, and enable the municipality to have greater input in the post-disaster recommendations of such agencies. A list of federal, state and county agencies available to assist in this effort is found in Appendix I.

A severe weather plan should also be prepared describing activities and responsibilities during an emergency, including evacuation procedures. The local emergency management coordinators should work closely with the county emergency management coordinators and the New Jersey State Police, Office of

Emergency Management (see Appendix I) in preparation of the severe weather plan.

Many of the hazard mitigation techniques presented have never been used in New Jersey. Because the concept of hazard mitigation is relatively new, any recommendations will have to be developed and refined cooperatively between appropriate state, county and municipal groups. The Municipal Land Use Law requires that a municipality reexamine its master plan and development regulations every six years and prepare a report of findings, including any recommended changes. This would be an appropriate time for discussion and implementation of hazard mitigation plans. Underlying this effort should be a recognition that the long term safety of the municipalities and their inhabitants is of primary importance, and also that the availability of future shore protection and post-storm recovery funds will be limited and may be contingent on local efforts to reduce or mitigate storm damages.

B. COASTAL FEATURES AND PROCESSES

1. Shore Forms

In New Jersey, about 80% of the open ocean coast consists of barrier islands and spits; the remaining 20% is headlands (Figure 2). The Northern Headlands area (most of Monmouth County) is characterized by narrow beaches at the base of subdued bluffs which have been eroded from the unconsolidated Coastal Plain formations. The beach sands are coarse to medium in size, with a characteristic mineral composition whose source can be traced to the Coastal Plain formations (McMaster, 1954). Coarser grain sands and this distinctive mineralogy also characterize the Sandy Hook spit to the north and the Northern Barrier Island Complex to the south. The coarser sand sizes in this northern sector result in steeper beaches and offshore profiles. The Northern Headlands extend from Monmouth Beach on the north through Long Branch, Asbury Park, and Point Pleasant to Bay Head on the south. The low headlands for this area have elevations of 15 to 25 feet and terminate in a low bluff line which borders the narrow beach. Headland elevations diminish and the beach widens progressively to the southern terminus of the headlands.

The Northern Barrier Island Complex consists of two long barrier elements: (1) the south-prograding Barnegat barrier which extends 21 miles from Bay Head to Barnegat Inlet and (2) Long Beach Island, 20 miles to the south. The tidal lagoons or backbays behind these barriers are quite wide, ranging from 3 to 4 miles in most places.

The Southern Barrier Island Complex consists of a chain of smaller islands separated by seven inlets. This complex is separated from the Northern Complex by the large double inlet system of Beach Haven-Little Egg Inlet. The beaches of the Southern Barrier Island Complex are characterized by fine-grain sand sizes and the resulting flatter beach slopes, as well as a heavy mineral assemblage distinctive from the northern beaches (McMaster, 1954). The Beach Haven-Little Egg Inlet system represents a sharp boundary between the compositional and textural characteristics of the northern beaches (medium to coarse sizes and opaque heavy minerals) and the beaches to the south (fine sizes and hornblende-garnet heavy minerals).

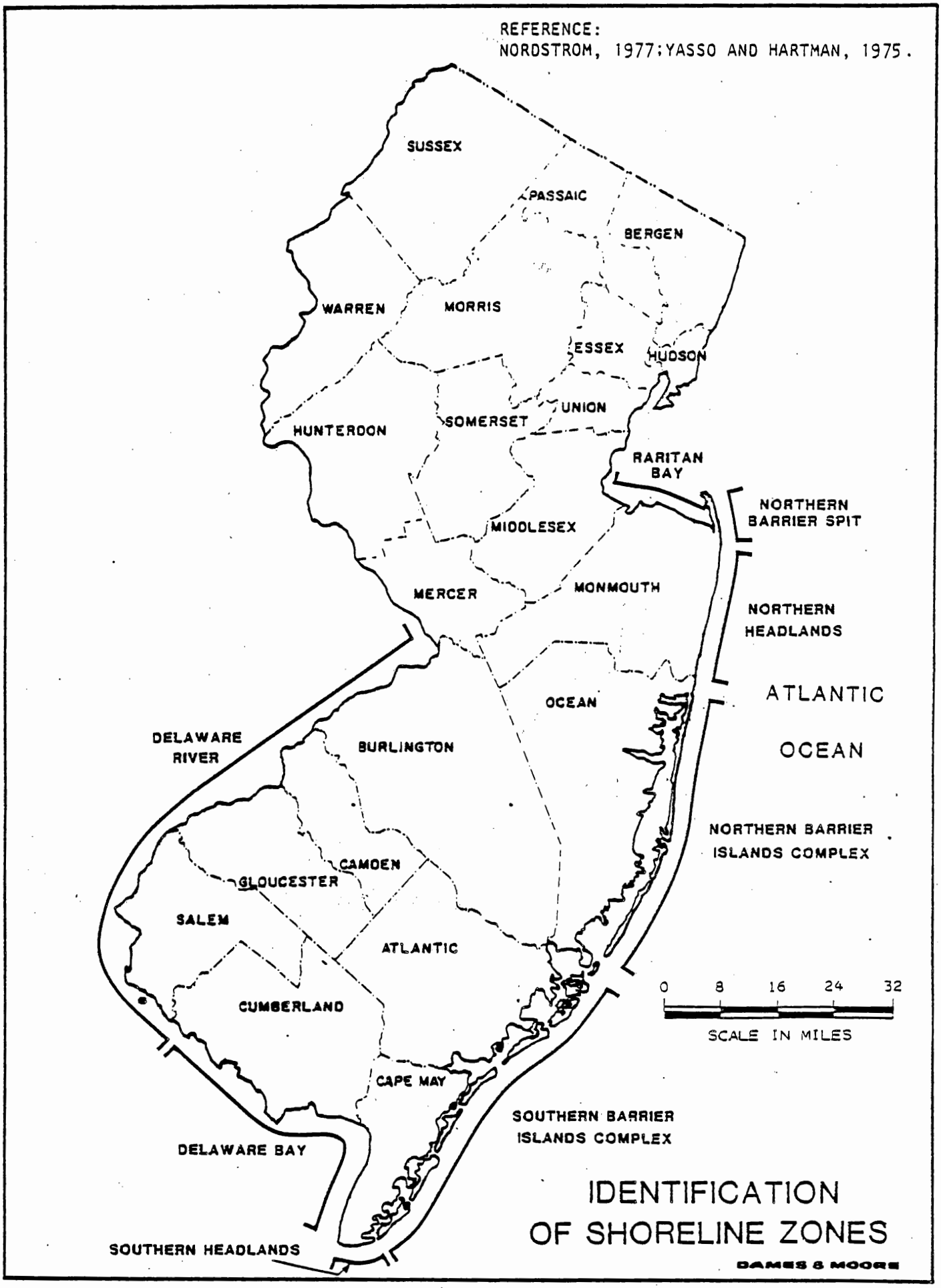

REFERENCE:
NORDSTROM, 1977; YASSO AND HARTMAN, 1975.
SUSSEX
PASSAIC
BERGEN
WARREN
MORRIS
ESSEX
HUDSON
UNION
SOMERSET
HUNTERDON
RARITAN BAY
NORTHERN BARRIER SPIT
MIDDLESEX
MERCER
MONMOUTH
NORTHERN HEADLANDS
ATLANTIC OCEAN
OCEAN
DELAWARE RIVER
BURLINGTON
NORTHERN BARRIER ISLANDS COMPLEX
CAMDEN
GLOUCESTER
SALEM
ATLANTIC
CUMBERLAND
0 8 16 24 32
SCALE IN MILES
CAPE MAY
SOUTHERN BARRIER ISLANDS COMPLEX
DELAWARE BAY
SOUTHERN HEADLANDS
IDENTIFICATION OF SHORELINE ZONES
DAMES & MOORE

FIGURE 2

2. Shoreline Dynamics

The natural dynamics of the coastal system must be evaluated in any study of shoreline erosion to determine potential hazard and mitigation measures.

a. Littoral Drift

The barrier islands and headlands along the coast represent a dynamic response to the forces of wind, waves, and tides. Waves impinge on the shore and move the sand along as littoral drift when they approach at an angle to the shore. The direction, angle of approach, and wave size and shape vary from place to place, and with time or season, depending on the characteristics of prevailing and storm-related winds in the offshore areas and the refracting effects of bottom configuration as the waves approach the shore.

The location of a "nodal zone" in the littoral system has a significant impact on sediment distribution. The nodal zone is the area at which the predominant direction of littoral drift diverges (American Geological Institute, 1962). A nodal zone is often characterized by increased erosion due to a lack of sediment remaining in the area. Because the direction of longshore drift diverges in the nodal zone, sediment is moved out of the area. The narrow beaches within the nodal zones are then more susceptible to damage from coastal storm erosion and flooding. However, due to inlet channel changes, the position of a nodal zone can shift, and therefore, the hazard to the adjacent beach areas can also change. This shift can occur seasonally or can happen over a period of years, thus changing the erosion pattern of the area. Therefore, it is important that observations and measurements of the littoral environment be made to identify the location and movement of a nodal zone before shore protection projects or substantive changes to the oceanfront are contemplated.

b. Waves

Storms pose a hazard to coastal areas because the wave heights and periods are increased. The resulting high energy waves reach the shore in quicker succession, thereby speeding up the process of beach erosion and coastal flooding. As more beach is eroded, more property is exposed to storm waves, and the risk of damage greatly increases. As storm waves destroy beachfront structures, the wreckage creates another serious hazard. This debris can be propelled by waves and currents, battering other structures along the way.

Sediment transport in the offshore direction on the beach face is a result of high energy storm wave action. Short period high energy waves tend to flatten the beach profile, eroding the dune-berm and forming a scarp (cliff). Wave swash moving alongshore hastens erosion at the base of the scarp by undercutting the dune-berm and transporting the eroded sediment downdrift and offshore.

c. Winds

In addition to its influence on waves and the related effects of transport in the shore zone, wind is also important in the transport of sand above the high water line, where it contributes to dune formation and the transfer of sand along and between the dune and beach systems. Sand transport begins when the wind velocity reaches a certain threshold level which varies as a function of the sand grain size. Bagnold (1954) suggests that the basic threshold value for the initiation of sand movement by wind is approximately 10 mph.

Over a given period of time, the total amount of sand transported in a particular direction is primarily dependent on the duration and direction of the wind. Other factors influencing sand transport in the beach and dune areas include rainfall, salt spray, drying, stabilizing vegetation, local topography, the degree of development, and human activities. Oceanfront highrise structures may aggravate beach erosion by channeling winds onto the same portion of the beach.

d. Tidal Inlets

Tidal inlets, another major element of the coastal system, are short, narrow waterways which hydraulically connect the backbays and estuaries with the open ocean. Natural inlet channels are primarily maintained by tidal currents, which help to prevent shoaling of the inlet. Inlets generally scour to a maximum depth in the area of greatest constriction, usually in the central part immediately between the barrier islands or land masses which contain them.

As with barrier islands, the tidal inlets are in a state of "moving equilibrium" because tidal current flow, waves, and littoral drift are constantly changing. Depending on the combination of these coastal processes, inlets may remain stationary and open, closed, or migrate laterally. The migration of inlets is generally a one-directional movement, following the net littoral drift.

Shore areas adjacent to the inlets thus represent highly transitory areas due to inlet dynamics. Where inlets of the Southern Barrier Island Complex have been artificially stabilized with terminal shore protection structures, the shore is continually subject to erosion caused by the dynamic fluctuations of the inlet system. In particular, the southern shore of each inlet is a persistent problem area because erosion threatens inlet and shore stabilizing structures and the developed areas behind them.

e. Storm Surge

During storms, reduced atmospheric pressure and strong winds pile up water along the coast, causing a temporary local rise in sea level known as storm surge. The surge associated with coastal storms and hurricanes usually consists of three parts (Gross, 1972): 1. a slow, gradual rise in water level beginning several hours before the storm's arrival, 2. a sharp rise in water level as the storm center passes (surge), and 3. a rise and fall of sea level as the resurgences or oscillations set up by the storm

pass. Combined with high energy storm waves and astronomically high tides, storm surges can be extremely destructive.

f. Sea Level Rise

The damaging effects of coastal erosion are amplified by the continued and gradual rise in sea level which has been occurring since the melting of the Pleistocene glaciers approximately 15,000 years ago, at which time the shoreline was at the edge of the continental shelf, some 80 to 100 miles east of the present-day coast. The change in sea level along the New Jersey coast is dependent largely on this change in the polar ice mass, which in turn depends on numerous climatic and atmospheric variables. A tectonic component, which may also affect the local rate of sea level rise, is difficult to quantify and, therefore, scientists use the term "relative" in describing sea level change.

Measurement of tidal levels in Atlantic City from 1940-1970 indicates that local relative sea level is rising at a rate of approximately one foot per century. Because of the low elevation and gentle slope of most New Jersey beaches, a slight vertical rise in sea level can result in a significant horizontal displacement of the shoreline. This results in more land being subjected to erosive forces of the ocean.

g. Coastal Storms

The most dramatic example of the effect of the dynamic forces of nature on the shore zone is the impact of severe storms. The storms which present the greatest hazard to New Jersey's coastal zone are hurricanes and northeast storms. These storms have historically caused significant shore erosion and associated property damage. Although these storms can be equally devastating, they are two very distinct storm systems.

Hurricanes are formed over the warm waters of the Gulf of Mexico, Caribbean Sea or Atlantic Ocean, and are classified as having winds of 74 m.p.h. or higher. Although the duration of a hurricane is relatively short, the intensity of hurricane wind, waves and associated storm surge produces the greatest hazard to coastal residents in New Jersey. In addition, because hurricanes require warm ocean water to maintain the storm's intensity, they occur in summer and early fall, the period when the coast is more heavily populated.

Extratropical storms, better known as northeasters, usually develop as low pressure systems that slowly move offshore. Accompanying winds, although not usually of hurricane force, blow onshore from an east-northeasterly direction for sustained periods of time. Because of the often slower moving nature of these storms, their duration may be longer (up to several days), and the resulting damage may ultimately exceed the destruction from a hurricane.

Perhaps the biggest difference between the two types of storms is that northeasters are usually more predictable than hurricanes in track and intensity. Due to more accurate forecasting, better pre-storm evacuation and preparation measures can be initiated. It should also be recognized that

astronomically high tides can significantly increase the potential for coastal erosion, flooding and property damage during either type of storm.

Mather and others (1964) have classified storms for the east coast of the United States according to the extent of coastal damage (light, moderate, and severe) from 1921 to 1962. New Jersey recorded 25 light, 26 moderate, and five severe storms for this period, with an average recurrence interval for moderate and severe storms of one every 1.4 years. This recurrence interval is low compared to other coastal sectors, indicating a lower frequency of damaging storms. Mather and others point out that once in every 30 years a very severe storm will bring extensive damage not only to a particular area but to the entire coast. This recurrence interval appears to be a conservative figure based on New Jersey's experience with damaging coastal storms of March 1962 and March 1984 (less than 30 year interval).

In light of the nature of coastal development and the characteristics of storm surges from hurricanes and northeasters, structures located directly along the beach and properties landward of these areas are subject to a high risk of damage from floating debris carried inland by storm surges.

The great northeaster of March 6-8, 1962, is an example of the severity of storms which affect the New Jersey coast. It was a complex, unexpected storm of sustained direction and intensity, combined with high spring tides. Although the water level was generally higher during the September 1960 hurricane Donna, the storm of March 1962 was more widespread and inflicted substantially greater overall damage and loss of life. This was primarily due to its duration, the damaging high waters, and destructive waves generated by gale force winds. The storm lasted for five successive high tides over a period of 2 days. Each succeeding tide had less beach or dune or bulkhead to dissipate its force and could reach farther inland, until in some cases the sea was able to cut completely through the barrier islands (USACOE, Philadelphia District, August 1963).

The damages resulting from the 1962 storm were unequaled by any storm in history along the New Jersey coast. In New Jersey alone, the storm was responsible for killing 14 persons and injuring more than 1300. Property damages in New Jersey exceeded $120 million (1962 dollars). Unfortunately, the devastation of the March 1962 storm was soon forgotten, and population and development have continued to increase in shore areas, much of it within the actual overwash zones of the storm. Since present population and development levels of the State's barrier islands exceed pre-1962 levels, future severe storms will undoubtedly result in far heavier tolls in lives, injuries and property damage.

The demand for oceanfront properties directly on barrier islands or onshore areas with ready access to beaches remains high, despite the history of hurricanes, northeasters, and other storms, the costly damages, and the inevitable risk.

C. PEOPLE AND PROPERTY AT RISK

The potential for loss of life and damage to property from a severe coastal storm or hurricane is high, though not uniformly high, throughout the coast. For example, a beachfront block in the casino district of Atlantic City has been assessed at over 170 million dollars (1982 dollars) while many interior blocks carry assessments of less than one million dollars. Less extreme disparities in property values occur along the beachfront of the entire coast.

The variation in property values, and the corresponding population densities, provide a basis for determining the benefits of alternative mitigating techniques as well as their likely costs. But whatever the potential loss in any particular section of a community at this time, the area becomes increasingly vulnerable as population grows and land values escalate. For the same reason that the risk of loss will increase with time, opportunities for hazard mitigation will decrease.

1. Population

The 1980 Census indicates that the total permanent population in oceanfront municipalities in New Jersey is 205,164. The distribution by county is shown in Table 1.

TABLE I - POPULATION IN OCEANFRONT MUNICIPALITIES

County	Population in Oceanfront Municipalities
Monmouth	107,650
Ocean	28,039
Atlantic	70,649
Cape May	38,826

Of more concern than the permanent population is the peak seasonal population, particularly as hurricanes, the most destructive and unpredictable storms, occur in the summer and early fall.

The New Jersey Shore Protection Master Plan (NJDEP, 1981) includes population statistics and seasonal population ratios by municipality. A more recent study of tourism in New Jersey (NJDEP, 1984c) includes estimates of shorefront visitors by municipality and by type of accommodation. Each of these sets of figures was used by James K. Mitchell (1984) to estimate peak summer populations in New Jersey's coastal municipalities and thus derive high and low peak population estimates. Mitchell focused his study on barrier islands and spits since they have the greater evacuation problems, with limited and frequently low access routes. His report included all of the oceanfront municipalities in Ocean, Atlantic and Cape May Counties. Only Sea Bright, Monmouth Beach and Gateway National Recreation Area were included in Monmouth County, as the other municipalities are considered headlands, with more numerous and higher evacuation routes. The peak population estimates for all of these municipalities range from about 693,000 to 1,589,000.

Evacuation times were estimated by Mitchell (1984) using both of the peak summer population estimates and assuming the traffic volume to be either at capacity or at what is defined as the 30th peak hour volume (Table 2). The latter is a frequently used figure in roadway design representing the 30th highest hourly volume measured over a long period (e.g. a month or a year) and is described by Mitchell as "typical rush hour traffic on a normal summer day".

The evacuation times are based on the following assumptions: (1) populations at risk are as shown in Table 2; (2) all evacuation is carried out by road; (3) no persons remain in communities at risk after evacuation is complete; (4) evacuation vehicles carry an average of 4 passengers; (5) two lane evacuation routes carry only outbound traffic while one lane of four lane routes remains open for inbound and emergency vehicles; (6) there is a uniform reaction of 1.0 hour in all communities at risk; (7) non-delayed travel time to safe locations varies from 1.0 hour (Long Beach Island to Absecon Island) to 2.0 hours (Cape May County); and (8) evacuees follow optimal routing and scheduling plans (Mitchell, 1984).

Estimates were made both for local evacuations (Table 2) (i.e. oceanfront municipalities only) and for a general evacuation of low-lying mainland areas and barrier islands.

Both Mitchell and the Division of Coastal Resources recognize the difficulty in accurately estimating peak summer populations, particularly for day visitors. The Division believes that the estimates derived from the coastal tourism study (NJDEP, 1984c) are more accurate, as population estimates were a major focus of the study and figures were carefully validated.

The National Hurricane Center has indicated that it is unlikely to be able to issue a Hurricane Warning for the New Jersey coast more than 12 hours before hurricane conditions occur. Furthermore, in many coastal areas, the available escape routes will be inundated several hours before the center of the storm passes. Mitchell noted that his evacuation time estimates do not take into account the closure of roads due to high winds or water. When all of this information is taken into account, it is apparent that if the high peak population estimates are correct, the local evacuation times for mid Ocean County, Long Beach Island and the Atlantic and Cape May County barrier islands already exceed the time period likely to be available between issuance of a Hurricane Warning and closure of evacuation routes. If the low peak population estimates are correct, the evacuation time approximately equals available time for Brigantine/Absecon Island and Strathmere/Sea Isle City. In either case, a large number of people is at risk on these islands and may be unable to escape should a hurricane strike.

If a general evacuation were required for all of Cape May County, the evacuation time for the barrier islands would be significantly increased.

TABLE 2: LOCAL EVACUATION TIMES IN HOURS[1]

Community	High Peak Population Estimate			Low Peak Population Estimate		
	Number of People	30th Peak Hour Traffic Flow	Capacity Traffic Flow	Number of People	30th Peak Hour Traffic Flow	Capacity Traffic Flow
Gateway National Recreation Area	20,000	3.7	2.5	10,000	2.6	2.0
Sea Bright	5436	3.6	3.0	2245	2.4	2.1
Monmouth Beach	4313	1.8	1.6	3812	1.7	1.6
Northern Ocean County	56,388	5.9	?	48,379	5.3	?
Mid Ocean County	178,953	9.0	6.7	91,363	5.3	4.2
Long Beach Island	122,215	9.3	7.9	30,214	3.8	3.5
Absecon Island	783,020	16.4	12.4	391,510	9.0	7.1
Ocean City	136,700	14.0	10.4	34,631	5.0	4.1
Strath-mere-Sea Isle City	25,560	13.3	6.2	13,079	7.8	4.2
Stone Harbor-Avalon	31,880	8.7	4.9	15,177	5.2	3.4
Wildwoods	216,269	16.9	11.9	52,585	5.6	4.4

[1] Taken from Mitchell (1984)

2. Assessed Values

The value of structures in the first block along the beachfront is typically a larger percentage of the total value of structures in the municipality than its size relative to total land area would suggest. Thus, the most vulnerable property is also the most valuable, owing both to the oceanfront vantage.

3. Insurance in Force

Nearly three-fourths (71%) of the federal flood insurance coverage in New Jersey insures structures in coastal municipalities.

In the four oceanfront counties, the total value of flood insurance policies in force in March 1984 was approximately 4.3 billion dollars, representing about 63,000 policies. The breakdown by county is as follows:

County	Number of Policies	Coverage
Monmouth	5,581	$ 304,770,000
Ocean	24,694	1,576,090,000
Atlantic	11,921	785,470,000
Cape May	20,572	1,613,700,000
Total	62,768	$4,280,030,000

These insurances policies do not provide coverage only in oceanfront municipalities but include structures located throughout each county. Although the amount of coverage is significant, much of the property in the coastal areas is not covered by flood insurance.

D. STORM HAZARD MITIGATION STRATEGIES

Storm hazard mitigation strategies are means by which loss of life, injuries to people and damages to property caused by coastal storms can be decreased. This section addresses general strategies which have been used in various parts of the country to reduce property damage due to storms, with examples from a number of states. Not all strategies would be feasible in every municipality. The mitigation strategies fall into five categories: land acquisition, land use controls, shore protection, construction standards and control of infrastructure construction.

1. Land Acquisition

Acquisition of land in high hazard areas for conservation, shore protection (e.g. dune creation) and public safety purposes is one strategy available for storm hazard mitigation. In addition to decreasing a municipality's vulnerability to storms, the public acquisition of lands increases public access to the shore and recreational opportunities, although access to dune areas would be restricted to preserve the dunes as protective features. There are several drawbacks to the approach, primarily the high cost of acquiring developed waterfront properties and the loss of tax ratables to the community. If the acquired property provides public access for recreation, the lost property tax revenue may be offset by

increases in recreational income from beach fees and the resulting tax revenue from recreation related expenditures. In some cases, businesses and residences could be relocated to safer areas within the municipality, thereby minimizing the revenue loss to the municipality. In addition, the reduction in storm damages would potentially save the municipality costs for post-storm clean up and repairs.

Funding for land acquisition is the critical and most important aspect of the program. The high level of development in New Jersey's coastal zone has caused property values to soar, making acquisition a very expensive option. Funding methods are discussed in Section E-3. In addition, municipalities may be able to exchange public properties located outside of high hazard areas for target hazard prone properties, either with or without monetary consideration. Local governments may also acquire land through condemnation (police powers) with compensation.

The acquisition of target area properties can be accomplished either in fee-simple or less than fee simple (i.e. easements) purchases. Fee simple purchase would transfer the property rights and ownership completely. The purchase of easements would transfer some but not all of the property rights, while not transferring ownership. Easements may be either positive (allowing some use of the property) or negative (prohibiting some use of the property). Although easements cost less than fee simple purchase, they do not provide as much control over the property. Acquisition of development rights is discussed in Section D-2-b.

Target acquisition areas should be identified and ranked prior to storm damage, based on the following natural and man-made physical factors as well as social factors.

Erosion Rate and Beach Stability: Erosion hazard areas have been delineated using factors such as beach width and height, presence of dunes, sediment budget and density of development (Nordstrom et al., 1977; NJDEP, 1981). A high erosion rate would be heavily weighed in setting priorities for land acquisition.

Inlet Proximity: Inlets are by nature highly dynamic and, therefore, adjacent areas are subject to cyclic patterns of erosion and accretion which may change suddenly. For this reason, the New Jersey Shore Protection Master Plan has identified barrier island tips as primary acquisition targets and the State has purchased several of these areas (e.g. Corson Inlet State Park, Townsend's Inlet Waterfront Park, Barnegat Light State Park, Strathmere State Natural Area).

Island Breaching: Areas of barrier island breaching, former inlets, and areas with lagoonal development on the bay side are especially vulnerable to breaching during severe storms.

Overwash Areas: Previous overwash areas can be identified by examining post-storm aerial photographs. These areas are likely to overwash in future storms. In addition, the system of roads in highly developed areas can act as a network of overwash passes during storms. Storm damage records indicate that damages are high in overwash areas.

Density of Development: Undeveloped sites should be prime acquisition targets because they serve as buffers to developed areas. Conversely, areas which have a history of high property damage and thus high hazard are also prime acquisition sites, though more likely to be available only in a post-storm setting.

Potential Public Use: Sites which have the potential for increasing the recreational use of and public access to the shore should be given high priority for acquisition.

Coastal land acquisition can be implemented as either a pre-storm or post-storm program. Pre-storm acquisition is preferable as it minimizes exposure of people and property to coastal hazards although it is more expensive. The level of coastal development and the associated property values create an economic obstacle for acquisition in much of the coastal zone. Because the value of structures in developed coastal areas is about equal to the value of the land, post-storm acquisition may be a more realistic approach (NJDEP, 1981) since the expected damage to structures during a severe storm will reduce the cost of post-storm acquisition.

Ideally, an acquisition plan identifying target acquisition sites should be developed prior to a major storm, consider the physical, social and economic factors discussed above and include an evaluation of potential funding sources. The acquisition plan could then be implemented immediately following a severe storm.

2. Land Use Controls

Each municipality in New Jersey is required under the Municipal Land Use Law (N.J.S.A. 40:55D-1) to adopt master plans and zoning ordinances, by approval of the governing body. These plans and ordinances can designate and regulate areas subject to flooding and thus incorporate storm hazard mitigation. Among the mitigation measures which could be incorporated in zoning ordinances are the establishment of conservation zones, maximum development densities, and waterfront setbacks. Property assessments should reflect development potential under these ordinances. A program can also be instituted for transferring development rights out of storm hazard areas.

If zoning ordinances were changed in a community to accomplish storm hazard mitigation, some existing uses would become non-conforming uses. The Municipal Land Use Law states that a non-conforming use may be repaired or restored in the event of partial destruction. This is generally taken to be less than 50% loss, although it may be otherwise defined by a municipality. In order for a storm mitigation plan to be effective, once a non-conforming dwelling unit or structure is damaged 50% or more by a storm, it should be permitted to be rebuilt only if it would comply with existing ordinances.

a. Density, Land Use and Setbacks: In order to reduce the danger to life and property from storms, the oceanfront area can be zoned at a lower density than areas further inland (e.g. single family homes or duplexes, rather than multi-family and high-rise structures), thus effectively setting limits to population and property exposed to storm hazards. Also, eroding shorelines pose a greater threat to oceanfront high-rise structures because of their permanence due to engineering design and long term use. Houses, on

the other hand, are more easily relocated. Motels, due to their seasonal occupation, limit the population exposed to risk from winter northeast storms and also provide public access to shorefront areas. Therefore, they are more suitably located near the beach than are private residences. Multi-family residences should be located on safer, interior portions of an island.

The planned overall density (i.e. full build out under the Master Plan) should be closely related to the carrying capacity of the island. Carrying capacity includes such factors as realistic evacuation capabilities, water supply, sewerage and road capacities, and land area. Sanibel, Florida has been zoned using this approach to establish maximum allowable density (Butler et al., 1980). Ideally, the maximum allowable density would not exceed the ability of the population to be evacuated between storm warning and storm arrival. Downzoning is warranted in many municipalities, particularly in areas where full build out has not yet occurred.

Another means of decreasing the vulnerability to storms is to establish a conservation zone along the oceanfront. Only limited development would be permitted in this zone, and only if the development were designed for recreational or water dependent use (for example walkways and gazebos over dunes for physical and visual beach access) or shore protection. The conservation zone may be defined to include only the beach, the beach and dunes, or extend further inland in high hazard areas. Protection of the beach alone is not adequate storm protection, and protection of beach, dunes and inland areas is ideal.

The definition of a dune is critical to determine the effectiveness and enforcement of any dune protection ordinance, and must at least include all dunes in existence at the time of enactment. Ideally, such ordinances should take into account the dynamic nature of dunes and protect them as they migrate. The definition of a dune may include areas which would under natural conditions have dunes, even if there is no dune at a given time. In some ordinances, the landward slope is not recognized as a part of the dune and has been weakened by heavy encroachment.

Various approaches have been taken to dune protection around the country. North Carolina has perhaps the strongest dune protection laws, requiring most development to occur inland of the crest of the primary dune where one is present, and elsewhere, inland of the frontal dune. In Texas, the counties establish dune protection lines and development is permitted only where it will not materially weaken or reduce the effectiveness of the dune as a means of protection from high wind and water. Georgia's Shore Assistance Act sets forth criteria for developing in a dune field, among them that the structure be placed at the landward part of the site, that the project retain and restore vegetation as best possible and that normal functions of sand dune transport be maintained. In beach areas, eroding sand dune areas and areas without dunes, no permits are to be issued except for shoreline engineering structures, boardwalks or crosswalks. Georgia does not require a permit for repair of a house damaged less than 80%.

Glynn County, Georgia, which includes St. Simons Island and Sea Island, has adopted regulations more stringent than Georgia's Shore Assistance Act (Butler et al., 1980). A Beach and Dune Protection District was established

in 1974 which includes both a primary and a secondary dune district. Only fencing and elevated boardwalks are permitted in the primary dune district, which extends 40 feet inland from the landward toe of the primary dune. This definition provides the benefit of a boundary which varies with conditions and over time. Buildings on pilings are allowed in the secondary dune district.

Other states, including Maine, Massachusetts and Rhode Island have also adopted various restrictions to building on dunes, generally aimed at preserving their protective features in terms of volume, vegetative cover and ability to respond to wave action.

Paul Gares et al., (1980) have suggested the establishment of Dune Management Districts for New Jersey. A Dune Management District would have a dynamic boundary subject to periodic review and would be based on a storm of given frequency. Gares et al. recommended using a 50 year storm and a 10 year planning period. In delineating the district, the shoreline erosion rate, dune formation and migration, the length of the planning period and the frequency of overwash would be considered to determine the recommended ideal dune height and width based on the amount of protection desired while still allowing dune migration. New construction would be prohibited in the Dune Management District, and overwashed sand would not be removed. Rebuilding of damaged structures would be examined on a case by case basis. Public acquisition of vacant land is also recommended.

Section 60.3 of the National Flood Insurance Program (NFIP) Regulations states that sand dunes function as natural barriers that mitigate the effects of coastal flooding and that alteration of dunes in coastal high hazard areas (V zones) must be prohibited if potential flood damage would be increased. The Federal Insurance Administration (1978) developed model ordinances for review of building permit applications which require review of development proposed in a Coastal High Hazard Area to determine if it would alter sand dunes so as to increase potential flood damage, and prohibit alteration of sand dunes which would increase potential flood damage. Such an ordinance has been adopted in all of the shorefront municipalities in New Jersey. However, the NFIP regulations and consequently a number of ordinances do not protect dunes outside of the V zone, nor clearly protect dunes in the V zone. Developers have often argued successfully that the replacement of a dune by a shore protection structure such as a bulkhead, revetment or seawall, provides better protection than a dune, regardless of impacts such a structure might have on the beach.

A recently completed assessment of dune ordinances in New Jersey (NJDEP, 1984b) indicates that most dune ordinances describe a fixed and static legally defined line, such as a building line or dune area, that does not recognize future beach erosion or past processes that may have caused the dunes to migrate landward past the building line since the ordinance was adopted. The consequence is that the ordinance does not prevent building in natural dune areas which are landward of the building line. A second problem is that municipalities often grant variances to their dune ordinances and allow building in dune areas out of fear that they would otherwise have to buy the property. Dune ordinances seldom provide clear guidance for building new dunes, repairing damaged dunes, improving existing

dunes, or for placing structures in a dune zone (e.g. walkways to the beach).

The establishment of setback lines beyond which no new development or redevelopment may occur is an extremely effective storm hazard mitigation technique. Setbacks can be established at either the state or the local level, through legislation or zoning regulations respectively. No development other than water dependent uses, shore protection or support facilities for public recreational use would be allowed seaward of the setback line in the area of extreme high hazard. Setback lines may be established on the basis of erosion rate, distance from the shoreline, elevation, wave runup, V zone boundary, existing shore protection structures and their anticipated useful life, limits of vegetation, presence of dunes, as well as other factors, or any combination of these. In order to be effective, the location of the setback line at a given site should change as conditions change rather than be stationary over time. Ordinances may incorporate language that provides for review and redesignation over time, usually a 2-10 year period.

Some states prohibit most development seaward of the setback, while others require special construction practices. The setback program and permitting authority reside with the state in some instances, and with county or local government in others. In any case, the local governments may establish more stringent setbacks.

North Carolina has established a setback from the vegetation line equal to the distance calculated by multiplying the average annual rate of erosion by 30, with a minimum setback of 60 feet. Exceptions are made where this precludes permanent structures, if the building is as far back as possible and at least 60 feet inland of the vegetation line. Rhode Island also calculates setbacks based on multiplying the average annual erosion rate by 30. The figure "30" was chosen as the anticipated life span of a structure. New York recently (1981) passed a law to establish coastal erosion hazard areas based on a 40 year life span. The New York statute is to be implemented by the adoption of municipal ordinances. In each of these cases, the types of structures permitted are accessways, decks, shore protection measures and temporary structures which will not exacerbate erosion nor expose further property to damages. Florida's setback line is unusual in that it does not prevent construction but defines an area where special structural and siting conditions are required.

The previous examples refer to setbacks from natural shorelines. Setbacks are also critically needed from oceanfront shore protection structures such as seawalls, bulkheads and revetments. Waves breaking on such structures rush up and over the structures, potentially damaging any buildings or other structures behind them. This process is termed wave runup and overtopping. Wave runup is measured as the vertical height above the stillwater surge level that the rush of water reaches. In New Jersey, where much of the oceanfront is fortified, storm damage due to runup is likely to be significant.

In Massachusetts, the Blizzard of 1978 struck a similarly fortified coastline causing extensive damages. The Flood Insurance Rate Maps in Massachusetts have since been revised to reflect the extreme hazard of

building close to these oceanfront structures. The areas within the wave runup zone are designated as Coastal High Hazard Areas (V zones). It is recommended that oceanfront municipalities in New Jersey petition FEMA to revise their maps in similar fashion, and that setbacks be required from oceanfront bulkheads and seawalls to prevent building in this area where severe damage is likely.

In addition to the establishment of strict oceanfront setbacks, municipalities could provide for the relaxation of setbacks on the landward side of a property to enable development to occur further inland. In other words, a municipal ordinance may state that a project located on an oceanfront lot is not required to meet the standard side or rear yard setback. Such a provision would be particularly useful in rebuilding after a storm, to allow damaged buildings on previously developed lots to be rebuilt further inland.

b. Transfer of Development Rights

The technique of transfer of development rights (TDR) involves the establishment of preservation/conservation zones with attendant development rights or credits and the establishment of receiving zones where development rights can be purchased to exceed the zoned density. Unsold development rights would be taxable just as property is taxable. Once development rights to a property were sold, the land would remain in ownership of the seller but would not be subject to development and would decrease in value accordingly.

In the context of storm hazard mitigation, high hazard/high erosion areas would be designated preservation zones and the development rights for the property within these zones would be calculated and allocated based on property ownership. Safer areas of the community would be designated as receiving zones, where higher density development would be allowed with purchased development rights. In municipalities which are already developed, this technique would come into effect as redevelopment occurred and, in some cases, might be associated with an overall downzoning of the municipality.

Development rights can be purchased in either a pre- or post-storm setting to prevent rebuilding of structures significantly damaged by a storm. In order to be most effective as a mitigation technique, the TDR program should be mandatory, although a voluntary program would also be worthwhile. In a mandatory program, the marketability of development rights would have to be guaranteed, perhaps through creation of a development rights bank by the municipality or the state. The bank would buy development rights and sell them to developers in the receiving zone when they became marketable.

The attractiveness of the TDR approach is that it would phase out and eventually eliminate development in areas of high hazard while monetarily compensating property owners for not developing or redeveloping their property, without spending tax dollars.

TDR has been used in Collier County, Florida, on the Gulf coast, where 40,000 acres have been designated as a special treatment zone which can generate development credits and thus serve as a preservation area. The

special treatment zone consists mainly of barrier islands, mangroves, salt marshes and beaches. The receiving zones for development rights are those areas in the County zoned multi-family, and housing can be built at a higher density in the receiving zones with the purchase of development rights. Areas from which development rights are transferred must be preserved either by a restrictive covenant or by donation to the County or a non-profit conservation organization. There has been a moratorium on the program since 1982 due to the increased density being placed on only one island, Marco Island, which has received all of the excess development to date and due to the perceived inequitability in receiving $3000 per acre of land assessed for tax purposes at only $50 per acre.

TDR is presently being used in New Jersey in areas covered by the Pinelands Act. The enabling legislation establishing the Pinelands Commission gave the Commission land use powers which are relied upon for this program. Burlington County is actively using funds from a revenue bond to buy transfer development credits which it plans to sell to developers in the future.

Elsewhere in New Jersey, the Superior and Appellate Courts recently ruled on East Windsor Township's use of TDR to preserve farmland. The Superior Court found that in the absence of specific regulations in the Municipal Land Use Law, municipalities do not have the authority to engage in TDR. The Appellate Court upheld this decision. The case had been appealed to the New Jersey Supreme Court but was recently settled prior to that court making a ruling. The courts did not rule on the constitutionality of TDR. Enabling legislation has been introduced in the New Jersey Senate and Assembly which would specifically give municipalities the authority to engage in TDR.

A TDR program to reduce storm-related losses is being explored in a municipality in Cape May County under funding from the New Jersey Department of Environmental Protection. The project will determine the viability of the program for one municipality and its applicability to other coastal communities. The project involves documentation of the risk and economic cost of past storms, analyzing existing land use and calculating the existing development potential of the island. Receiving sites are to be identified and their development capacity evaluated. Preservation and receiving districts will be delineated and a market analysis of development rights undertaken.

c. Land Exchange

Where publicly owned vacant land is available within a reasonable distance and outside of a flood hazard area, that land may be traded for privately owned land in a high flood hazard area. As an example, Arizona law provides for a governing body to petition the State to designate an area as eligible for flood relocation assistance and exchange for State land. The program is voluntary (a majority of people within the area must have signed a petition requesting relocation) and a suitable parcel of land owned by the State or other governmental entity must be located within 25 miles. A floodplain land exchange fund may be used by the State either (1) to purchase land to support the relocation, (2) for condemnation of private land within a floodplain which is not exchanged, or (3) to compensate the

State trust for exchanges involving private land valued lower than the State land for which it has been exchanged (Sections 26-322 and 37-610-01, Arizona Revised Statutes).

3. Construction Standards

Requiring that builders build to minimum hurricane or storm resistant building standards is a means of reducing storm damage. Building codes can take the form of performance standards or specifications. The floodproofing requirements of BOCA are, for the most part, performance standards.

The Federal Emergency Management Agency's 1981 publication entitled Design and Construction Manual for Residential Buildings in Coastal High Hazard Areas provides technical information on construction materials and design details to withstand storm winds and waters. These guidelines are not binding upon builders and are not considered to be stringent standards. Other publications provide design standards as well, including Elevated Residential Structures (AIA Foundation, 1984), Coastal Design: A Guide for Builders, Planners and Homeowners (Pilkey et al., 1983), Model Minimum Hurricane Resistant Building Standards for the Texas Gulf Coast (Texas Coastal and Marine Council, 1981) and A Supplement to the Southern Building Code for Hurricane Protection (Edge et al., 1984). These guidelines cover such information as materials, anchoring, fastenings, foundations, bracing, shape of house, wind and water loads, etc.

In New Jersey, the Basic Building Code of the Building Officials and Code Administrators International, Inc. (BOCA) has been adopted as a Uniform Construction Code (N.J.S.A. 52:27D-1 et seq.) and must be used by all municipalities. It is administered by the New Jersey Department of Community Affairs and enforced at the local level. Floodproofing requirements were not made part of the code until January, 1984 nationally and August, 1984 in New Jersey. The floodproofing section of the code (Section 1313) applies to all new structures located in flood prone areas, and to structures undergoing substantial changes (greater than 50%), using the 100 year flood as the minimum criterion for determining flood prone areas and establishing the base flood level. The code requires that all buildings and structures located within a flood prone area have the lowest structural member, except pilings and columns, at or above the base flood level. Buildings and structures which are not in Use Group R (i.e. which are not residential) may alternatively comply with water tight construction provisions of the code. The floodproofing requirements of the code in coastal high hazard areas pertain to anchoring of buildings and structures to piles and columns, fastening of building components, and placement of obstructions below the lowest floor. A registered professional architect or engineer must certify that all applicable floodproofing requirements are met before a Certificate of Occupancy can be issued.

A New Jersey committee consisting of local construction officials, State officials and a FEMA representative developed a revised section on flood resistant construction. The proposed revisions were submitted to BOCA on August 1, 1984 by Robert Williams, the construction official of Atlantic City, for consideration for incorporation in the 1985 edition of BOCA.

Although the addition of these floodproofing requirements to the BOCA Basic Building Code has strengthened the code and incorporated the construction standards of the National Flood Insurance Program, it is still considered by many to be somewhat inadequate. Because Flood Insurance Rate Maps do not recognize wave runup in delineating coastal high hazard areas and, therefore, there are no specific construction standards for development in wave runup zones, there is the potential for major storm damage. In addition, standards are felt to be inadequate with regard to design wind speeds and anchoring of walls and roofs. Lastly, the performance standards are too general, which makes interpretation and enforcement difficult. More specific guidelines are needed (e.g. to interpret the regulations for breakaway walls).

Municipalities in New Jersey are required to use the BOCA Basic Building Code as the construction standard and may not supplement the code with more stringent standards, either as a building code or under a zoning or special ordinance. Therefore, in order for adequate standards to be adopted in coastal communities, the standard must first be incorporated into the BOCA Building Code at the national level and then the amended code adopted by the State. Alternatively, legislation could be passed at the State level establishing stronger floodproofing controls.

4. Floodproofing Existing Structures

Modifications can be made to existing structures to decrease the likelihood of flood damage. Houses can be jacked up and elevated on piles, although this is less practical for structures with a slab-on-grade foundation, attached units and large brick or masonry structures (Illinois DOT, 1984). In Elevated Residential Structures, a FEMA publication (AIA Foundation, 1984), the following four criteria characterize structures for which raising is generally feasible:

1. accessible below the first floor for placement of jacks and beams,

2. light enough to be jacked with conventional house moving equipment,

3. small enough to be raised in one piece, and

4. strong enough to withstand the stress of the raising process.

Particularly suitable are wood frame homes and light commercial buildings which are raised above the ground, although brick and masonry structures can be raised. The publication also includes a comparison of the costs of elevated foundations over conventional foundations and design and construction guidelines for new construction.

Structures which are located in flood zones and are not anchored (i.e. only anchored by gravity), or are poorly anchored, can be anchored to prevent flotation. The means of anchoring depends on the design of the house. Some alternatives are driving piles at house corners to which the house is then fastened, use of ground anchors, and use of diagonal struts under the house (Pilkey et al., 1983). Additional fastenings can be added

to existing houses which are not adequately tied together (e.g. fastening of roof to wall) and interior walls reinforced (Pilkey et al., 1983).

William Gordon (1981) notes an additional method of preventing flotation: reducing hydrostactic pressure by providing trap doors in first floor rooms. Small openings can also be made in walls of crawl spaces, basements and garages to allow floodwaters to more easily enter these areas. This is a wet floodproofing technique and will allow hydrostatic pressure to equalize on each side of the structure walls and minimize the likelihood of wall and foundation failure. If wet floodproofing is done it should be accompanied by raising the contents within the house where feasible (e.g. furnace, hot water heater, electrical service) (Illinois DOT, 1984). Raising these utilities may also be beneficial where the house floods only a few feet. Tax incentives, such as credits, deductions and rebates are all means of encouraging property owners to take floodproofing measures.

5. Construction and Reconstruction of Infrastructure

Proximity to infrastructure is an important determinant of where development occurs because access to roads, sanitary sewer lines and potable water is essential. Thus by not extending infrastructure to particularly hazard prone or sensitive areas, development of these areas can be discouraged. On densely developed coastlines such as New Jersey's, this approach would only be useful in guiding post-storm redevelopment of damaged utilities and roads where existing homes and businesses have been largely destroyed. Utilities and roads could then be relocated outside of high hazard/erosion areas.

6. Shore Protection

Several steps can be taken to combat the erosion problem on barrier island beaches. The options range from "no action" to "corrective measures". The various corrective shore protection measures, including structural engineering and non-structural solutions, are listed in Table 3. These include measures which armor the shorelines, decrease offshore wave energy, or increase sedimentation. The majority of these solutions are high cost options and require large expenditures, usually from passage of federal and/or state legislative appropriations or, in New Jersey's recent experience, bond issues.

TABLE 3: CATALOG OF SHORE EROSION CONTROL METHODS

METHODS	OBJECTIVE	REQUIREMENTS	PROBLEMS
Structural			
Groins	To impede longshore transport and induce sedimentation	Sufficient longshore transport or artificial nourishment	Can cause downdrift erosion. Aesthetically unpleasing. Hazard to swimmers.

METHODS	OBJECTIVE	REQUIREMENTS	PROBLEMS
Bulkheads	To retain soil and protect eroding shore-lines	Sufficient soil foundation to withstand forces	Can cause erosion in front of and adjacent to structures. Impedes beach access.
Seawalls	To protect shorelines from moderate - heavy wave action	Supply of suit-able stone	Cause erosion in front of and adjacent to the structure. Impede beach access and are aesthetically unpleasing.
Revetments	To protect eroding shore-lines from wave and current scour	Availability of suitable stone and protection from toe scour	Can cause erosion in front of and adjacent to structure. Subject to scour and settlement damage.
Breakwaters	To diminish wave energy and induce sedimenta-tion	Suitable supply of stone and supply of sediment in longshore system	Swimming and navigation hazard. Can cause shoaling and completely block longshore drift causing adjacent erosion.
Non-Structural			
Beach Nourishment	To increase beach width and height and provide sedimentation to the long-shore system	Large quantity of suitable sand nearby	Temporary - has to be done on a periodic basis. May require structures to hold sand in place.

METHODS	OBJECTIVE	REQUIREMENTS	PROBLEMS
Dune Building & Maintenance	To create and maintain a dune line or zone	Space for dunes, supply of sand, vegetation and fences to stabilize	Easily disturbed. Requires regular maintenance.
Artificial Seaweed	To reduce current velocity and induce sedimentation	Purchase of "seaweed" and anchoring materials	Does not significantly attenuate wave action. Can be dislodged and carried away. Preliminary research by NJDEP found this method to by ineffective.

The problem of beach erosion is affected primarily by wave action, size and supply of littoral sediment, predominant winds, and proximity to tidal inlets. Therefore, each solution must be "customized" to each specific problem site, taking into account all possible variables. The physical processes acting in certain areas must be examined to determine the probable response to different shore protection solutions. The cost of a project must also be weighed against the value of the property being protected and the expected benefit, both economic and recreational, from such a project.

a. New Jersey Shore Protection Master Plan

The New Jersey Shore Protection Master Plan (NJDEP, 1981) provides a plan for all future shore protection work. It represents 1) a review of past and present erosion and shore protection trends, 2) an evaluation of impacts and implementation of alternative approaches to shore protection (engineering and land management) and 3) a comprehensive shore protection plan which is consistent with State coastal management policies and objectives. The geographical area studied in the New Jersey Shore Protection Master Plan includes the Raritan Bay shore from Perth Amboy to Sandy Hook, south along the Atlantic Ocean shore to Cape May, and north along the Delaware Bay and River to Crosswicks Creek.

b. The Reach Concept

Development of the engineering plans for New Jersey coastal areas is based on a regional (reach) approach, rather than stop-gap piecemeal solutions. Along ocean shores, piecemeal solutions often tend to aggravate the erosion problem in adjacent shore areas. The "reach concept" is the method whereby consistent shore protection engineering plans are developed within areas affected by similar coastal processes. The reach concept attempts to reduce the potential for any one shore erosion control program to produce adverse effects in adjacent shore areas. Shore protection is thereby provided for an entire coastal section, irrespective of political

subdivision boundaries, rather than for only local erosion problem areas as has been the traditional practice in New Jersey. The reaches that have been developed for the New Jersey Shore Protection Master Plan are shown on Figure 3, together with the affected counties and political subdivisions within each reach.

c. Erosion Classification

Four erosion categories for New Jersey Shoreline reaches were presented in the New Jersey Shore Protection Master Plan (NJDEP, 1981). Criteria for these erosion classifications include beach width, presence of dunes, sediment budget, presence and functional performance of shore protection structures, proximity to development, and wave climate. The erosion categories are defined as follows: Critical Erosion (I) - areas having the least suitable natural and man-made protection from the operating erosive forces, while receiving significant erosive attack and damage to protective features; Significant Erosion (II) - areas where a low to moderate level of protection exists, but where erosive forces are expected to reduce this level in time; Moderate Erosion (III) - areas with a moderate to high degree of protection for the level of erosive processes that are operative; Non-Eroding (IV) - non-eroding or stable. The erosion categories for New Jersey's coast are identified in Figure 4. Most of the shorelines are classified as critical or significant erosion areas.

d. Recommended Shore Protection Plans

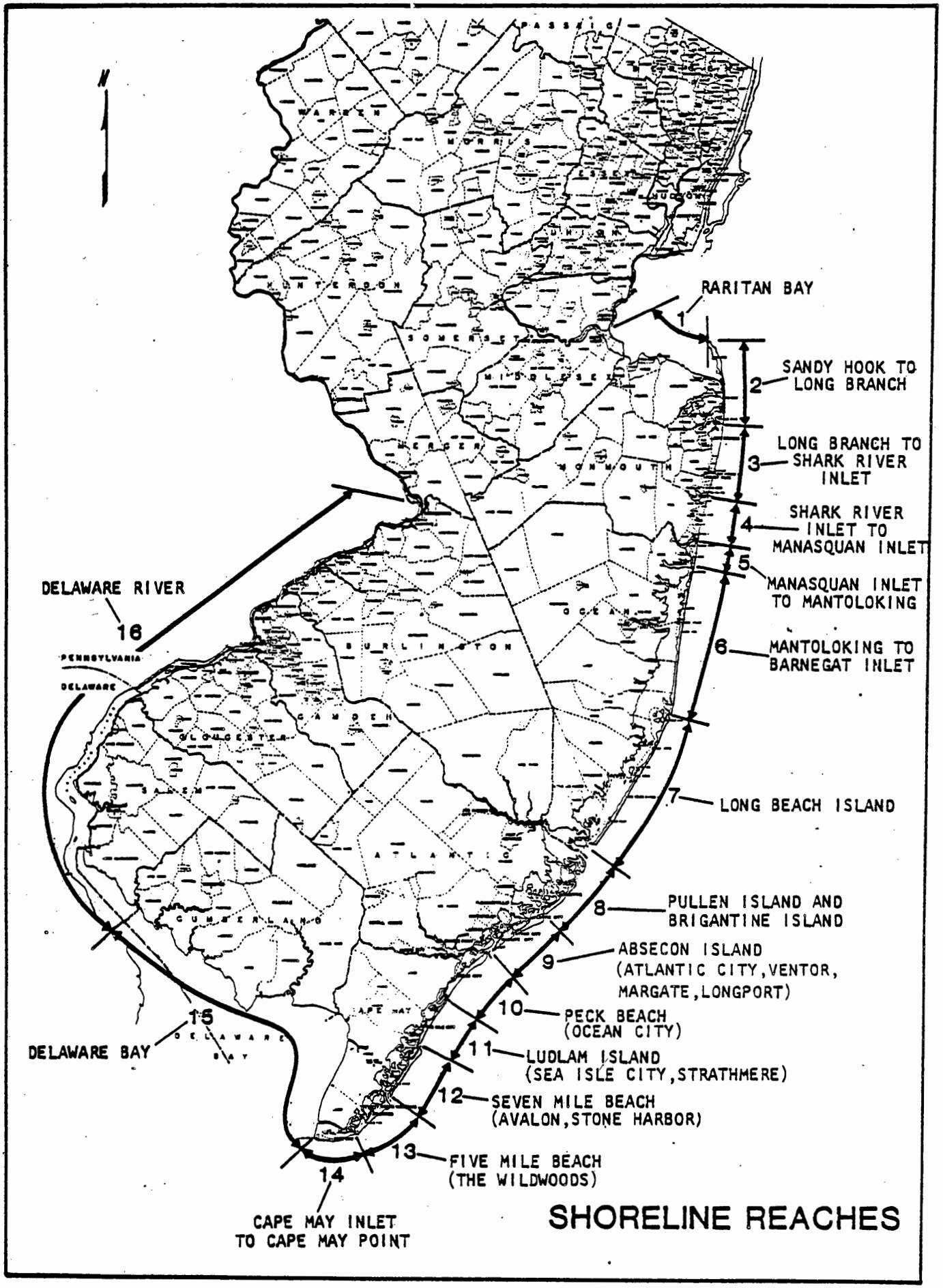
The New Jersey Shore Protection Master Plan ranks different engineering alternatives in order of benefit-cost ratio. This analysis was based on four parameters: engineering costs, public service costs, recreational benefits, and property protection benefits.

Under the New Jersey Shore Protection Program Rules and Regulations (N.J.A.C. 7:7F), the State's shore protection grants and loans are conditioned on compliance with the Department of Environmental Protection Rules on Coastal Resource and Development Policies (N.J.A.C. 7:7E-1.1 et seq.) pertaining to dunes, beaches, coastal erosion hazard areas, and public access. Thus, if a municipality permits building on beaches, dunes and in erosion hazard areas, it is not eligible for state shore protection funding.

E. IMPLEMENTATION OF STORM HAZARD MITIGATION STRATEGIES

1. Public Education

In order for storm hazard mitigation strategies to be accepted and implemented at the local level, the public must be made aware of their vulnerability to storms, potential costs of storms and means of reducing storm damage. In particular, local officials must be convinced of storm hazards and evacuation problems in order to better serve, advise and educate their constituents. Public awareness programs can involve a variety of media and techniques including radio and TV spots, newspaper article series and supplements, and publication and distribution of brochures and pamphlets.



SHORELINE REACHES

FIGURE 3

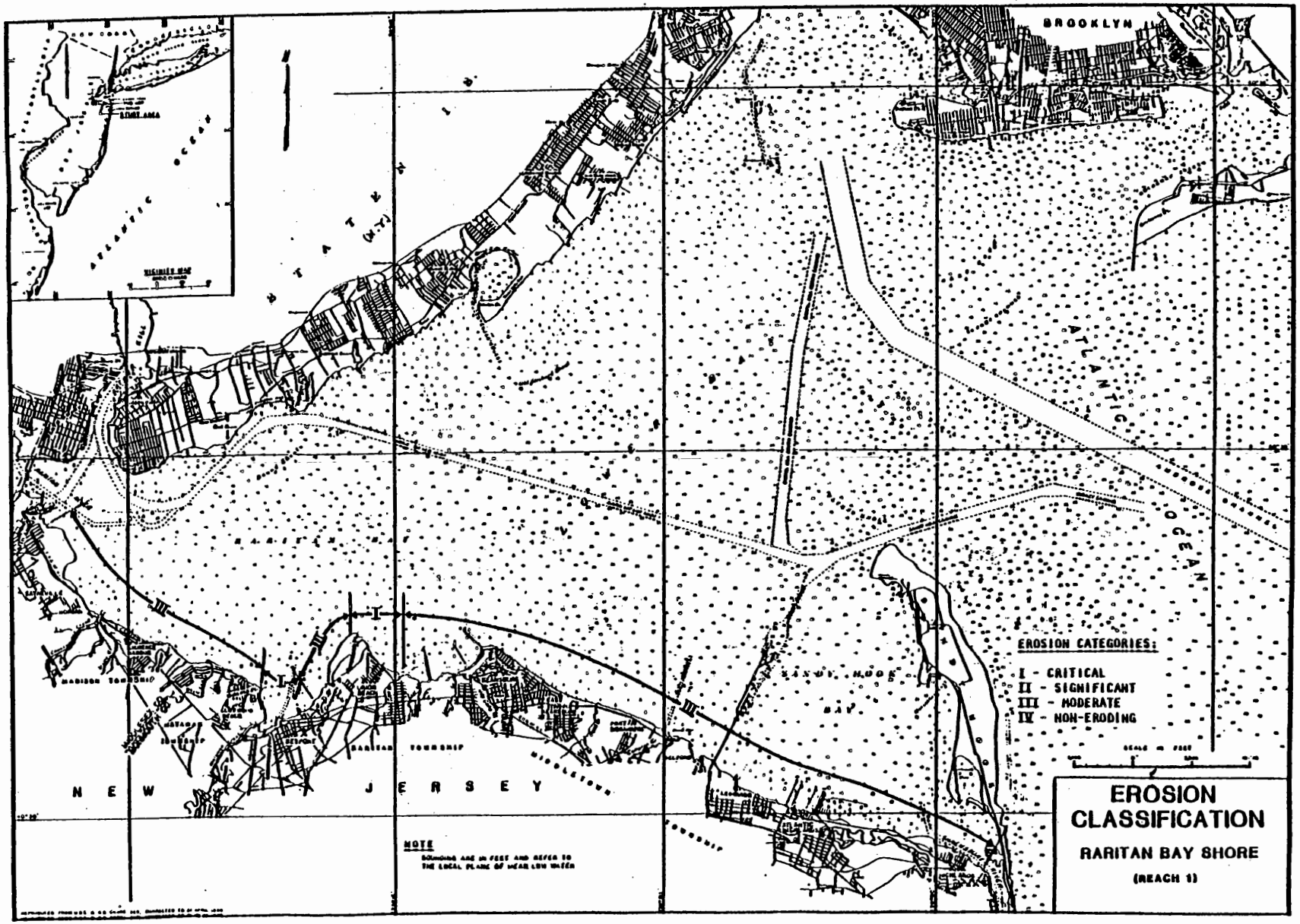

BROOKLYN
ATLANTIC OCEAN
NEW JERSEY
EROSION CATEGORIES:
I - CRITICAL
II - SIGNIFICANT
III - MODERATE
IV - NON-ERODING
NOTE
EROSION CLASSIFICATION
RARITAN BAY SHORE
(REACH 1)

FIGURE 4

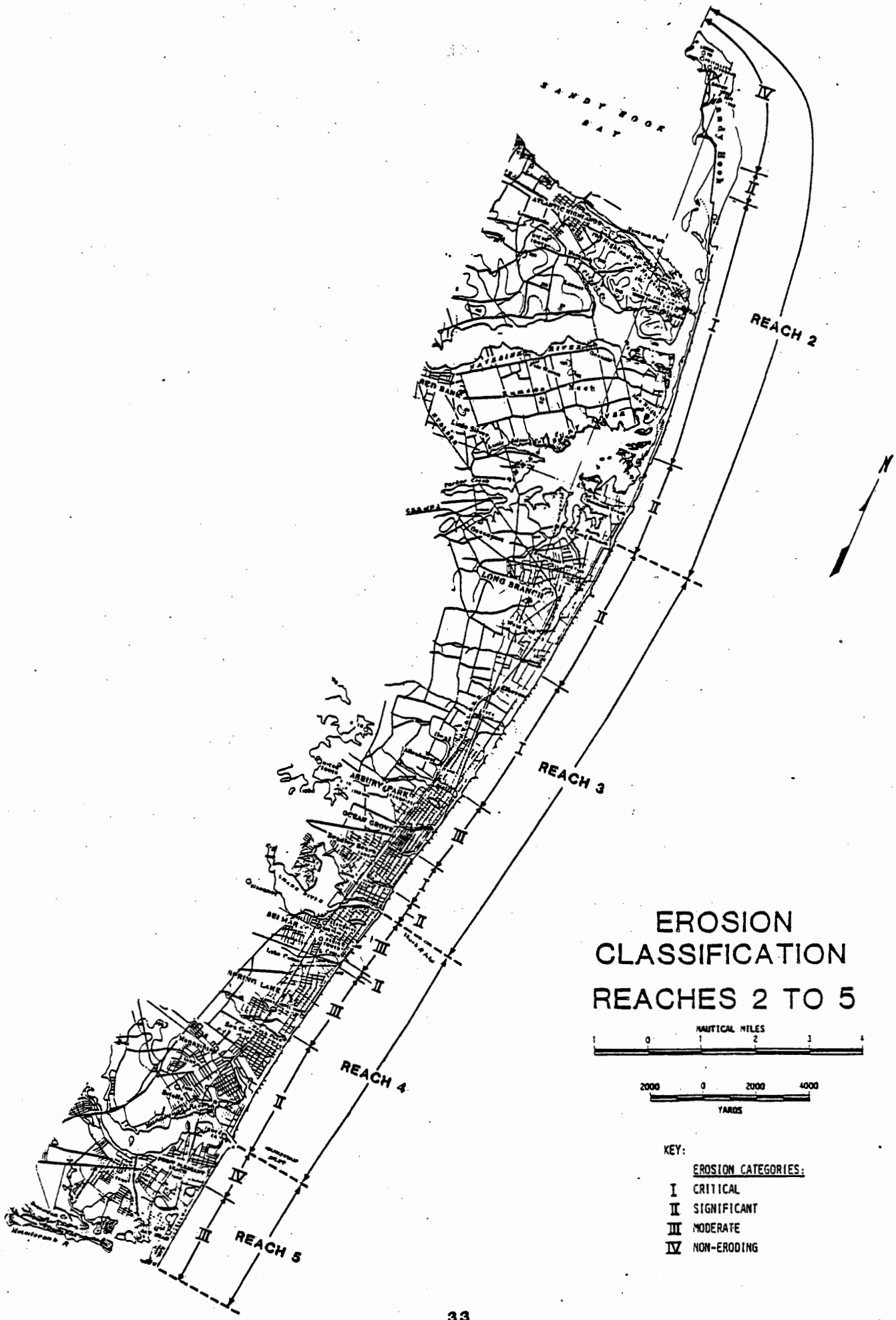
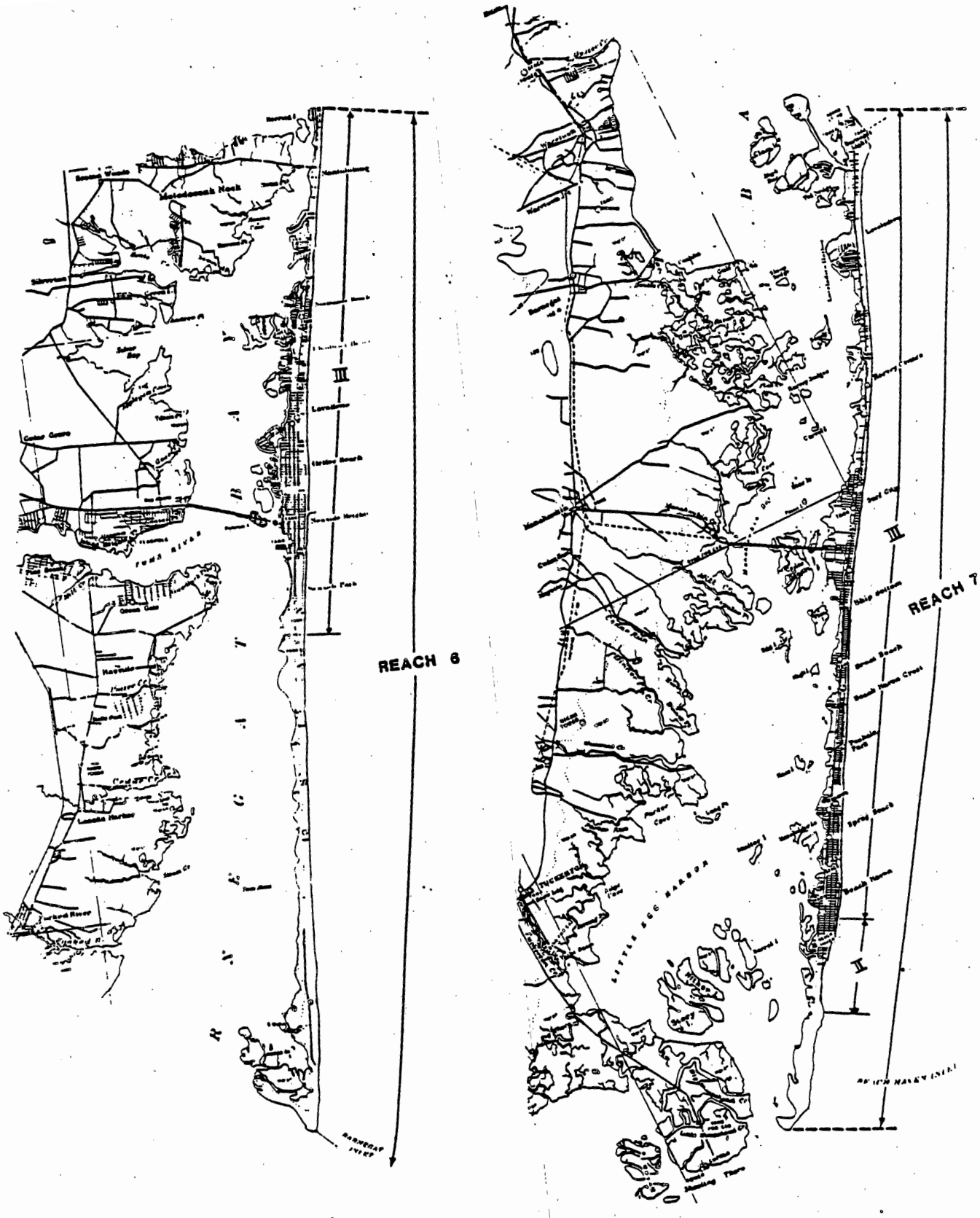


FIGURE 4 (cont'd.)



EROSION CLASSIFICATION
REACHES 6 TO 7

FIGURE 4 (cont'd.)

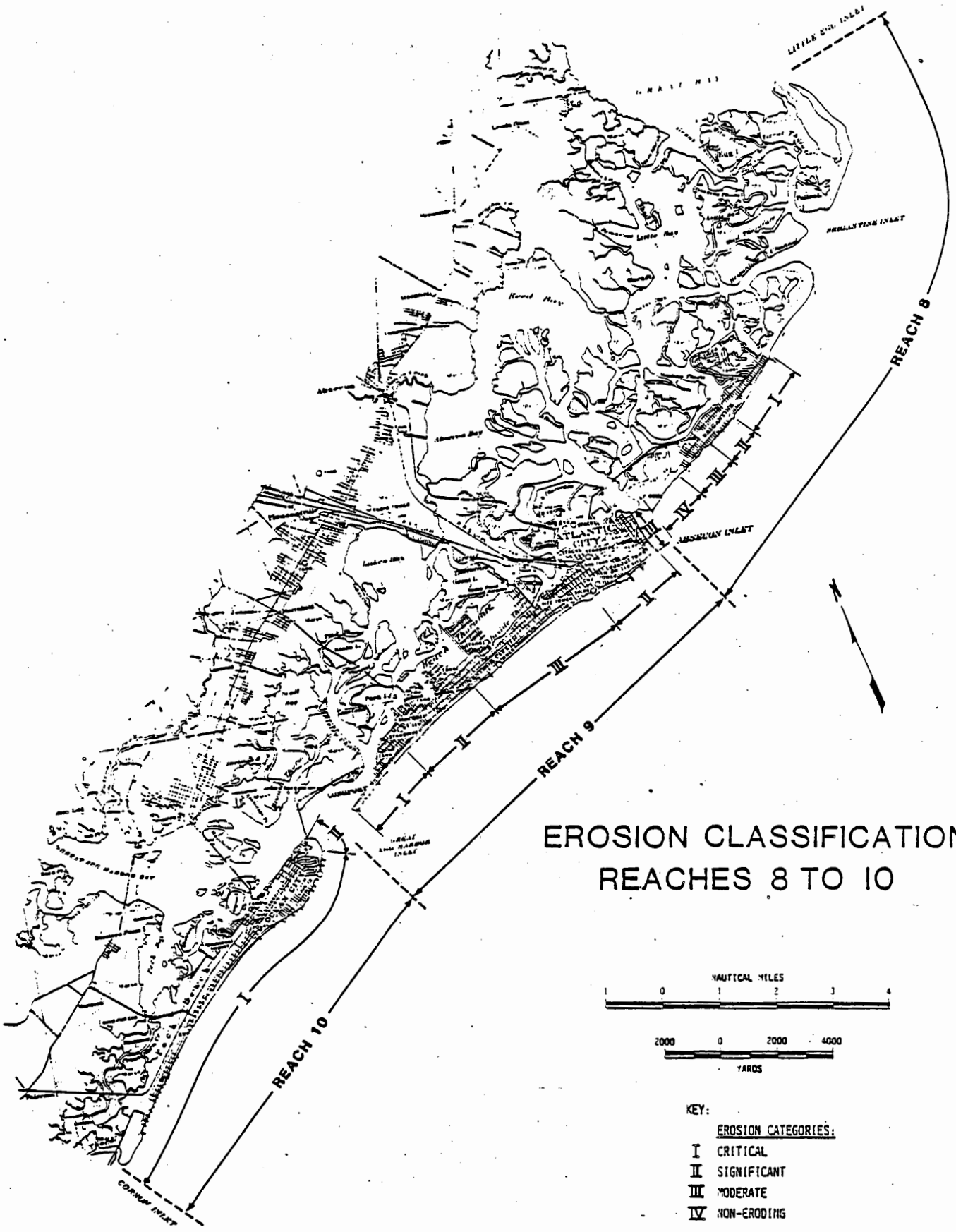
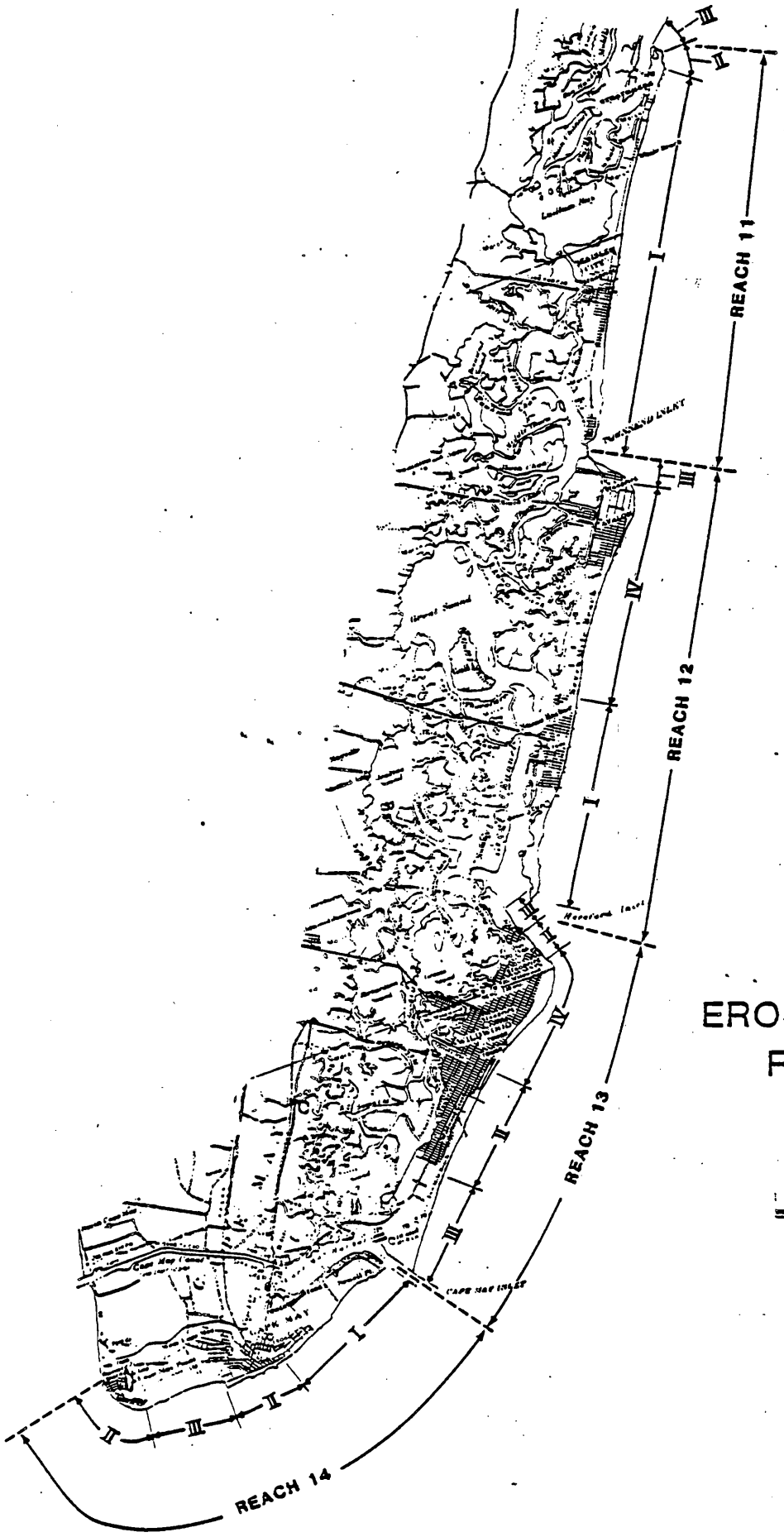


FIGURE 4 (cont'd.)



EROSION CLASSIFICATION
REACHES II TO 14

NAUTICAL MILES
1 0 1 2 3 4

2000 0 2000 4000
YARDS

KEY:

EROSION CATEGORIES:

I CRITICAL
II SIGNIFICANT
III MODERATE
IV NON-ERODING

FIGURE 4 (cont'd.)

Community outreach programs are another way of educating the public. These include school curricula in coastal storm hazard mitigation as well as public meetings, slide shows and presentations at civic or club meetings. All can be used to educate and attempt to gather support for implementation of hazard mitigation strategies at the local level.

Community awareness can also be increased by techniques such as marking historical flood levels in conspicuous locations, or requiring notification in deeds, mortgages, or real estate sales that a particular property is subject to flood hazards (Hildreth, 1980; U.S. Water Resources Council, 1981). Such hazard notification not only involves home buyers and developers, but has the added benefit of involving realtors, financial institutions (lenders) and title companies.

Funding for information and educational programs may be available at the federal level (Federal Emergency Management Agency, National Oceanic and Atmospheric Administration, U.S. Geological Survey, U.S. Army Corps of Engineers), as well as the state and local levels.

2. Building Moratorium

Enactment of a post-storm building moratorium prohibiting reconstruction and repair of storm damaged structures may be useful to enable a state or municipality to evaluate damages and more wisely accommodate post-storm development so as to incur less damages and costs from future storms. During the moratorium period, damages would be assessed, reconstruction plans made and changes in high hazard area designations accomplished. Effectiveness of building codes, acquisition priorities and funding sources would be evaluated. A moratorium could be imposed at either the state or local level and could be restricted to structures receiving a specified amount of damage (e.g. 50% damage or higher). A municipality could be divided into districts, with a moratorium imposed on those areas which received heavy damage and where redevelopment should be questioned. Sanibel, Florida is an example of a municipality which has proposed such a plan (Rogers, Golden & Halpern, 1981).

The adoption of post-storm development plans by both local and state government prior to the next major storm would minimize the need for and duration of a post-storm building moratorium, and provide for a speedier recovery.

3. Funding

A number of the hazard mitigation strategies require funding for implementation. The highest cost strategies are land acquisition and shore protection measures. Funding may be available at the federal, state and local level. A number of funding sources are discussed below, as well as their use in several states.

a. National Flood Insurance Act (1968): Section 1362 of this act provides for federal purchase of high hazard properties which have federal flood insurance and are damaged substantially beyond repair by flooding. Furthermore, properties in flood hazard areas which are covered by flood insurance and have sustained damage as a result of a single casualty of any

nature under such circumstances that a statute, ordinance or regulation precludes repair or restoration, or permits repair or restoration only at a significantly increased construction cost, may also be purchased. Lastly, structures which incur significant flood damage three times in five years equal to 25% of the value of the structure each time are eligible for purchase. This voluntary program pays the pre-flood value of the property less the insurance payment, but does not pay relocation costs.

FEMA evaluates the anticipated savings through property acquisition, the community's commitment to hazard mitigation (e.g. floodplain management regulations, matching funds) and the community's proposed use of the acquired property (which must be recreational or open space) in evaluating the request for Section 1362 funds. The major problem with the program is that its funding by Congress has been significantly lower than the applications for funds. These funds were used to acquire storm-damaged property in Scituate, Massachusetts following a major northeaster in 1978 and to acquire properties in Baytown, Texas following damage due to Hurricane Alicia in 1983.

b. Congressional Appropriation and Initiatives: Past Congressional Appropriations for the Departments of State, Commerce and Justice (P.L. 98-411), have included funding for the continuation of New Jersey's Coastal Management Program and, on one occasion, for specific beach and dune restoration projects. Other appropriations may be made in the future. In addition, each year Congress may appropriate funds for the U.S. Army Corps of Engineers to implement authorized navigation and shore protection projects.

Outer Continental Shelf Revenue Sharing legislation and the reauthorization of the Federal Coastal Zone Management Act, which would provide funding for the state Coastal Management Programs, are being considered by Congress in 1985.

c. Bond Issues: The voters at the state, county or municipal level could decide to fund an acquisition or shore protection program by authorizing a bond. In 1977, the State passed a $30 million bond issue, $20 million of which was for shore protection, and a second shore protection bond issue, for $50 million, was passed in 1983.In 1983, New Jersey also passed a $135 million bond issue for Green Acres, $28 million of which was for open space or park acquisition.

d. Green Acres: The State, through its Green Acres Program, could provide partial funding for land acquisition. Newly acquired sites could be added to the State Park System.

The Green Acres priority ranking system considers various characteristics in determining prime acquisition target areas. These characteristics include water frontage, other water resources features, outstanding or unique natural features, endangered species habitats, native wildlife and plant species habitats, historic and cultural resources, acquisition costs, alternative preservation techniques, alternative sites, development threats, statewide and immediate service area recreation needs, critical recreation access sites and connectors, accessibility, special needs, integrity of purposes, public use potential, public support, and

relationship to planning. This priority system favors larger parcels of land because of the greater potential for public use.

e. Legislative Appropriation: The State could enact legislation which would appropriate funds to purchase high hazard coastal property. Such legislation may be more likely in the wake of a severe storm for purchase of damaged property.

As an example, in 1981, the North Carolina General Assembly enacted a beach access statute and appropriated $1 million for initial implementation. It has appropriated $1.2 million for the program in each of the past three years. The statute requires that land which is in a high hazard area, and thus unsuitable for development, but is useful for access, be given high acquisition priority.

f. Taxes and User Fees: A surcharge, similar to a luxury tax, could be added to the cost of tourist-related products, housing, and services provided in coastal towns, or a tax could be placed on property or non-tourist activities or uses. Florida and North Carolina both use this approach, with Florida permitting the creation of municipal services taxing units and the imposition of special benefits taxes for beach preservation and North Carolina authorizing transient occupancy taxes at the county level.

Florida also places an excise tax on deeds and other instruments which convey lands, tenements, or other realty, or interest therein (Chapter 81-33) which may be used in part to acquire lands for water management and protection of water resources. An additional 13.3% is paid into a Land Acquisition Trust Fund.

Another alternative would be a reduction in property taxes on undeveloped properties in high hazard areas which agree to remain undeveloped, or generally a tax structure which encourages appropriate use of high hazard areas and discourages inappropriate use, for example by placing a special assessment on building in high hazard areas to partially cover public costs of building there. Tax incentives such as deductions, credits and rebates can also be used to encourage relocation out of flood hazard areas.

Several methods of imposing taxes or user fees to fund shore protection are currently under consideration in New Jersey. A bill proposing a one percent tax on hotels, motels, campgrounds and seasonal homes to fund shore protection was introduced to the State legislature in 1985. A bill which would require that each coastal municipality pay a certain percentage of the collected beach fees into a fund for shore protection is also being considered.

g. Conservation Organizations: Such groups purchase high hazard property and retain it as open space.

h. Corporate Donations: Large companies and businesses in the shore area, especially those which benefit most from summer tourists, could consider making tax deductible contributions to an acquisition program.

i. Private Donations: Donations of land or money for an acquisition program can be made as outright conveyances (fee simple) which provide the greatest tax benefits, bargain sales (selling at less than full market value), life estates, or donations in trust. The granting of conservation or scenic easements is another possibility. In New Jersey, lands can be transferred to the State Natural Lands Trust or other qualified recipients including federal, state, county and municipal government agencies and conservation groups. The State Natural Lands Trust was created by the legislature in 1968 and is an arm of State government formed to seek donations of land to hold as permanent open space and to assist potential donors of such lands.

F. LEGAL ISSUES AND ORDINANCE PREPARATION

1. Legal Issues*

Floodplain regulations raise constitutional issues similar to those involved in broader land use regulatory efforts. In determining the constitutional validity of regulations, courts look first at the general validity of the regulations and then at their specific validity as applied to a particular landowner. They first decide whether the unit of government or agency adopting the regulation was authorized to do so by an act of Congress or a state statute, and whether statutory procedures were followed. Having found sufficient statutory powers and compliance with statutory procedures, they then decide whether the regulations (1) serve valid police power objectives, (2) have a reasonable tendency to achieve or aid in the achievement of those objectives, (3) afford equal treatment to similarly situated landowners, and (4) permit reasonable private use of land so that a "taking" of private property does not occur. During the last decade, most lawsuits contesting floodplain regulations did not challenge the general validity of restrictions (adequacy of basic power and compliance with statutory procedures), but rather contested the constitutionality of regulations as applied to a particular property in the context of these four basic tests.

This approach has been followed by courts across the nation in floodplain and other cases. When arguing their claims, landowners may concede the general validity of a floodplain, wetlands, or other regulation but argue that it is irrational, arbitrary, or capricious as applied to their land or that it "takes" their property without "just compensation". A court may find that the regulation is in fact unconstitutional as applied to particular property, but this will not stand as a determination of the constitutionality of the regulation as applied to other lands. A pinpoint approach favors general judicial acceptance of floodplain regulations; however, it has led to a fair amount of litigation.

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* This section is excerpted from Jon A. Kusler, 1982, Floodplain Regulations and the Courts 1970-1981. Prepared for the U.S. Water Resources Council and the Tennessee Valley Authority. Legal case citations found in Kusler are not included and the publication is quoted without identification of omissions.

a. General Judicial Responses

During the 1970s courts responded to the following general legal requirements for floodplain and resource protection regulations.

(1) The agency or local government adopting regulations must be authorized to do so by an enabling statute or home rule powers. Inadequately authorized regulations fail to meet due process requirements; they are considered ultra vires and invalid by the courts.

In the 1970s, no court invalidated regulations for lack of enabling authority. In fact, several cases commented upon the sufficiency of general enabling statutes, and several upheld the power of special districts to adopt regulations. In addition, some courts held that local units had a duty to adopt floodplain regulations or consider flooding when required to do so by a particular statute: those courts directed compliance with the statutes.

(2) Statutory procedures for adoption and amendment of regulations must be carefully followed, otherwise regulations violate due process requirements and are ultra vires.

This general requirement was adhered to in the 1970s. One court held that an informally adopted floodplain "resolution" did not regulate because the local government had not followed procedures required for a formal ordinance. Several cases have held the denial or approval of a special exception permit invalid because statutory procedures had not been followed.

(3) State land use regulations must not, in general, pertain to matters of exclusively local concern, otherwise state regulations may contravene local home rule statutes or constitutional provisions.

In the 1970s, no court invalidated state regulations as violating local home rule powers. Courts in at least three cases specifically upheld regulations against claims that state regulations violated home rule provisions, concluding that flooding is a matter of greater than local concern. In addition, courts in at least six cases have upheld state coastal zone, wild and scenic river, and similar resource regulations against home rule arguments with no adverse decisions for such resource-based state regulations.

(4) Regulations must serve legitimate police power objectives. Regulations that fail to do so violate due process requirements. Regulations designed to prevent landowners from increasing flood damages on other lands, threatening public safety, or causing victimization were clearly designed to serve valid objectives. The reduction of losses to the landowners themselves (which indirectly affect society) and the reduction of the need for flood control works at public expense were also considered valid objectives, although few cases had yet been decided on these points.

Cases in the 1970s provided strong support for protection of public safety, and prevention of nuisances and victimization. Courts in some cases endorsed not only these traditional objectives but also regulations adopted to protect owners from flooding, protect flood storage, qualify a community

for flood insurance, reduce flood losses, protect floodways until public purchase was possible, and reduce the cost of public services.

(5) Regulations must be reasonable; that is, the regulatory standards and procedures must have some tendency to accomplish the regulatory goals such as reduction in flood losses. If regulations are not reasonable, they violate due process requirements.

(6) Standards for agency action must not be vague or indefinite, otherwise regulations violate due process requirements.

In the 1970s courts sustained broad statutory and ordinance standards for issuance of special permits and variances when they were challenged. However, some courts have found an insufficient factual basis (of erosion or flooding, for example) to deny or justify issuance of permits.

(7) Regulations must not discriminate between similarly situated landowners, otherwise regulations violate 14th Amendment due process requirements.

Courts strongly endorsed equal degree of encroachment and cumulative impact standards in floodway restrictions and quite often focused on equity considerations in deciding whether regulations were a taking of private property.

(8) Regulations must not "take" private property without payment of just compensation, otherwise regulations violate 14th Amendment and 5th Amendment requirements of due process and prohibitions against taking. Floodway and coastal high hazard area restrictions, and elevation requirements for outer flood fringe areas do not take property, even where such restrictions severely affect private landowners. Prior to 1970, very strict regulation of outer fringe areas and "wetland restrictions" might be held a taking. With few exceptions, in the 1970s courts upheld floodplain regulations against taking challenges. Restrictions upheld included highly restrictive regulations for outer areas as well as for floodway and coastal high hazard zones.

(9) Units of government may not, under most circumstances, increase flooding or flood damages to private lands. Under certain circumstances, government bodies may be responsible for increased flood damage on private lands under theories such as taking, nuisance, and trespass when the governmental unit constructs, operates or maintains flood control works, roads, or other public structures or facilities.

Despite a growing trend during the 1970s to hold governments responsible for positive actions resulting in increased flood losses, governments were not held responsible for failing to provide flood insurance, disaster assistance, flood control works, or floodplain regulations. Several federal court decisions refused to hold the Federal Insurance Administration liable for failure to broadly advertise the National Flood Insurance Program (NFIP). The courts held that the program has been adequately advertised. A relatively large number of decisions have addressed NFIP responsibility for payment of local insurance claims. Most of these involved interpretation of the flood insurance statutes.

b. The Taking Issue

Tests for a taking. Federal and state courts decisions during the decade emphasized similar factors in deciding whether a taking had occurred. Several tests were often simultaneously applied. The taking issue was not usually addressed in isolation but in combination with questions about the validity of the regulatory objectives, the reasonableness, basic fairness (due process) and nondiscriminatory nature of the regulations. Regulations that were deficient in other aspects were in several instances held to be a taking. The usual final test was, Did the regulations prevent all economic or reasonable use of the land? The entire parcel was generally examined, not just the area subject to flooding. Regulations which confined property to open space uses were sustained in a number of important decisions.

Preventing nuisances. Without exception, courts held that prevention of nuisances on private lands was not a taking. Regulations controlling uses that would be "nuisance like" in causing damage to adjacent lands or threatening public safety do not take any property right because landowners have no right to make nuisances of themselves. During the 1970s many cases upheld floodway and other regulations designed to prevent offsite nuisance-like effects even when those regulations prohibited all or essentially all economic use of lands.

Physical interference with private lands. In contrast with the decisions on nuisance prevention, courts have almost always held that public activities which physically interfere with private lands constitute a taking. For example, public construction of a dune on private land which had been damaged by a severe storm in March 1962, was held to be a taking. But several courts held that because regulations do not physically interfere with private lands, they do not constitute takings.

"Public use" of private land. Courts have usually held that natural conveyance of flood flows, flood storage, erosion control, and other passive flood hazard reduction functions are not public uses of private land that require compensation. As one court in a floodplain case noted, "[T]he State has not placed appellant's land in the path of floods, nature has". Floodplain regulations do not enhance any government enterprise.

Balancing private and public interests. Courts generally have balanced society's need for regulations against the impact of regulations on private landowners: severe impact on individual property owners can be justified when the public need is great. In recent years courts have come to rely increasingly on the legislative process to balance the needs and impacts and have minimized judicial oversight.

Equity in the distribution of benefits and burdens. Courts noted that government actions which "unfairly" burden a few for the good of the many may be held a taking, although during the decade no floodplain regulations were held invalid on equitable grounds alone. Two Supreme Court decisions and many lower court decisions on takings have stressed the need for equity in regulations.

Regulations adopted to serve regional, statewide, or national needs and which apply uniformly to flood-prone properties are less likely to be held a

taking. In finding that no taking had occurred, several courts emphasized the role of regulations as part of a broader plan or program.

Diminution in value. Courts held that regulations may diminish property values, but that at some point such diminution will constitute a taking. This test has been cited in many cases during the last decade, but rarely has it been more than one of several factors considered. Instead, courts have paid more attention to whether the regulations deny all reasonable use of the land.

Denial of all reasonable or economic use of land. The most common "final" test taking during the decade was whether regulations denied all "reasonable" or "economic" use of land. A detailed economic analysis was rarely undertaken. In a number of cases, courts have found that agriculture, forestry, and other open space uses were "reasonable" in certain contexts. Courts also held that the regulation's impact on an individual's entire property, not just the floodplain portion, must be considered in deciding whether reasonable uses remain. Although courts emphasized, as a matter of principle, that regulations must not prohibit all reasonable use, in several cases they held that proposed uses that would increase flood heights or would be subject to severe flood damages were not reasonable despite few remaining economic uses for the land.

No right to destroy the natural suitability of the land. Several courts held that landowners had no right to destroy the natural suitability or capability of lands. Hence, prohibition of uses threatening such suitability was not considered a taking.

c. Avoiding Legal Problems

During the 1980s state and local governments will be able to regulate floodplain areas with greater confidence because of the last decade's favorable court decisions on the taking issue, the sufficiency of floodplain enabling statutes, regulatory objectives, and maps. They can also adopt broader resource management programs with flood-hazard reduction components due to the widespread support for wetland, coastal zone, and other environmental regulations during the decade. Despite greater confidence, communities and states should carefully prepare and implement regulations to avoid legal problems. Where there are questions concerning the validity of adoption procedures (e.g., for resolutions) regulations should be readopted.

States and local governments should design programs to avoid inverse condemnation ("taking") problems. One way of doing this is to focus regulatory goals and standards upon the "nuisance" impacts of floodplain activities such as cumulative increases in flooding, pollution, or other damages to adjacent, upstream, or downstream lands. Courts have been sympathetic to regulations designed to prevent any increased damage to other lands, including not only traditional floodways but also zero-rise floodway restrictions, dune protection regulations, flood storage and stormwater detention regulations, strict control of chemical and gasoline storage and other hazardous and nuisance uses in the floodplain. The difficulties posed by the taking issue can also be diminished by applying regulations consistently to similarly situated properties and by distinguishing between

the application of regulations (controlling private use) and eminent domain powers (some measure of public use).

Comprehensive community planning and regulations and even-handed administration of regulations will also help to meet taking challenges because courts carefully examine the overall rationality and fairness of regulations in deciding whether a taking has occurred.

Governments should provide a sound factual base (maps and other data) for regulations and for the issuance and denial of permits since courts now examine the data base with increasing care. Floodplain maps should be upgraded as watershed conditions change, new flood data becomes available, or development pressures occur. Nevertheless, relatively small-scale and inaccurate maps may suffice where administrative procedures are available to upgrade data on a case-by-case basis as development permits are submitted.

It is also important that the raw data used to prepare maps be preserved for future support of regulations in court. Communities and states should retrieve such information from flood insurance study contractors before the data are lost. Contractors are required to keep it no longer than five years. It is also important that states and communities use experts in hydrology, water resources engineering, and other water-related subjects in fact finding to form the basis for issuance or denial of permits.

Governments should, to the extent possible, provide similar degrees of regulations for similarly situated flood-prone properties since courts are increasingly concerned with the fairness and equity of regulations. In general, regulatory agencies should define floodway lines to provide conveyance on both sides of a stream. However, mathematical precision is not necessary for setting boundaries. Uniform flood protection elevations should be applied to similarly flooded properties. Only when there are sound reasons should distinctions be made between similarly situated properties.

Regulations should be consistent with broader community and regional planning goals and guidelines. Courts more easily justify the rationale and equity of regulations that are based on soundly conceived short-term and long-term comprehensive data-gathering, planning, and regulatory programs. Comprehensive data gathering may include community-wide or regional resource inventories. Comprehensive planning may include that done for floodplain management, disaster mitigation, drainage, and land use management.

Governments should review floodplain permits and subdivision plans with care to avoid potential claims of liability which may arise if development increases flood heights. To avoid such liability, agencies may require that landowners whose activities increase flood heights on other lands purchase easements from other affected landowners. Governments should also define floodway boundaries to avoid substantial flood height increases. They should describe flood maps as approximate and warn that larger flood events may occur. Governments should also construct and operate drainage works, dikes, dams, and other flood control measures with increasing care in light of the emerging doctrines of municipal liability. In short, governments should avoid any action which may increase private flood damages.

2. Model Ordinance

The Southwest Florida Water Management District and the Center for Governmental Responsibility, University of Florida College of Law (1982), have prepared A Model Flood Management Ordinance which illustrates the principles discussed in this section and also includes a detailed commentary and legal analysis. Part I of the Ordinance, Findings of Fact and Objectives, is included in its entirety as Figure 5. It should be noted that "The model ordinance was developed primarily for inland, freshwater situations. It incorporates the minimal regulations for Coastal High Hazard Areas required by the NFIP... coastal communities should probably consider strengthening those sections, however, in view of the high hazard posed by hurricane forces and the instability of many coastal locations" (Southwest Florida Water Management District et al., 1982, p.13). The Findings and Objectives section (Figure 5) clearly shows the purpose of the regulation to be the protection of the public from the harmful effects of the prohibited use, rather than to acquire benefits for the public which it would not otherwise have.

G. FEDERAL PROGRAMS

The Federal Emergency Management Agency (FEMA) is the Federal agency responsible for coordinating emergency management at all levels of government. It has the statutory responsibility to deal with a broad range of hazards through mitigation, preparedness, response and recovery activities. These activities are embodied in each of the programs which FEMA administers.

Among the FEMA Programs are the Hurricane Preparedness Program, the National Flood Insurance Program (NFIP) and the Federal Disaster Assistance Program established by the Disaster Relief Act of 1974 (P.L. 93-288).

1. Hurricane Preparedness Program

The Hurricane Preparedness Program is FEMA's program to foster hurricane preparedness at high-risk, high-population areas by providing financial and technical assistance to state and local officials to conduct quantitative hurricane preparedness studies. This program includes a comprehensive planning study of the hurricane vulnerability and necessary response for a high-risk, high-population region, resulting in elements for state and local Emergency Operations Plans that provide the highest possible level of hurricane preparedness and evacuation capability. The study utilizes state of the art hurricane hazard planning tools and emergency transportation planning techniques and normally is composed of two projects; first, a Population Preparedness Project and subsequently, a Property Protection Project.

The State of New Jersey recently completed a vulnerabiltiy analysis and storm hazard mitigation plan for the barrier islands of Atlantic County and Ocean City (NJDEP, 1984a; NJDEP, 1985).

FIGURE 5: A MODEL FLOOD MANAGEMENT ORDINANCE

I. FINDINGS OF FACT AND OBJECTIVES

A. This ordinance is based on a finding of the following facts:

1. Because of variations in rainfall and the amount of surface water, flooding is a natural, recurring phenomenon.

2. Flooding and lands that are subject to flooding (flood prone lands) serve the following important functions in the regional hydrologic cycle and ecological system.

   a. Flood prone lands provide natural storage and conveyance of flood waters;
   b. The water on flooded lands may provide recharge to groundwater and is a basic source of flow to rivers, streams and estuaries;
   c. Temporary storage of surface waters on flood prone lands regulates flood elevations and the timing, velocity and rate of flood discharges;
   d. Flood prone lands maintain water quality by reducing erosion, removing nutrients and other pollutants and allowing sediment to settle;
   e. Natural flood prone lands export detritus and other food sources to open water bodies and are vital habitat for fish, birds, wildlife and native plant communities.

3. Uncontrolled development of flood prone lands inconsistent with their natural functions and improper management of flood waters have the following significant adverse impacts on the health, safety and welfare of the community:

   a. The owners of homes and business structures located in frequently flooded areas and their customers, guests, employees, children and future generations are subjected to unreasonable risk of personal injury and property damage.
   b. Expensive and dangerous search and rescue and disaster relief operations must be conducted when developed properties are flooded.
   c. Roads and utilities associated with development are subject to damage from flooding at great expense to taxpayers and rate payers.
   d. Flooding of developed properties leads to demands for government to construct expensive and environmentally damaging projects to control flood waters.
   e. Loss of natural water storage capacity leads to reduction in available water supply.
   f. The level, velocity, frequency and duration of flooding on other lands are often increased when flood waters are obstructed, diverted, displaced or channelized.
   g. Water quality is degraded, freshwater inflows to estuaries are disrupted and habitat is lost.
   h. Property values are lowered and economic activity is disrupted by damaging floods.

B. This ordinance has the following objectives:

1. To minimize the potential for property damage and personal injury from flooding;

2. To restrict adverse interference with the normal movement of surface waters;

3. To maintain the optimum storage capacity of watersheds;

4. To maintain desirable groundwater levels;

5. To maintain the natural hydrological and ecological functions of wetlands and other flood prone lands;

6. To prevent increased erosion and sedimentation;

7. To maintain water quality;

8. To protect the public from the economic and social disruption of flood damage;

9. To protect the public from the costs of flood relief;

10. To avoid the need to construct costly and environmentally disruptive flood management structures;

11. To assist the community in qualifying for participation in the National Flood Insurance Program.

C. The objectives of this ordinance are to be achieved by implementing a flood development review system that:

1. Restricts the construction of buildings in the most frequently flooded areas;

2. Requires the elevation or flood proofing of buildings in less frequently flooded areas;

3. Restricts interference with the normal movement of flood waters;

4. Restricts increases in the rate or volume of surface water discharge.

5. This ordinance is not intended to waive more stringent local regulations or the permitting requirements of any other governmental agency.

SOURCE: Southwest Florida Water Management District and The Center For Governmental Responsibility, University of Florida, College of Law, 1982

2. Disaster Assistance Program

The declaration of a major disaster or an emergency by the President authorizes Federal assistance under P.L. 93-288 and sets other Federal disaster relief programs into action. The flow chart in Figure 6 indicates the procedures taken once a disaster has been declared. FEMA can require various mitigation measures as a condition of disaster assistance.

FEMA promotes hazard mitigation immediately following a disaster through the activation of an intergovernmental interagency hazard mitigation team. The team surveys the disaster area, identifies hazard mitigation opportunities and makes recommendations concerning these opportunities. The team is composed of representatives of various federal agencies, state representatives and FEMA employees who coordinate team activities. The team draws upon its members' broad expertise in damage assessment and disaster recovery to identify mitigation opportunities and formulate recommendations incorporated into a report that is completed within fifteen days of a Presidential Disaster Declaration. The report includes team recommendations, identifies a lead agency responsible for implementation, and establishes a schedule for implementation and possible sources of funding or resources. A subsequent report is prepared by FEMA 90 days after the Disaster Declaration to monitor implementation of the initial recommendations and update them as appropriate.

State's which accept federal disaster assistance are required by Section 406 of the Disaster Relief Act to prepare long range hazard mitigation plans within 6 months of signing the federal/state agreement, following the declaration of a disaster. This hazard mitigation plan provides for activities designed to protect the health, safety and welfare of the citizens of New Jersey who reside in the affected counties, and to reduce future damage to public and private property. The plan is intended to serve as a guide to those federal, state and local government agencies responsible for instituting plans for the reduction of damage from coastal storms.

Thus the implementation of hazard mitigation plans is an important aspect of the Federal Disaster Assistance Program and the granting of disaster aid in the future may depend on the progress the state and municipalities have made in implementing these plans.

3. National Flood Insurance Program*

The FEMA program that normally provides the greatest opportunity for coastal storm and flood damage mitigation is the National Flood Insurance Program (NFIP). All of New Jersey's oceanfront municipalities participate in the NFIP.

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* Portions of this section are taken from Rhode Island Office of State Planning, 1984, The National Flood Insurance Program: A Handbook for Rhode Island Communities.

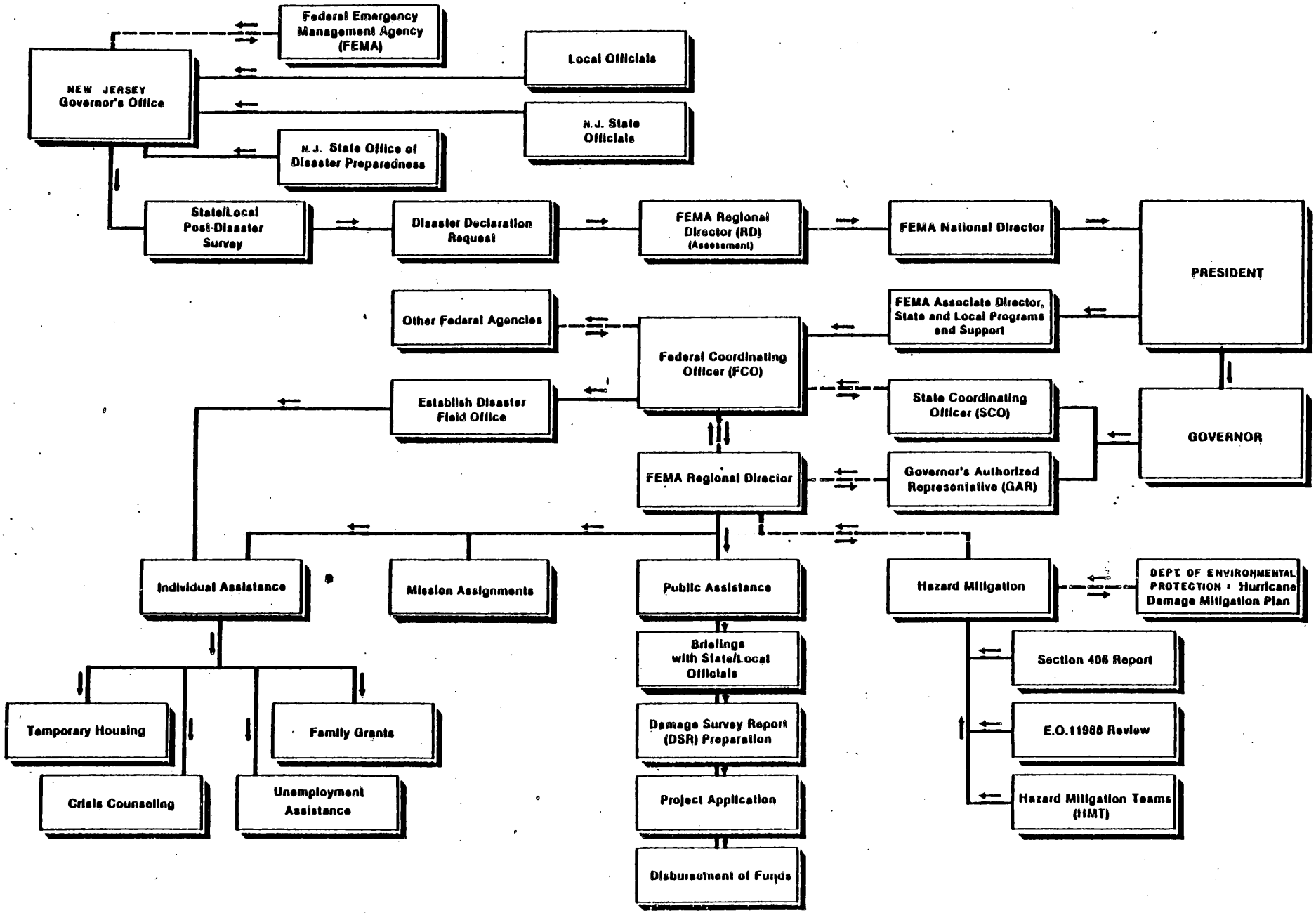

Figure 6

DISASTER RESPONSE FLOW CHART

SOURCE: LONG ISLAND REGIONAL PLANNING BOARD , 1984

The NFIP is a federal program which makes flood insurance available to owners of flood-prone property. Prior to the institution of the Program by Congress in 1968, flood insurance was not generally available at rates which the average homeowner or small business could afford. Congress felt that by providing floodplain property owners with insurance against future flood damages, it could alleviate the heavy financial burdens and economic distress which recurring flood disasters have traditionally created for individuals, local economies and for the nation as a whole.

In addition to making flood insurance available to current floodplain occupants, Congress also had the longer-range goal of reducing the drain on the federal treasury due to flood disaster relief efforts and expenditures for remedial flood control projects. To accomplish this, Congress linked the availability of low-cost insurance for floodplain dwellers and businesses to the institution of land use and construction practices designed to protect new construction and development from future flood damages.

Participation in the NFIP begins at the local level, with an agreement between a municipality and FEMA. The municipality agrees to adopt and enforce the NFIP floodplain management regulations (44 CFR 60.3) and FEMA agrees to sell flood insurance in the community. FEMA prepares Flood Insurance Rate Maps (FIFMs) which identify the flood prone areas in the municipality. The flood prone areas are based on a 100-year flood, which is a flood having a one percent change of being equalled or exceeded in any given year, or occurs on the average once every 100 years.

The NFIP regulations (CFR, Title 44, Ch. 1, Parts 59 and 60) define a Coastal High Hazard Area as an area subject to high velocity waters, including coastal storm and hurricane wave wash. These areas are identified on a FIRM as a Zone V1-30. More specifically, a Coastal High Hazard Area is an area capable of supporting at least a three foot high breaking wave. This criterion was established after tests by the U.S. Army Corps of Engineers indicated that waves of this height possess sufficient energy to damage structures of designs typically found in coastal areas. Wave runup areas can also be included in the V zones on FIRMs, but have not been in New Jersey.

Waves with heights of less than three feet can be expected to exist within the remaining portion of coastal flood hazard areas, (mapped as Zones A1-99) where the ground surface elevation is below the Base Flood Elevation or 100-year stillwater surge elevation.

Storm surge or stillwater surge is defined as the sea level rise above normal tide level on the open coast due to the action of wind stress and the reduction of atmospheric pressure on the water surface caused by coastal storms, particularly hurricanes (U.S. Army Corps of Engineers, 1977).

The NFIP Regulations (44 CFR 60.3) include design, performance and elevation standards for building in flood hazard areas. The regulations are to be enforced at the local level, which has been a weakness of the program in some areas, and must be incorporated into the ordinances of municipalities which participate in the NFIP. The regulations recognize the function of sand dunes as natural barriers that mitigate the effects of

coastal flooding and, therefore, require that the alteration of sand dunes in coastal high hazard areas (V zones) be prohibited if potential flood damage would be increased.

The local administration of the NFIP is monitored through the Community Assistance and Program Evaluation (CAPE) program, which in New Jersey is carried out by the Office of Floodplain Management in the Division of Water Resources. In addition, FEMA annually reviews information provided by participating communities pertaining to permits and variances granted. If FEMA finds that a municipality fails to adequately enforce the floodplain management regulations, it may place the municipality on probation or suspend it from the NFIP. If a community is suspended, no new flood insurance policies may be written and existing policies may not be renewed when they expire.

H. RECOMMENDATIONS

1. Because of the densely developed nature of the New Jersey coast and the associated high property values, hazard mitigation techniques may have to be implemented primarily as a post-storm program. It is important that coastal residents and officials now plan, develop and implement specific hazard mitigation plans in order for rational post-storm recovery and redevelopment to take place.

2. Coastal municipalities should reevaluate their master plans and zoning ordinances in light of storm vulnerability. The implementation of hazard mitigation strategies should be accomplished as part of the periodic master plan review and revision required under the Municipal Land Use Law.

3. Because funding for shore protection projects is very limited and shore protection costs are high, coastal municipalities that make a concerted effort to mitigate future storm damages should receive higher funding priority from the State. Shore protection funding and post storm recovery assistance may be contingent on local efforts to implement hazard mitigation strategies.

4. Staff of the New Jersey Department of Environmental Protection are available to assist municipalities in developing and implementing hazard mitigation techniques and educational programs. This support can consist of technical assistance (scientific and planning), expert witness testimony, and references on a wide range of subjects. In order for an effective hazard mitigation plan to be accepted and implemented, local residents must understand the concept. A public awareness/education program is needed for the public to learn why hazard mitigation is such an important planning element.

5. Each coastal municipality should request that FEMA include wave runup data on the Flood Insurance Rate Maps. This data will more accurately determine coastal high hazard areas. Non-water oriented development should be prohibited in coastal high hazard areas.

6. Coastal municipalities should initiate a structural inspection program to determine whether buildings are adequately anchored to foundations. Guidelines for the inspections, as well as remedial measures, should be

developed by the local building officials and the New Jersey Department of Environmental Protection.

7. Each oceanfront municipality should adopt and enforce an effective beach and dune ordinance to protect the beach area and promote dune building, planting and maintenance. The building restriction line should be subject to periodic review, particularly after major storms. A thorough, well written dune ordinance can be a very effective management tool. Property assessments should reflect development potential under such an ordinance.

8. Dune fields should be created where possible using standard fencing and planting techniques, thus providing additional protection for landward development. Where dunes already exist, maintenance and enhancement through fencing, planting and closing gaps will improve the protective capacity of the dune system. Wooden walkovers or angled walkways should be used to gain beach access.

9. Each oceanfront municipality should establish oceanfront setbacks. Setback lines can be measured from bulkheads, seawalls or boardwalks, and should be at least 25-50 feet landward of these structures, depending on beach and nearshore profiles.

10. Oceanfront property should be acquired for conservation purposes whenever possible. The acquisition and conservation should not be limited to the beachfront but should also include building lots adjacent to the beachfront. The New Jersey Green Acres Program often purchases property, especially along the beachfront, for conservation and recreation use.

11. All oceanfront property presently in municipal ownership should be retained in municipal ownership, preferably for open space or recreational use.

12. Property owners should be advised to install protective shutters on windows and glass doors and minimize use of wide paned glass.

13. Municipalities should institute programs for inspection, repair and reinforcement of bulkheads and seawalls.

14. Peak population in some oceanfront municipalities is estimated to approach or exceed that which can be evacuated within the anticipated warning time of a hurricane strike. Each municipality should review its zoning in terms of maximum population at full build out and consider downzoning.

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APPENDIX I

FEDERAL, STATE AND COUNTY CONTACTS

The following is a list of the various federal, state and county agencies which are available to provide information and assistance in analyzing and responding to coastal storm hazards and flooding problems.

Federal Agencies

Federal Emergency Management Agency
Region II
26 Federal Plaza
New York, N.Y. 10278
(212) 264-8395

Technical Assistance

U.S. Army Corps of Engineers

a) New York District
26 Federal Plaza
New York, N.Y. 10007
(212) 264-0100

b) Philadelphia District
U.S. Custom House
2nd & Chestnut Streets
Philadelphia, PA 19106
(215) 597-4848

Technical Assistance

U.S. Geological Survey
Water Resources Division
P.O. Box 1238
RM. 420, Federal Building
402 East State Street
Trenton, N.J. 08607

State Agencies

Flood Insurance and NFIP Regulations

New Jersey Department of Environmental Protection
Division of Water Resources
CN 029
Trenton, N.J. 08625
(609) 292-1840

Coastal Management/ Planning

New Jersey Department of Environmental Protection
Division of Coastal Resources
CN 401
Trenton, N.J. 08625
(609) 984-0856

Emergency Management, Evacuation Planning	New Jersey Department of Law & Public Safety Division of State Police Office of Emergency Management P.O. Box 7068 West Trenton, N.J. 08625 (609) 882-2000 Ext. 201

County Agencies

Planning, state/federal coordination, evacuation

Monmouth County	Planning Board P.O. Box 1255 Freehold, N.J. 07728 (201) 431-7460
	Office of Emergency Management Hall of Records Annex, Main St. Freehold, N.J. 07728 (201) 431-7400
Ocean County	Planning Board CN 2191 Toms River, N.J. 08753 (201) 929-2054
	Office of Emergency Management Robert J. Miller Air Park Rt. 530 Berkeley Twp., N.J. 08721 (201) 341-3451
Atlantic County	Planning Board 1333 Atlantic Ave Atlantic City, N.J. 08401 (609) 345-6700
	Office of Emergency Management 201 Dolphin Ave. Northfield, N.J. 08225 (609) 645-7700 Ext. 4470
Cape May County	Planning Board Library Building Cape May Court House, N.J. 08210 (609) 465-7111
	Office of Emergency Management Library Building Cape May Court House, N.J. 08210 (609) 465-9408

APPENDIX II

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