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Coastal Flood Hazards and the National Flood Insurance Program

Office of Federal Insurance Administration
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COASTAL FLOOD HAZARDS

AND THE

NATIONAL FLOOD INSURANCE PROGRAM

H. Crane Miller
Washington, D.C.

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TABLE OF CONTENTS

Page

Executive Summary i

Introduction 1

Physical Setting of the Coastal High Hazard Zone 3

Beaches 3
Sand dunes 5
Hurricanes, barrier islands, beaches and dunes 7
Coastal Wetlands 9

Trends in Federal Strategies for Flood Loss Management 10

Trends in Coastal Management 13

The National Flood Insurance Program 14

Background of legislative efforts 14
Flood Disaster Protection Act of 1973 15
Emergency Program 15
Regular Program 16
When Flood Insurance Is Required 16
Flood Plain Management Measures 16
(a) Emergency Program Minimum Flood Plain Management Requirements .. 17
(b) Flood Hazard Boundary Maps: Additional Requirements 17
(c) Flood Insurance Rate Maps and the Regular Program 18
(d) Coastal High Hazard Zones 19

Experience, Expectations and Decisions in Coastal and Riverine Flood Plains -- The Wharton School Field Survey 22

Population Characteristics 23
Field Survey Characteristics 24
Uninsureds' Expectations of Federal Aid 24
Post-Disaster Sources of Recovery Funds 24
Role of Past Experience 25
Past Damages 27
Expectations of Future Damages 28
Attitudes toward Rebuilding 28
Government Responsibility for Personal Losses 29
Protective Measures 30

Impacts of the National Flood Insurance Program in Fifteen Coastal Communities 32

Does the National Flood Insurance Program support non-federal efforts to reduce flood damages which are more restrictive than the Program's requirements? 32

How do the Program's actuarial rates and flood plain management regulatory requirements affect demand for property and construction practices? 37

Page

What is the effect of the National Flood Insurance Program on property values? 41

What is the effect of the National Flood Insurance Program on lending practices? 41

Implications of the National Flood Insurance Program for Coastal Communities 42

Implications for coastal high hazard zone management 43
Graduated actuarial rates 46
Implications for financing and lending practices 47
Implications for technical information 47
1. Maps 47
2. Wave action effects 49

Tables

Table 1. Population Density in Counties within 50 miles of Coastal Shorelines: 1940 - 1973 1
Table 2. Maximum Amount of Flood Insurance Available 16a
Table 3. Recovery from Past Most Serious Disaster 26
Table 4. Perception of the Flood Problem 25
Table 5. Past Damage to Present Home 27
Table 6. Distribution of Expected Damage to Property from a Future "Severe" Disaster 28
Table 7. Attitudes toward Rebuilding on the Same Site if the House Were Destroyed 29
Table 8. Attitude toward Government Responsibility for Personal Losses 30
Table 9. Homeowners' Adoption of Protective Measures 31
Table 10. Atlantic and Gulf of Mexico Coastal Communities in the Regular Phase of the National Flood Insurance Program as of April 15, 1977 ..... 32a
Table 11. Actuarial costs of flood insurance 38

Figures

Figure 1. Market Preference 1
Figure 2. Standard Beach Profile 3
Figure 3. The effects of various structures on the transport of sand along ocean shorelines (littoral drift) 4
Figure 4. Recession of beachfront in response to relative rise in sea level 5
Figure 5. Diagrammatic cross sections of generalized beach types occurring on barrier islands 6
Figure 6. Cross sections of typical Rhode Island sand barriers 6
Figure 7. Schematic diagram of storm wave attack on beach and dune .. 8

COASTAL FLOOD HAZARDS AND THE NATIONAL FLOOD INSURANCE PROGRAM

H. Crane Miller

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Executive Summary

From New Hampshire to Florida, and virtually the entire coast of the Gulf of Mexico, our shoreline is a succession of low-lying barrier islands, beaches, sand dunes, bluffs, and unconsolidated landforms. They are the front line of storm defense for a thousand miles of United States Atlantic and Gulf of Mexico coastline. The low-lying lands immediately adjacent to the open oceans are hostile environments for man to build in. The combination of coastal storm surges, wave action, battering by debris, scouring, and high winds makes development highly hazardous in such coastal areas.

The coastal area of the United States is richly endowed with natural resources, abundant wildlife, agricultural lands, commercial and sport fishing resources, and diverse recreational potential. These and other features have attracted nearly 53% of our total national population to our coastal communities. Demand for property with easy access to beaches and the ocean has grown tremendously during the last 25 years. Those years have been remarkably quiet in terms of major hurricane activity -- the last major storms on the Atlantic coast were during the 1950s; those in the Gulf of Mexico in the 1960s. Major shifts in U.S. population to coastal areas have occurred during that quiescent period, so that more than 80 percent of those presently living in the coastal areas of the Atlantic and the Gulf of Mexico have never experienced a major hurricane. When the quiet cycle ends, many coastal areas will sustain heavier damages than ever before because of the influx of population and development. Such coastal damages will, in turn, test the effectiveness of federal flood loss management strategies.

Flood loss management strategies adopted by the Federal Government have evolved from the 19th Century strategy of virtually no government responsibility for flood loss management, through the high degree of federal involvement in emplacement of flood control structures pursuant to the Flood Control Act of 1936 and in federal disaster relief assistance, to the current attempt to shift some of the cost of flood losses to those at risk on our flood plains. Increased encroachments on our flood plains led to mounting annual flood losses and federal disaster relief assistance payments. The National Flood Insurance Program is one attempt to reduce flood loss susceptibility through flood plain management, to reduce federal disaster relief assistance costs, and to shift some of the burden of flood losses to those whose presence on our flood plains creates the losses. Some impacts of the Program in coastal communities are reported here.

Operation of the National Flood Insurance Program in three Rhode Island coastal communities studied by the author in 1975 indicated a number of counter-productive forces to the goals of the Program. In response, the Federal Insurance Administration questioned extrapolation of the Rhode Island experience to all of the nation's coasts, but expressed concern that phenomena found there might be more widespread. It proposed to investigate the effects of flood insurance availability at several points along the U.S. coast, and to perform a random investigation of coastal development to determine the impact of flood insurance on the acquisition or construction of coastal properties. The author's ensuing study, reported here, has combined field investigations of fifteen coastal communities with survey data obtained by the Wharton School of Finance of the University of Pennsylvania.

The results of the Wharton School survey permitted comparisons between coastal and riverine areas regarding flooding experience and respondents' expectations of flood hazards, the seriousness with which they view riverine and coastal flooding, their anticipation of federal aid for disaster losses, attitudes toward adoption of protective measures, and a number of other variables. They indicate sharp contrasts between a number of coastal and riverine flooding characteristics.

The Wharton School survey found the following population and field survey characteristics:

Population characteristics.

Houses. Coastal properties tended to be held and lived in longer than riverine houses; coastal homeowners were more likely to rebuild in the same place after a severe disaster, and were less likely to move in the next five years.

Values. As one approached the coast houses and properties became more expensive. Housing values tended to appreciate faster in coastal and riverine high hazard areas than in less hazardous regions.

Structural and contents damages. While the percentage of coastal owners who have suffered structural damage was slightly greater than the percentage of riverine owners (20 vs. 16 percent), average per capita coastal total damages in special flood hazard (A Zones) and coastal high hazard areas (V Zones) were more than double comparable riverine zones ($12,300 coastal vs. $5,400 riverine). Coastal and riverine contents damage experience was almost equal (20.4 percent vs. 20.5 percent riverine), but per capita contents damage for those who had damage was more than three times as high in coastal A and V Zones than in riverine A Zones ($7,300 coastal vs. $2,300 riverine).

Field Survey Characteristics.

Uninsureds' expectations of federal aid. In both riverine and coastal surveys uninsured homeowners had consistently low expectations of Federal aid for future damages (76 percent expected no federal aid for damages under $10,000, and about 60 percent expected none for damages over $10,000). Generally, the survey indicated that the less damage anticipated, the less likely uninsured respondents expected to turn to the federal government for financial assistance after a flood disaster.

Post-disaster sources of recovery funds. In damage categories above $10,000, neither insured nor uninsured victims tended to recover fully financially, considering all forms of insurance reported (flood, wind, and vehicle), government loans, savings, and bank loans as sources of post-disaster recovery funds. Insured victims tended to recover less fully than uninsureds in the highest damage categories above $10,000, for reasons not revealed by the survey data.

Perception of the flood problem -- role of past experience. Past experience was found to be the most important variable in alerting individuals to the seriousness of a natural hazard. Those who insured tended to see flooding as a serious problem; uninsureds did not. The principal contrasts were the perceptions of riverine and coastal insureds. Seventy-five percent of riverine

insureds viewed riverine flooding as serious vs. 53 percent of all coastal insureds.

Past damages to present home. Past damages to respondents' present homes were the most important factor in individuals' perception of seriousness of flooding problems and their decision to purchase flood insurance. High percentages of both coastal and riverine uninsured owners have experienced no past damages (81 percent and 82 percent, respectively). Among insured owners, 77 percent of coastal owners had experienced no damages, in contrast to 41 percent of insured riverine owners who had sustained no past damage.

Coastal respondents (both insured and uninsured) tended to sustain damages greater than $5,000; riverine respondents tended to sustain more damages in the range below $5,000 than did their coastal counterparts.

Expectations of future damage. Expectations of future damage varied according to flooding experience and also showed contrasts between riverine and coastal settings. As with past damages, homeowners in riverine areas expect less damage than those in coastal areas for both the experienced and inexperienced groups. Expectations of future riverine damage were greatest on the lower end of the damage scale (below $10,000); expectations of future coastal damage were greatest on the upper end (above $10,000).

Government responsibility for personal losses. People living in coastal flood hazard areas tended to expect less government responsibility for paying personal damage losses than did their riverine counterparts. These differences exist whether the individuals are experienced or inexperienced, insured or uninsured.

Adoption of protective measures. Coastal homeowners (22 percent) were less likely to adopt protective measures than riverine respondents (36 percent); coastal respondents who did take protective action typically spent more per action than riverine respondents -- $1,620 (coastal average) vs. $1,030 (riverine average).

Only a small portion of the Wharton School survey data could be analyzed, but the data tend to demonstrate that people's reactions to coastal and riverine flooding characteristics are distinctly different. The data also tend to support the notion that models of economic rationality do not apply well to people's voluntary decisions in these situations, particularly in our coastal areas. As noted by Howard Kunreuther, who directed the Wharton School study, the findings suggest that in developing institutional mechanisms for shifting risks involving low-probability events, considerably more emphasis must be placed on the demand side of the market. We are only beginning to learn about the quality and quantity of information available and used by individuals in making voluntary decisions with respect to natural hazards.

Does the NFIP Support More Restrictive, Nonfederal Efforts?

The Rhode Island experience that gave rise to the author's studies showed the FIA's emergency program regulations to be "totally inadequate". Rhode Island officials asserted that FIA's regulations stimulated shorefront development; the regular program regulations were less than compatible with sound coastal management objectives insofar as they tacitly affirm development in coastal high

hazard areas. Communities imposing more restrictive regulations than required by the FIA must do so without positive leverage exerted by the National Flood Insurance Program in all of its regulatory, financial, and insurance aspects.

That experience was not prevalent elsewhere in the communities studied. However, the reason appears to be that none of the other states or communities studied have more stringent requirements than FIA's minimum standards, nor have they advanced in coastal management to the same extent as Rhode Island. Both states and communities tend to treat the FIA minimum flood plain management requirements as maximum requirements. Most of the state coastal zone management plans or proposals reviewed have not extended coastal flood plain management beyond the FIA minimum requirements.

The Rhode Island experience suggests a need for an active, affirmative role by FIA to support good flood plain management, with explicit authority to make its minimum requirements consistent with more stringent state or local requirements. FIA's regulations currently "encourage" more restrictive standards than their minimum requirements. However, the consistent response from both state and local officials interviewed was that they need positive political leverage exerted by the National Flood Insurance Program if they are to strengthen their flood plain management measures.

Enforcement. Throughout the study communities there was a high degree of enforcement of existing FIA regulations, corroborated by state and local officials, lending institutions, realtors and developers, and community records. For instance, with the exception of the four Florida Gulf coast communities, few flood elevation variances have been granted in the study communities. Where variances were being granted there was a growing, although not prevalent, trend that homeowners were comparing the costs of elevating their homes against the annual cost of flood insurance, and were deciding to elevate.

There was also limited evidence that failure to elevate adversely affected the later saleability of a home, encouraging developers to comply with the minimum flood elevation requirements.

A perceived willingness of most local officials interviewed to support more stringent regulations if FIA requires them was noted consistently throughout the study area. The basic motivation for this was the importance of federally assisted financing to each community, the concern that such financing might be suspended, and a perception that their communities were vulnerable to coastal storms the next time one occurs.

Financial community response. Federally assisted financing is basic to the force of the National Flood Insurance Program. Financial institutions consistently reported a difficult initial period with the Program, characterized by confusion, lack of maps and difficulties in using those that they had, and client difficulties in obtaining coverage. Almost all reported that after a turbulent beginning, lending procedures involving flood insurance settled into a routine and normal part of processing loans. Financial institution support and enforcement are key to the operation of the Program; lending institutions may be the prime enforcer of the Program.

Undergirding a high degree of financial institution support for the Program in coastal areas is that flood insurance has had no discernible negative impact

on demand in their experience.

How Do Rates and Flood Plain Management Requirements Affect Demand?

Actuarial rates and demand. No evidence was found during the study that current actuarial rates depress demand for coastal property. Realtors and lenders in each community reported that they could discern no decrease in demand for coastal properties attributable to the cost of flood insurance. The period from 1972 to the present, when most of the study communities entered the regular flood insurance program, was marked by the peaking of the real estate "boom" and the depressing effects of the recession. Those high growth and depressing forces would have overwhelmed any possible depressing effect of the actuarial rates.

The key variable whether flood insurance increases demand for coastal property appears to be local lending practices. If local lending institutions previously refused to take mortgages in flood hazard areas before the community entered the National Flood Insurance Program (as occurred in Rhode Island and Galveston), but changed their lending practices after the community entered, there is an immediate and direct cause/effect relationship on demand for property in the former flood hazard mortgage exclusion area.

Flood plain management requirements and demand for coastal property. No evidence was found of any decrease or direct increase in demand for coastal property attributable to existing FIA regulations. Existing flood plain management requirements directly affect construction practices; evidence is strong and observable that the study communities are complying substantially with the existing FIA minimum requirements. However, existing flood plain management requirements do not affect where coastal flood plain development is taking place.

Effect of the National Flood Insurance Program on property values. Where there is a direct cause and effect relationship between the availability of flood insurance and the availability of financing for development, the effect of the National Flood Insurance Program is to increase property values of theretofore undeveloped land. Where lending institutions have not previously restricted financing in coastal flood hazard areas, the values of the real estate market prevail, adjusted by the additional costs of complying with the flood plain management requirements.

No consistent pattern of cost to comply with the FIA elevation requirements emerged from interviews with developers. The primary impact of flood proofing appears to be on structures selling for less than $40,000, where it is more likely that the quality of materials, equipment, and other items will decrease than that the cost of the structure will increase.

Effect of the National Flood Insurance Program on lending practices. In most coastal communities, the National Flood Insurance Program has not affected basic investment decisions as to the availability of financing. In such communities the principal change in lending practices wrought by the National Flood Insurance Program is the requirement of flood insurance as a condition of financing, which the financial community has accepted, and enforced, both because it is mandatory and because it provided additional security for their loans.

Implications of the National Flood Insurance Program for Coastal Communities.

The Congress recently amended §202(b) of the Flood Disaster Protection Act of 1973, removing the prohibition against federally assisted financing for individuals whose communities were not participating in the National Flood Insurance Program. It is too early to predict what impact amendment of §202(b) will have in coastal communities. Based on past coastal community voluntary entry into the Program, the author believes that relatively few coastal communities bordering the Atlantic and the Gulf of Mexico will revoke their participation in the Program.

One impact of the repeal is fairly predictable -- it will be increasingly difficult both for the Federal Insurance Administration and for local communities to strengthen their flood plain management regulations beyond the minimum requirements now in force.

The Congress having spoken forcefully in amending §202(b) of the Flood Disaster Protection Act of 1973, the predominant strategy called for over the next two to four years may be to acknowledge and improve upon the gains that have been made, and work to encourage as high a degree of community participation and compliance with the current regulations as possible.

Should it be deemed possible to strengthen FIA's flood plain management regulations without inducing a mass exodus of communities from the Program, certain concepts and proposals should be considered:

- no development in vital coastal areas needed for habitat, natural system productivity, or the structural integrity of the coast.

- hurricane resistant building standards graduated according to hazard zones, perhaps adapted from model minimum hurricane-resistant building standards proposed by the Texas Coastal & Marine Council.

- actuarial rates in coastal high hazard areas graduated according to hazard zones, with appropriate adjustments or incentives for compliance with hurricane resistant building standards.

- use of aerial photograph maps for flood hazard area delineation, and multiple-purpose cartography for more comprehensive management purposes such as encouraged by FIA in §1910.22 of its regulations.

- study by the National Academy of Sciences/National Research Council of wave runup and the effect of storm wave action on buildings and structures or on land features, including an evaluation of the concept of graduated hazard element zones and hurricane-resistant building standards for adoption and adaptation by the Federal Insurance Administration.

COASTAL FLOOD HAZARDS AND THE NATIONAL FLOOD INSURANCE PROGRAM

Introduction. From New Hampshire to Florida, and virtually the entire coast of the Gulf of Mexico, our shoreline is a succession of low-lying barrier islands, beaches, sand dunes, bluffs, and unconsolidated landforms.

> "The natural properties of barrier islands provide an absolutely unique combination of values. These islands are the front line of storm defense for a thousand miles of United States Atlantic and Gulf of Mexico coastline. They have scenic qualities -- vividness, variety, and unity -- unparalleled elsewhere in the coastal zone. They offer broad sandy beaches and a score of other recreational opportunities. They provide habitats and food for unique biotic communities -- hundreds of species of coastal birds, fish, shellfish, reptiles, and mammals." [John Clark, The Conservation Foundation, Coastal Ecosystem Management, John Wiley & Sons, New York (1977)].

The coastal area is further characterized by interconnecting natural and manmade waterways, bays, lagoons, and estuaries, and tidal wetlands, including mangrove stands. Richly endowed with natural resources, abundant wildlife, agricultural lands, commercial and sport fishing resources, and diverse recreational potential, nearly 53% of our total national population resides in our coastal counties, cities, and local communities.

While the percentage of our total population living in coastal counties and communities may be decreasing slightly, the Bureau of the Census reports that the population density in counties within 50 miles of coastal shorelines continues to increase, as shown in Table 1:

Table 1

Population Density in Counties within 50 Miles of Coastal Shorelines: 1940 - 1973

Population per square mile:	Total Coastal	Atlantic	Pacific	Great Lakes	Gulf of Mexico	Balance of U.S.
1940	131.0	245.9	64.1	146.9	44.8	28.5
1950	159.1	284.6	97.6	169.8	59.8	30.9
1960	201.0	344.0	142.7	205.7	83.1	34.3
1970	235.1	397.6	182.3	228.4	101.0	37.5
1973	241.1	406.3	187.5	230.7	109.2	39.5

Source: U.S. Bureau of the Census, Statistical Abstract of the United States, 1976, at p. 9.

Population densities in coastal counties not only exceed those for the balance of the United States in absolute terms, but their growth rate has also exceeded the rest of the country during the same 34-year period. While the density for the balance of the U.S. grew 138% from 1940 - 1973, the total coastal

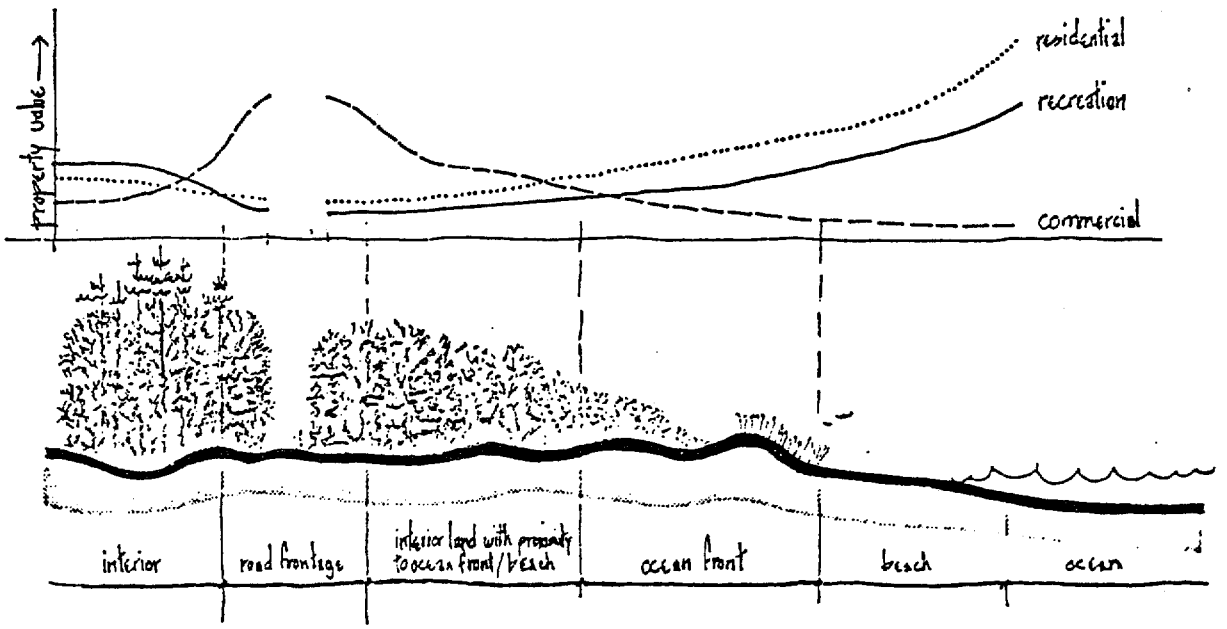
density grew 184%, ranging from 165% along the Atlantic coast to 292% along the Pacific coast.

Much of the Pacific coastal area is vulnerable to tsunamis, earthquakes, and natural forces that can trigger destructive slides along steep, eroding bluffs; long coastal reaches of the Great Lakes are subject to severe erosion and damages from winter storms. This report, however, focuses particularly on the coastal high hazard zones of the Atlantic and Gulf coasts because of their exposure to hurricanes, their history of severe damages from hurricanes and other more frequent storms, and the high developmental pressure being experienced along those coasts.

Increased population density is a particular problem in that part of the coastal zone that is closest to the sea. That area, which for convenience is called the coastal high hazard zone, is physically very dynamic, subject to hurricanes, winter and other storms which cause severe damage from wind, waves, erosion and scouring, and battering by debris. The area is subject also to high demand for residential, commercial, recreational, and other development.

Drawn by scenic beauty, recreation, and other values, a common pattern in coastal areas places the highest land values on oceanfront properties. Market preference for coastal property is graphically displayed in the accompanying figure taken from a permit application for Kiawah Island, South Carolina:

Figure 1: MARKET PREFERENCE



Source: Planned Development District Application
Kiawah Beach Company, Charleston, S.C. (1974)

In their application the developers of Kiawah Island articulated well a basic demand that is being experienced in many coastal areas of the United States:

> "Perhaps the foremost consideration in Coastal Shores' decision to acquire the island is the great market demand for ocean-related resort and residential opportunities. This fundamental human urge to vacation, or preferably live near the ocean has led to the dramatic increase in new, ocean-related communities along the South Atlantic Coast. Swimming, fishing, sailing, sunbathing, beachcombing and other water-based activities are the most important recreation activities for most Americans according to the Bureau of Outdoor Recreation. [Planned Development District Application, Kiawah Beach Company, Charleston, S.C. (1974), vol. 1 at p. 37].

Physical Setting of the Coastal High Hazard Zone. Where the coastline exposed to the open ocean is characterized by barrier islands, beaches, sand dunes, and other unconsolidated landforms, particular attention must be directed for planning, development, management, and other purposes. Such areas are highly dynamic in response to the actions of wind and sea. Stabilizing them with flood control and erosion control structures or with houses or other buildings basically interferes with the dynamic coastal processes, frequently compounding damage to the areas and buildings that were to be protected.

Beaches. Beaches exist in a state of dynamic balance, continually changing in response to the erosive forces of storms, winds, and waves, and adjusting back to equilibrium through the restorative forces of tides and currents. (See Figure 2 for a profile, description, and nomenclature of the standard beach).

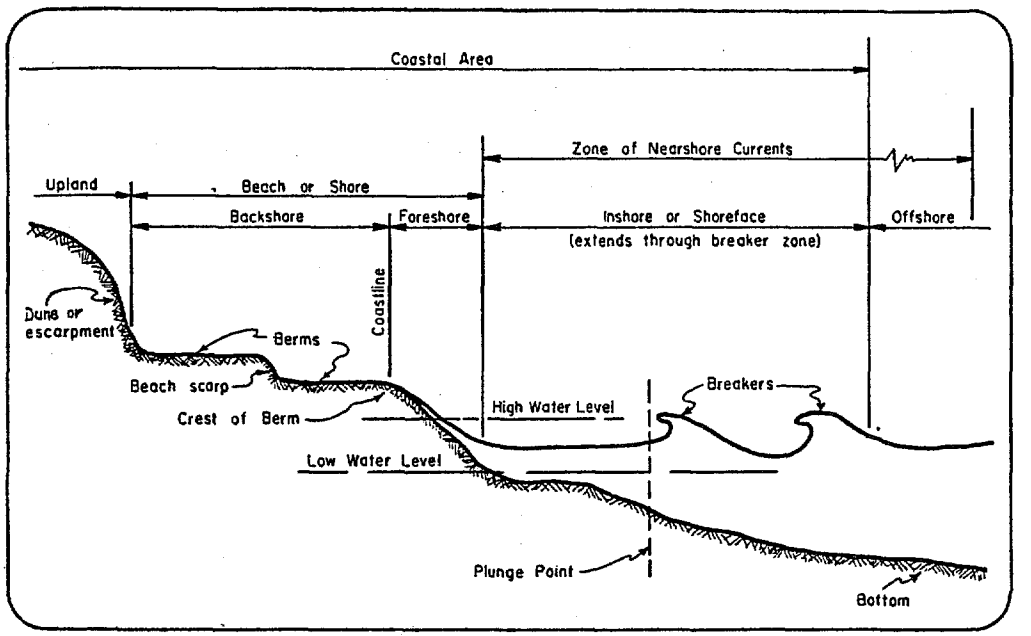


Figure 2. Standard beach profile -- description and nomenclature. Source: Department of the Army, Corps of Engineers. "Shore Protection Guidelines", National Shoreline Study, August 1971

"Long-term stability is gained by holding the slope or profile intact through balancing the sand reserves held in various storage elements'-- dune, berm, offshore bar, and so forth. Each component of the beach profile is capable of receiving, storing, and giving sand, depending on which of several constantly changing forces is dominant at the moment. Stability is fostered by maintaining the storage capacity of each of the components at the highest level.

"When storm waves carve away a beach, they are taking sand out of storage. In the optimum natural state there is enough sand storage capacity in the berm or dune to replace the sand lost from the beach to storms. Consequently, the effects are usually temporary, with the dune or berm gradually building up again." [John Clark, op. cit. at pp. 320 - 321].

Waves and currents are natural parts of the everchanging beach. During the summer waves carry sand onto the beach and help build it up. During the winter larger, higher energy waves cut into the beach, carry sand offshore, and may create one or more sand bars parallel to the beach. Longshore currents also affect the beach, created in part by waves striking the beach at an angle, putting sand in suspension, and carrying the sand alongshore. While the direction will shift from day to day or season to season, over the long term waves dominate from a given direction and produce a net drift up or down the beach. Where groins, jetties, or other structures obstruct the longshore drift of sand, characteristically one finds sand accumulated on the upcurrent side of the structure, and erosion immediately on the downcurrent side. (See Figure 3).

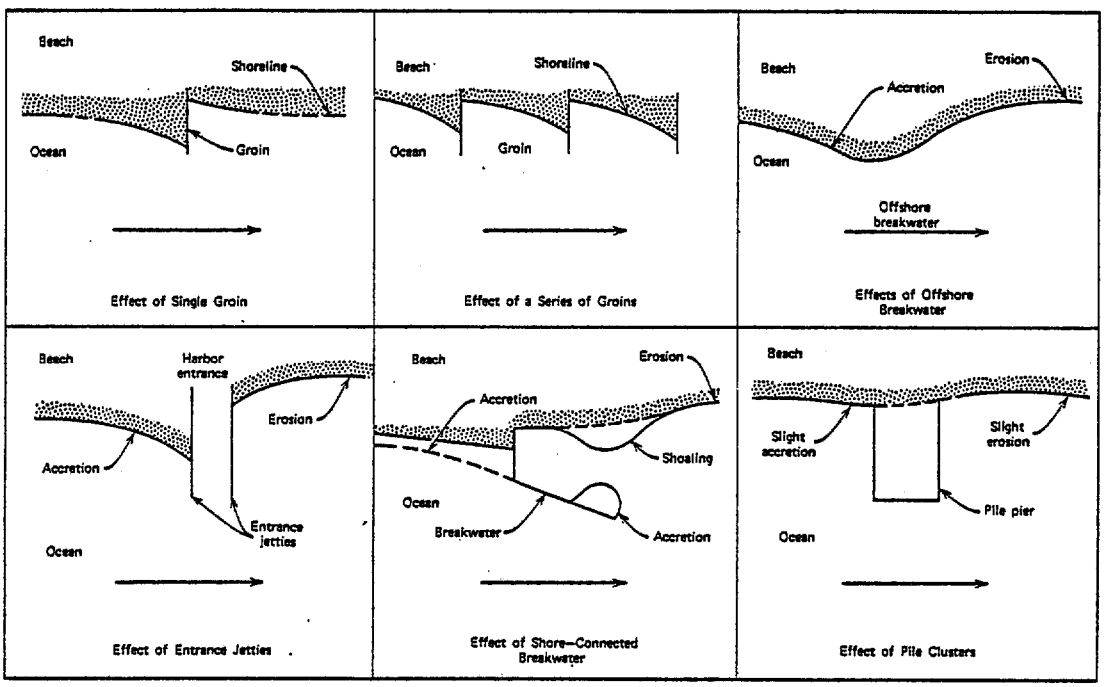


Figure 3. The effects of various structures on the transport of sand along ocean shorelines (littoral drift). Source: John Clark, The Conservation Foundation, "Coastal Ecosystem Management", John Wiley & Sons, New York (1977)

Much of the sandy shoreline of the United States is receding before the sea, as the relative sea level rises. The increase averages about 2 inches for United States coasts in the past 35 years, or 0.5 feet per century. One of the study communities, Galveston. is experiencing an average sea level increase of 1.4 feet per century. The effect of increased sea height is to force the beach inland at a rate that may vary from 30 - 100 feet per century, a natural recession that must be taken into account in planning, development, and management. (See Figure 4).

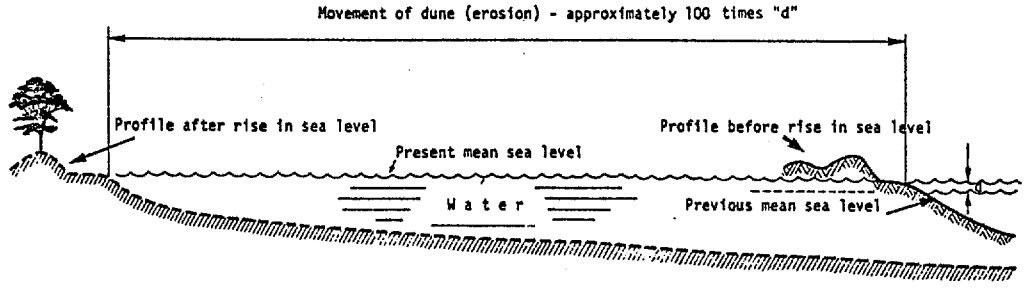


Figure 4. Recession of beachfront in response to a relative rise in sea level (Bogue Banks, N.C.). Source: Clark, op. cit.

Sand dunes. Behind the beaches are frequently found sand dunes developed from sand blown off the beach and accumulated around beachgrass, snowfences, or other semipermeable objects. Dunes have a variety of sizes and shapes: sometimes they are small, flat ridges, such as found on the west coast of Florida, and are difficult to distinguish from parts of the beach; others are large, well developed, and active, that is, visibly gaining or losing sand. (See Figures 5 and 6, on p. 6).

> "Dunes and lesser beach ridges serve as storage areas for sand to replace that eroded by waves or torn away by storms and thus provide long-term stability to the shorefront. Because dune formations are fragile, activities of man that cause even slight alterations to them may lead to significant disruptions." [John Clark, op. cit., at p. 96]

On dune lines successions of vegetation change from grasses on the frontal dune to forest communities on the back dunes. Vegetation traps sand, thereby expanding the dune and its reserve of sand. Frontal dunes tend to remain mobile and are less vegetated; back dunes tend to become stabilized by the heavier vegetation -- perennial shrubs, trees, and vines.

Owing to their fragile qualities and their susceptibility to destruction from development, management strategies generally place many constraints on their use. Vegetation should be kept intact, for it is critical to the stability and growth of dunes. All vehicle and foot traffic should be strictly controlled, limited to well defined areas, or prohibited altogether. Roads, highways, houses or other permanent development should be placed well inland of active dune systems, providing a buffer area to allow for dune movement. Removal of sand from any storage element of the beach, berm, or dune system should be prohibited, in order to preserve their natural buffering function

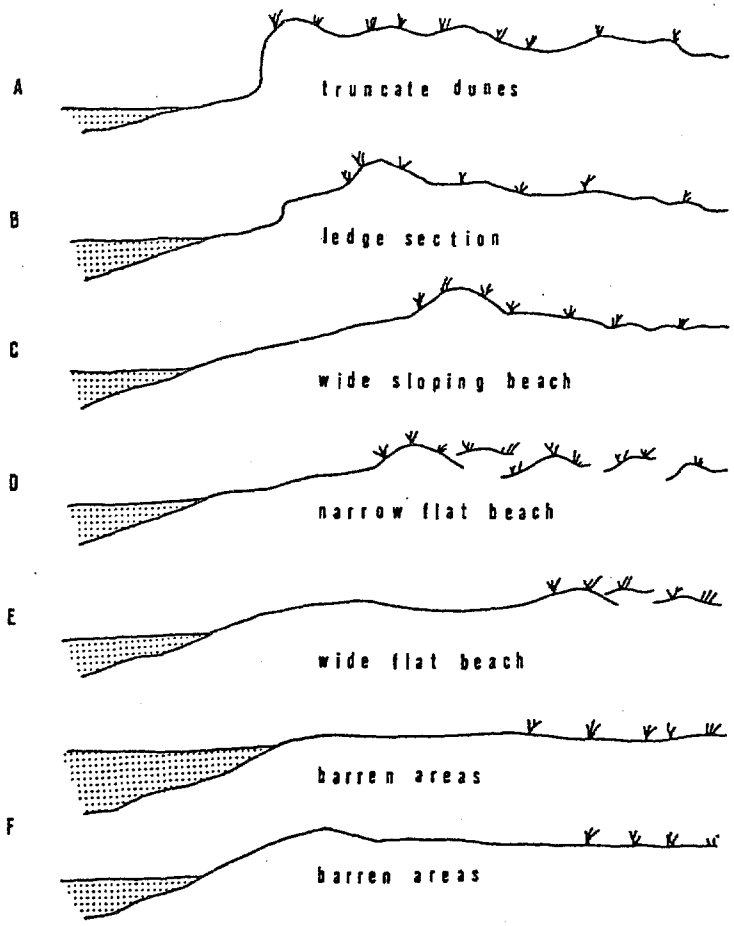


Figure 5. Diagrammatic cross sections of generalized beach types occurring on barrier islands. Source: A. Sydney Johnson, et al., An Ecological Survey of the Coastal Region of Georgia, National Park Service, Scientific Monograph Series No. 3, Washington, D.C.

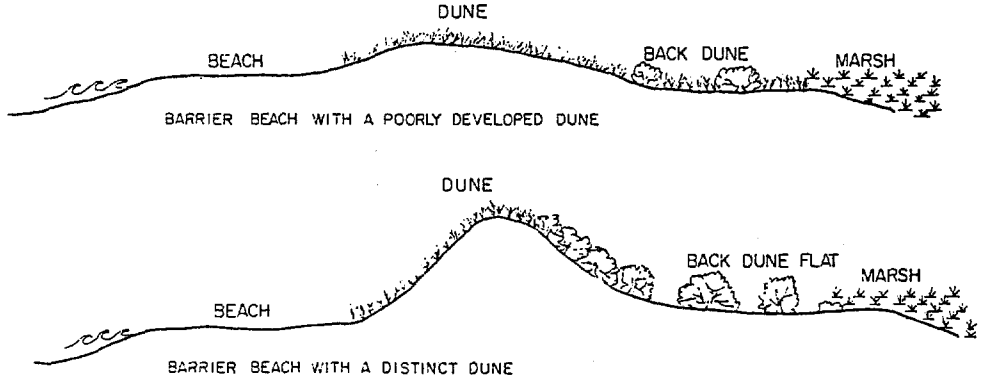


Figure 6. Cross sections of typical Rhode Island sand barriers showing the beach, undeveloped and developed dunes, the back dune, and the salt marsh. Source: Stephen B. Olsen & Malcolm J. Grant, Rhode Island's Barrier Beaches, vol. 1, Marine Technical Report Series No. 4, Coastal Resources Center, University of Rhode Island (1973).

during storms.

> "If the dunes are bulldozed away, the berms built upon, or the shore bulkheaded, the reserve sand in storage will be reduced to a level no longer capable of replacing sand losses from severe storms. The beach system then becomes unstable, slumps in places, and attempts to reestablish its old equilibrium profile, or 'angle of repose.' But with less sand the equilibrium angle of repose can be established only at a position inland of the previous beach profile. When this occurs, the beach cuts back into the land. The natural forces at work are immense, and the power of man to hold the beach at a higher than natural angle of repose to protect property is limited. Structural solutions are often ineffective and usually only temporary." [John Clark, op. cit., at p. 322].

Hurricanes, barrier islands, beaches and dunes. During hurricanes barrier islands and barrier beaches may be breached along their entire length, their dunes destroyed. In so doing, the beaches and the dunes are performing a natural function that provides a remarkably efficient and effective buffer against the fury of storm seas. (See Figure 7).

> "In their natural state barriers respond to severe wave erosion in a unique and efficient manner. In a big storm waves quickly erode the foredune and carry the sand seaward thus extending shallow water further out from the dunes. Waves therefore break, and lose much of their energy, progressively further away from the barrier. If, however, the barrier has been developed and artificially stabilized by seawalls the self-sacrificing process cannot take place and the force of the waves will remain concentrated upon the barrier. As a result erosion during a severe storm may be worse." [Olsen, S.B. and Grant, M.J., Rhode Island's Barrier Beaches: Volume I, at pp. 10 - 11].

The vulnerability of barrier islands and barrier beaches to waves and flooding is described by Stanley R. Riggs:

> "The hazards to barrier islands can be summarized as follows:
>
> 1. High winds produce high ocean and estuarine storm surges which upon occasion cause water levels to completely exceed all but the highest of elevations on the barrier islands.
>
> 2. High wave heights on top of the storm surge often cause the energy to be dissipated above and inland of the normal storm beaches and often sets up major high velocity water currents across unvegetated portions of the barrier.
>
> 3. Heavy rains after landfall produce flood conditions and an exceptionally high fresh water back pressure upon the barrier system.

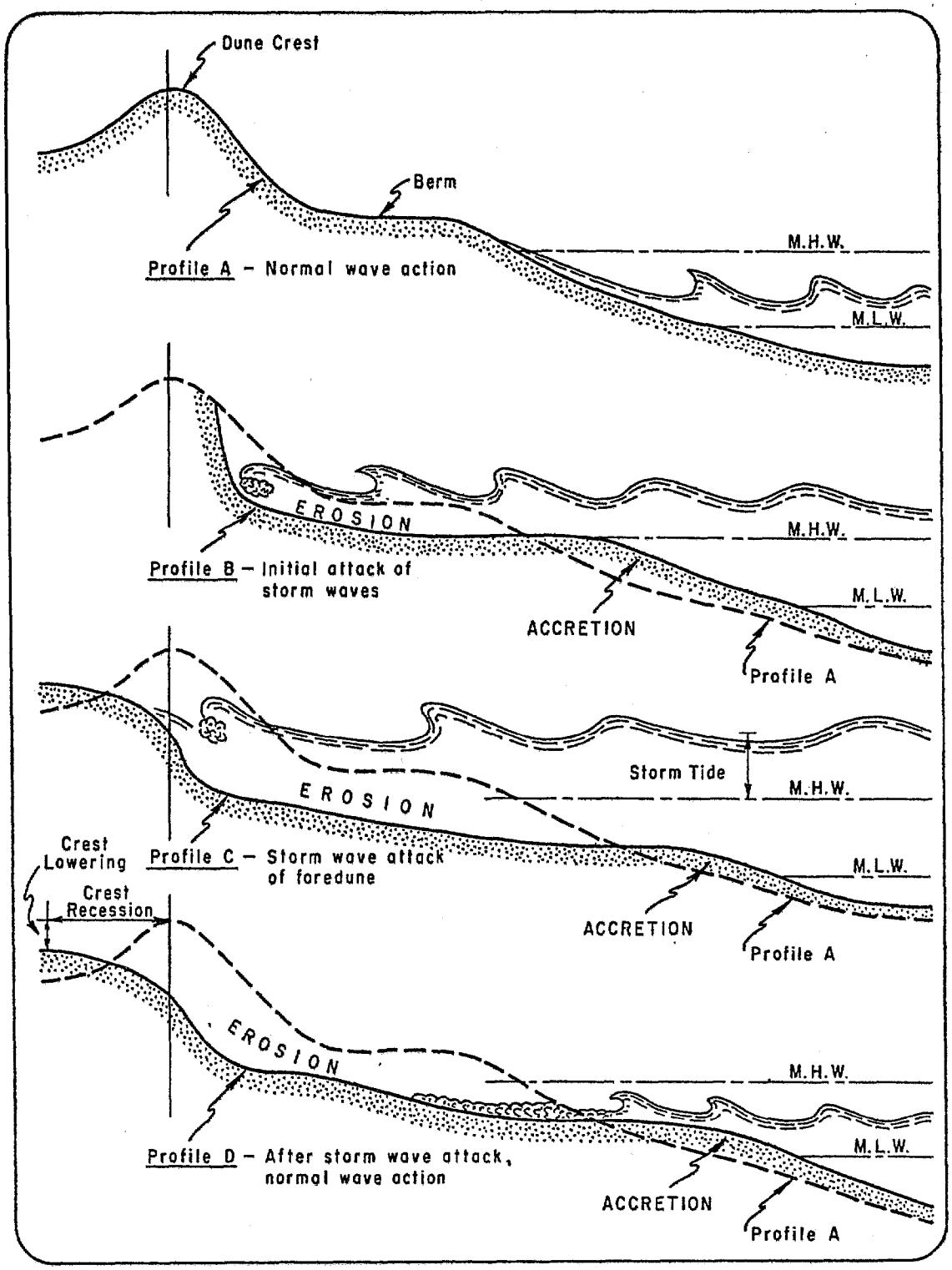


Figure 7. Schematic diagram of storm wave attack on beach and dune. Source: Department of the Army, Corps of Engineers, Shore Protection Guidelines, National Shoreline Study, Washington, D.C. (August 1971).

> "The consequences of the major storm hazards to the barrier island . . . are all natural processes which have been important in the geologic origin and still are basic to the maintenance of the barrier islands as we know them today. As geologic conditions continue to change, these processes will continue to be important in maintaining an equilibrium system in the future.
>
> "Such natural processes only become hazards when man enters the scene, whereupon such natural processes as shoreline recession, which results from rising sea levels and the consequent migration of the coastal system landward, immediately becomes a severe economic hazard. Thus, the indirect consequences are those natural processes which are only hazards because they represent a change to the natural system which indirectly affects the economic structure. Whereas the direct consequences represent actual damage to man-made structures which don't belong in a high energy changing natural system." [Riggs, S.R., "Barrier Islands as Natural Storm Dependent System," in Barrier Islands and Beaches: Technical Proceedings of the 1976 Barrier Islands Workshop, The Conservation Foundation, Washington, D.C. (1976)]

Coastal Wetlands. Coastal wetlands are areas subject to flooding by brackish or salt water and vegetated with plants that are salt-tolerant. The plants occur in communities dominated by grasses, rushes, and other salt-tolerant species, including mangrove trees found particularly in Florida below the 28th parallel (Tampa Bay/Indian River and south). The form, vegetation, and functions of wetlands differ markedly above and below the mean high water mark, and distinctions are made between upper and lower wetlands. Upper wetlands extend landward from about the mean high water mark to the inner limits of annual flooding, that is, the area covered annually by the highest expected storm surge. Lower wetlands extend from the low water mark shoreward to about the mean high water mark. The lower wetlands are most often dominated by a species of Spartina grass, such as alterniflora, or, in subtropical parts of Florida and isolated areas along the Gulf of Mexico, by red or black mangroves.

Coastal wetlands serve many vital ecological and other functions. They provide habitat for many important estuarine species. They are important as stabilizers of estuarine shorelines, inhibiting or preventing erosion. They are water purifiers, producers of nutrients, storers of sediment traps, and aesthetic attractions. They have often been assumed to function as flood storage areas and to act to reduce the severity of flooding, two hypotheses that have yet to be conclusively established scientifically.

Never exposed to the open ocean, but always found in sheltered waters, such as on the landward side of barrier islands, the predominant values of coastal wetlands from a flood plain management perspective may be for flood water storage and shore protection from storm-induced erosion. Under very severe hurricane circumstances, land areas fronted by mangroves could receive an additional benefit, dissipation of wave energy. But the extraordinary natural values of wetlands are never limited to their benefits for flood loss reduction, for flood loss reduction is an incidental bonus accompanying their other natural functions.

Coastal development of shoreland sites has often ignored the important natural functions of beaches, dunes, creating untold problems when excessive amounts of sand are removed or efforts are made to stabilize them. Dunes, beach sands, and gravels have been mined for building and highway construction purposes; dunes have been leveled for real estate development or to provide access or views of the beach and ocean; groins have been constructed to control alongshore erosion, but have often failed and accelerated erosion processes; and breakwaters, jetties, solid wharves, fills, seawalls, bulkheads, and other structures placed in the water or in beach or estuarine areas have disturbed the tidal, wave, current, sand supply, and other natural processes which perform vital ecological and protective functions for the coast. The substitution of "seawalls for sea oats", of engineered structures for natural protective features, may increase the problems they sought to correct, more often than not.

Having described briefly certain natural coastal features and some of their functions during hurricanes and other storms, we turn to federal strategies for flood plain management and the workings of the National Flood Insurance Program.

Trends in Federal Strategies for Flood Loss Management. *

During the 19th Century and the early years of the 20th Century, federal strategy in flood plain management and disaster assistance was basically that of no government involvement, except for federal flood control activity in the Lower Mississippi River Basin, beginning in 1879. During that period the costs and risks of flood losses were borne and internalized by the victims. Beginning roughly in 1910, federal policies began to change in recognition of the value of flood plain development to the nation. Milestones in federally authorized activities until 1936 included stream flow measurements for preparation of plans for navigable stream improvements (1910); flood control improvements of the Sacramento River, California, flood control surveys, and federal assumption of responsibility for Lower Mississippi flood control (1917); and surveys on comprehensive development for navigation, hydroelectric power development, and flood control (referred to as "308 Reports") (1927).

Technological advances in the early 1900s helped bring into being the concept of multiple purpose, single means construction, for which the Hoover Dam is cited as the major prototype. The multiple-purpose, single means construction concept was expanded to include planning for entire river basins, exemplified by the proposals for flood control on the Lower Mississippi, and the 1927 authorization of "308" basin-wide reports on navigation, flood control, irrigation, and hydroelectric power. When the Tennessee Valley Authority was established in 1933, multiple-purpose, single means construction was further expanded to promote economic and social change throughout the Tennessee River Valley. And with these concepts emerged federal policies that increasingly shifted, or externalized, the costs of flood control and flood losses to the public at large.

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* Discussion of federal strategies for flood loss management is adapted in part from Gilbert F. White's "Strategies of American Water Management", University of Michigan Press, Ann Arbor (1968).

Evolving federal activity in flood control was codified in June 1936 when the Congress enacted the Flood Control Act of 1936, marking the first major federal strategy and involvement in flood control nationwide. The Act declared flood control to be a proper federal activity; that improvements for flood control purposes promoted the general public welfare; and that the federal government should improve or participate in the improvement of navigable waters or their tributaries for flood control "if the benefits to whomsoever they may accrue are in excess of the estimated costs, and if the lives and social security of people are otherwise adversely affected." [33 U.S.C. 701a]. Under the Act, federal investigations and improvements were to be under the jurisdiction of the Department of the Army, supervised by the Chief of Engineers. [33 U.S.C. 701b]. Requirements of local cooperation were prescribed, namely: (a) provide without cost to the United States all lands, easements, and rights-of-way necessary for the construction of the project; (b) hold and save the United States free from damages due to the construction works; and (c) maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of the Army. [33 U.S.C. 701c].

By 1940 the main characteristics of multiple-purpose, single means construction had been set. Over the next 20 years refinements were made, primarily opening the possibility of additional purposes. Thus, the Southeast Basins Study, begun in 1958, identified eleven purposes typically included in major drainage basin studies: navigation, flood control, hydroelectric power, irrigation, municipal water supply, industrial water supply, municipal waste disposal, recreation, wildlife conservation, low flow regulation, and soil conservation. And after 1936 a pattern of federal (public) assumption of the costs of water resources development, including flood control, incentives for further flood plain development, and disaster relief for mounting flood losses, was established. The pendulum had swung to the other extreme.

A third major stage in the evolution of federal strategies for flood plain management began in the 1950's, but did not receive political impetus until 1966. President Johnson's message to Congress, accompanied by a report of the federal interagency Task Force on Federal Flood Control Policy and by new Executive Order 11296, "Flood Hazard Evaluation", marked the first major change in executive administrative policy for dealing with flood loss reduction away from solely engineering means to include other management tools. It also marked an attempt by the Government to reduce the burgeoning costs of federal disaster relief assistance and to shift some of the costs and risks of flood losses to those who create the risks, the occupants of the flood plains. Twelve years later the fate of "new" strategy still hangs in the balance.

The Task Force had found that despite the protection afforded by flood protection works, flood damages were continuing to grow and exceeded $1 billion annually. From 1936 to 1966 the United States had invested over $7 billion for flood control works and a recurring pattern emerged of flooding, flood losses, disaster relief, flood control projects to modify flooding, further development on the flood plain "protected" by the flood control projects, flooding that exceeded the flood control project design flood, flood losses, disaster relief, more projects, more development, and so on. Protective works were not keeping pace with increasing flood losses, and after providing protection for existing development, increasingly federal funds were being used to support projects justified on the basis of protection of lands for future use, essentially underwriting new development on the flood plains.

> "Studies of flood plain use show that some flood plain encroachment is undertaken in ignorance of the hazard, that some occurs in anticipation of further Federal protection, and that some takes place because it is profitable for private owners even though it imposes heavy burdens on society. Even if full information on flood hazard were available to all owners of flood plain property (a service now conspicuously lacking) there still would be conscious decisions to build in areas where protection has not been feasible, . . . Moreover, the chief encouragement [the private owner] now receives under Federal programs is the prospect for relief or future Federal protection. Technical assistance in developing alternative ways of dealing with flood losses . . . is not provided. . . . Similarly, alternative uses for flood plains are not thoroughly canvassed. Insurance against flood losses is not generally available. . . .
>
> "[Despite flood plain regulation and floodproofing encouraged by TVA, and flood plain information provided by the Corps of Engineers] the alternatives apparent to the general public remain either building new protection works or suffering larger losses." ["A Unified National Program for Managing Flood Losses", House Document 465, 89th Congress, 2d Session (1966), at p. 11].

The Task Force on Federal Flood Control Policy report recommended a unified national program with five basic elements:

- Improve basic knowledge about flood hazards;
- Coordinate and plan new developments on the flood plain;
- Provide technical services to managers of flood plain property;
- Move toward a practical national program for flood insurance;
- Adjust Federal flood control policy to sound criteria and changing needs.

The U.S. Water Resources Council later described succinctly the paths taken after 1966 by federal legislation which are related to flood plain management:

> "In the following decade, significant new Federal legislation affected the role of State and local governments in flood plain management. Federally subsidized flood insurance was made available in return for community exercise of flood plain regulation. Funds were made available for flood disaster preparedness planning. Federal planning, technical assistance and construction grants were made available to States in return for areawide waste treatment facility planning; and financial assistance was made available for defining and enforcing permissible land and water uses in the coastal zone. A Federal permit system was utilized to monitor more closely dredge and fill activity, which often affects flood plains. Federal cost sharing was extended in principle to "nonstructural" measures directed primarily at flood loss reduction. Water resource planning principles and standards moved

> toward a more consistent evaluation of federally funded management measures. The requirement of environmental impact statements forced consideration and public display of alternative plans affecting flood plain use. In net effect, State and local governments were urged to exercise their flood plain management prerogatives with new Federal incentives, regulatory tools, and a comprehensive management philosophy." [U.S. Water Resources Council, "A Unified National Program for Flood Plain Management" (July 1976), at pp. II-3, 4].

Trends in coastal management. In the discussion of trends in federal strategies for flood plain management, the strategies have been applied almost exclusively to riverine contexts. In the coastal context, as in the riverine, early federal strategies were also dominated by engineering construction solutions for navigation improvements, shore erosion control, and hurricane protection projects, under the aegis of the Corps of Engineers.

Before 1930, federal activity in shore erosion problems was limited to federal property and navigation improvements. In 1930, Congress established the Beach Erosion Board, which was authorized to make studies of beach erosion problems at the request of, and in cooperation with cities, counties, or states. Federal policy was modified in 1946 to provide federal aid in construction costs where projects protected publicly owned shores, and amended again ten years later to authorize federal participation in the protection of private property if such protection was incidental to the protection of publicly owned shores, or if such protection would result in public benefits. Federal interest in protection against hurricane damage has not been expressly defined, but has been essentially established through Congressional authorizations of hurricane protection projects on a case-by-case basis.

Not until the Commission on Marine Science, Engineering & Resources identified the coastal zone of the United States as an area of particular importance was the coast singled out as requiring special planning and management attention. The Commission's report, "Our Nation and the Sea" (1969) focused principally on coastal development, resources, and environmental management concerns, and only minimally on natural hazards loss management. Where mention was made of hurricanes, coastal storms, and other hazards, the strategies enumerated continued to be basically engineering construction responses to the physical dynamics of the sea -- seawalls, groins, jetties, and other coastal structural facilities.

Responding to the Commission's recommendations, the Congress enacted the Coastal Zone Management Act of 1972. This Act places primary responsibility for planning and regulation of coastal land and water uses on State and local governments, and encourages the States to exercise their full authority over lands and waters in the coastal zone. Grants awarded through the National Oceanic & Atmospheric Administration (NOAA) of the Department of Commerce are to assist the States in developing and administering land and water use management programs for the coastal zone, including ecological, cultural, historic, and esthetic values as well as the need for economic development. The Act and its regulations treat coastal flood loss management incidentally to the purposes stated previously, and to date the natural ties between the goals of coastal zone management and coastal flood plain management have not been developed fully. However, as state coastal zone management plans are emerging, the role of the National Flood Insurance

Program becomes increasingly evident through its relationship of subsidized flood insurance in consideration of community adoption of minimum flood plain management requirements, and its leverage on the availability of federally assisted financing of loans secured by real estate.

It remains to be seen whether federal, state, and local governments will effectively adopt flood loss management tools other than engineered structures both in riverine and coastal flood plain management. To date it has been easier and more visible to manipulate single engineering works to control flood losses than to adopt land use regulations, building codes, flood insurance, public land acquisition, and other more intricate management tools. Most flood loss management has occurred in the post-flood crisis context in which simple, dramatically visible engineering works are often preferred "to keep the water away from the people", rather than the complexities and uncertainties of politically less acceptable measures "to keep the people away from the water." The National Flood Insurance Program is both relatively new as a federal flood loss management strategy and its flood plain management requirements are hotly contested various interest groups. Thus, a description of the background and workings of the National Flood Insurance Program is in order, and follows.

The National Flood Insurance Program.

Background of legislative efforts. Efforts to institute a national flood insurance program date back to 1951 when President Truman requested an appropriation for a flood insurance program, following a series of costly floods in the Midwest. A modified proposal for flood insurance was offered in 1952, and, as in 1951, defeated. Still another proposal was made and enacted in the Flood Insurance Act of 1956, in which 40% of the premiums were to be subsidized by state and federal governments. However, no funds were ever appropriated, a major factor being the absence of effective flood plain management requirements in the Act. Without flood plain management requirements many members of Congress felt that subsidized flood insurance would merely stimulate both riverine and coastal flood plain development, and would inevitably lead to additional flood losses.

Although bills were introduced almost annually during the 1960's to resurrect a national flood insurance program, not until submission of "A Unified National Program for Managing Flood Losses" (1966), and submission of HUD's "Insurance and Other Programs for Financial Assistance to Flood Victims" (1966), was political impetus given to an alternative to structural flood control measures. A result was the National Flood Insurance Act of 1968, which established a voluntary program and provided subsidized flood insurance for existing properties located in identified special flood hazard areas, and which required communities to adopt local flood plain management measures as a strict condition of eligibility in the flood insurance program.

Amendments to the Act in 1969 created the emergency phase of the Program, authorizing flood insurance coverage before detailed flood insurance studies had been completed in a community, as required by the 1968 Act. Further minor amendments were made in 1971 to encourage greater community participation in the Program, including extension of the emergency program. By 1973 it was apparent that the principal defect in effecting the Congressional purpose was the voluntary nature of the Program.

> "Despite the efforts of the Federal Insurance Administration to carry out the Congressional intent for land use and control measures in its administration of the Act, it became quite obvious that without mandating provisions to bring about these measures, no real accomplishment could be expected in this respect." [Report to accompany H.R. 8449, Flood Disaster Protection Act of 1973, Committee on Banking, Housing and Urban Affairs, United States Senate].

Voluntary community participation in the Program was insufficient to make the flood insurance program viable. [See Table 10, below]. Changes made by the Flood Disaster Protection Act of 1973 mandated community participation in the Program in return for the availability of federally assisted financing, and increased the volume of technical studies identifying flood hazard boundaries in flood prone communities. The current status of the Program is reflected in the operating factors of the National Flood Insurance Act of 1968, as amended by the Flood Disaster Protection Act of 1973.

Flood Disaster Protection Act of 1973. The National Flood Insurance Program now requires communities that have formally identified special flood hazard areas to have entered the Program by July 1, 1975, or to enter the Program within one year after a community has been notified that it has a special flood, mudslide, or flood-related erosion hazard area. The Act required such communities to maintain eligibility in the Program thereafter, lest one or more sanctions be imposed for failure to comply: (1) suspension of the community from the Program if it fails to enact and enforce minimum flood plain management measures. (2) denial of federally assisted financing, such as mortgages, loans, or guarantees, to property owners located in flood hazard areas; and (3) denial of federal disaster assistance for permanent restorative work if the community does not enter the Program. The Congress recently amended the Act to permit individuals to obtain federally assisted financing in flood prone communities that are not participating in the National Flood Insurance Program. However, the Congress also repealed the "one more time" provisions for federal disaster relief assistance for permanent restorative work in nonparticipating communities, potentially denying all but emergency federal relief in communities that opt not to participate in the Program.

Emergency Program. The National Flood Insurance Program has two levels of eligibility -- the emergency phase and the regular phase. The salient features of the emergency program are that flood insurance can be sold before a technical study is conducted to determine risk premium (actuarial) rates for the community, subject to certain minimum flood plain management regulations. Half of the Program's total limits of flood insurance coverage are available under the emergency program and sold at federally subsidized rates; subsidies have ranged as high as 90 percent of the cost of the flood insurance, and are currently about 60 percent.

To qualify for the sale of flood insurance, a community must submit a completed application to the Federal Insurance Administrator, and adopt minimum flood plain management regulations required by FIA, including effective enforcement provisions. Minimum flood plain management requirements include legally enforceable regulations uniformly applied throughout the community to all privately owned land within the flood and flood-related erosion areas, as well as land owned by the community. Communities are encouraged to exceed the minimum

FIA requirements, and provision is made that any flood plain management regulations adopted by a State or a community which are more restrictive than the FIA criteria "shall take precedence" (24 C.F.R. §1910.1(d)].

Under the emergency program certain minimum flood plain management measures are required and are described below under Flood Plain Management Measures.

Regular Program. The second level of eligibility in the National Flood Insurance Program is the regular program under which the total limits of flood insurance coverage become available within the community. The triggering event for entrance into the regular program is when the Federal Insurance Administrator makes a final determination on flood elevations within a community and publishes a Flood Insurance Rate Map (FIRM) for determining actuarial rates, with an effective date. Maximum amounts of flood insurance available under the Program are set out in Table 2.

When Flood Insurance Is Required. Before July 1, 1975, no flood insurance purchase requirement existed under the Act unless two conditions were met: (1) the property was located in a formally identified special flood hazard area; and (2) the community was participating in the Program and flood insurance was being sold on properties in that area at the time of closing or time of commitment of financial assistance. As used throughout the Act, the term "financial assistance" means financial commitments (such as mortgages, loans, guarantees, etc.) through financial institutions which are supervised, approved, regulated, insured, or guaranteed by a federal agency [Federal Reserve System, Comptroller of the Currency, Federal Deposit Insurance Corporation, National Credit Union Administration, Federal Home Loan Bank Board, or the Federal Housing Administration], and in those federal agencies that give direct financial assistance for acquisition for construction purposes [e.g., Veterans Administration, Small Business Administration].

Since July 1, 1975, financial assistance cannot be provided legally for properties in special flood hazard areas unless the community involved is participating in the National Flood Insurance Program. Community participation is contingent upon adoption of certain minimum flood plain management measures, the stringency of which, in turn, varies with the degree of technical information that is available on flooding conditions in the community.

Flood Plain Management Measures. The Federal Insurance Administration does not have authority to intervene directly in state or local regulatory efforts. Nevertheless, in return for the availability of subsidized flood insurance to the communities and property owners in flood hazard areas, the FIA imposes minimum flood plain management requirements. In determining the adequacy of the community's flood plain management measures, the Administrator of FIA must find that: the regulations are legally enforceable; apply uniformly throughout the community to all privately and publicly-owned flood prone areas; and the regulations must take precedence over any less restrictive conflicting local laws, ordinances, or codes.

FIA's minimum flood plain management measures for flood prone areas are incremental, depending upon the type of data that are available. Generally, the FIA provides the technical data upon which flood plain management regulations can be based. As the FIA provides more data, the eligible community is both enabled and required to improve its regulations with respect to flood hazard

TABLE 2

Maximum Amount of Flood Insurance Available

	First Layer [a] Maximum Amount at Subsidized or Actuarial Rates [c]		Second Layer [b] Maximum Additional Amount at Actuarial Rates	
	Building	Contents	Building	Contents
Single-family Dwelling				
All states except	$ 35,000	$ 10,000	$ 35,000	$ 10,000
Alaska, Hawaii, Guam, V.I.	$ 50,000	$ 10,000	$ 50,000	$ 10,000
Other Residential (except single family)				
All states except	$100,000	$ 10,000	$100,000	$ 10,000
Alaska, Hawaii, Guam, V.I.	$150,000	$ 10,000	$150,000	$ 10,000
All Other Structures	$100,000	$100,000	$100,000	$100,000

[a] Maximum insurance available under the emergency program for structures in existence on and not substantially improved after December 31, 1974, or the effective date of the Flood Insurance Rate Map, whichever is later. Subsidized rates are charged, i.e., $2.50/$1000 coverage for single-family and other residential buildings, and $3.50/$1000 coverage for the contents of such buildings; $4.00/$1000 coverage for all other structures, and $7.50/$1000 coverage for the contents of such other structures.

[b] When a community is eligible under the regular program, the subsidized rate or the actuarial rate is used, whichever is lower, for existing structures. Newly constructed buildings, or structures substantially improved after December 31, 1974, or the effective date of the FIRM, whichever is later, pay the applicable actuarial rate.

[c] Second layer insurance is available under the regular program only. Actuarial rates are used for the second layer. The maximum actuarial rate payable on one-to-four family residential structures is $5.00/$1000 coverage for (a) first layer limits on new construction, if the first floor elevation is at or above the 100-year flood level, or (b) second layer limits of insurance on all existing one-to-four family structures.

areas. The sanction for failure to meet the minimum requirements is suspension of the community from the Program, and with such suspension, the inability of property owners in flood hazard areas to obtain federally assisted financing.

The incremental management stages are based on the amount and type of flood information data available.

(a) Emergency Program Minimum Flood Plain Management Requirements. Before a community has received a map delineating the danger zone, its flood plain management measures must include the following as a minimum in order to establish and maintain eligibility in the National Flood Insurance Program:

1. Require permits for all proposed construction or other development in the community, including mobile home placement.

2. Review proposed development to assure that all necessary federal or state permits have been received.

3. Review permit applications to determine whether proposed building sites will be reasonably safe from flooding. Provide that new construction and substantial improvements, including prefabricated buildings and mobile homes shall:

   a. be anchored to prevent flotation, collapse, or lateral movement;
   b. be built with flood resistant materials and equipment;
   c. be constructed using methods and practices that minimize flood damage;

4. Review subdivision and new development proposals to determine whether they will be reasonably safe from flooding, and to assure that:

   a. they minimize flood damage;
   b. locate and construct public utilities and facilities, such as sewer, gas, electrical, and water systems, so as to minimize or eliminate flood damage;
   c. provide adequate drainage;
   d. eliminate or minimize infiltration in new and replacement water supply and sanitary sewer systems; and
   e. locate on-site waste disposal systems to avoid impairment or contamination during flooding.

(b) Flood Hazard Boundary Maps: Additional Requirements. As of February 28, 1977, nearly 19,500 communities in the United States were formally identified as flood prone, 1,514 (8%) of which were coastal communities. Estimates run as high as 22,000 communities (roughly 4/7 of the nation's communities) that will be identified as flood prone. In each of the flood prone communities, the first technical information on flooding conditions in the community provided by FIA is the Flood Hazard Boundary Map, which delineates where flood hazards exist, but do not provide essential elevation and flood frequency data needed for determining actuarial risks, or for identifying floodways of rivers or coastal high hazard areas. The FIA flood hazard boundary mapping program is approaching completion, and communities seeking to enter the program have, in most cases, a flood hazard

boundary map available to accompany their application to FIA.

Where Flood Hazard Boundary Maps exist, two flood plain management requirements are imposed in addition to those cited in subparagraph (a) above, namely: (1) require permits for all proposed construction or other development within the area designated as Zone A on the flood hazard boundary map; (2) require all subdivision proposals and other new development greater than 50 lots or 5 acres to include flood elevation data for the 100-year flood; (3) obtain elevation information of the lowest floor (including basement) of all new or substantially improved structures, the elevation to which the structure is flood proofed, if at all, and maintain records of such information in a designated community office.

Mobile homes to be placed in Zone A on the community's flood hazard boundary map must be anchored to resist flotation, collapse, or lateral movement by providing over-the-top and frame ties to ground anchors. Finally, the regulations call for an evacuation plan indicating alternate vehicular access and escape routes to be filed with disaster preparedness authorities for mobile home parks and mobile home subdivisions located within Zone A.

(c) Flood Insurance Rate Maps and the Regular Program. Once a community is eligible under the emergency program and a flood hazard boundary map has been issued for that community, the FIA undertakes to have detailed flood studies of the community conducted in order to determine the actuarial rates to be charged in the community. Detailed topographic (elevation) and hydrologic (water distribution) studies are performed, at federal expense, to develop technical information about the base flood elevation that has, on average, a one percent chance of occurring each year (the "100-year flood"). Using the data gathered in their flood insurance studies, a detailed flood insurance report is prepared for the community. After a period of time in which the community may contest and appeal the information included in the map, a Flood Insurance Rate Map (FIRM) is published, with an effective date. The FIRM both delineates the special flood hazard areas and divides the mapped area into zones according to flood hazard factor. The flood hazard factor is FIA's device to correlate flood frequency information directly into insurance actuarial rate tables.

The signal point for a community to enter the regular flood insurance program is the effective date of the Flood Insurance Rate Map for the community, i.e., after completion of the flood insurance studies, preparation of the FIRM, review by other federal agencies, the state, and the community, and after completion of any appeals taken by the community regarding the flood insurance rate study.

To be eligible for, and to remain in, the regular program, the minimum flood plain management measures adopted by the community for the identified special flood hazard areas within it must include not only those permit and review procedures required for the emergency program [subparagraphs (a) and (b), above], but also must:

1. Require new or substantially improved residential structures in areas designated A1 - 30 to have the lowest floor, including basement, elevated to or above the level of the 100-year flood, unless the community is granted an exception.

2. Require new or substantially improved nonresidential structures in Zones A1 - 30 must be similarly elevated to or above the 100-year flood level, or be watertight with substantially impermeable walls and structural components that will resist static and dynamic loads and buoyancy effects.

3. Provide that where flood proofing is used, a professional engineer or architect must certify that the floodproofing methods are reasonably adequate to withstand the flood depths, pressures, velocities, impact and uplift forces, and other forces associated with a 100-year flood, and a designated community official must maintain records of such certificates indicating the specific elevation to which such structures are floodproofed. Alternatively, a local floodproofing regulation which satisfies the watertight requirements mentioned above may be submitted to the Administrator of FIA for approval.

4. Require in new mobile home parks, mobile home subdivisions, and their expansions, that stands or lots are elevated on compacted fill or on pilings at or above the 100-year flood level, provide adequate surface drainage and access for haulers, and provide adequate space for steps, spacing and reinforcement for pilings.

5. Provide similar requirements for individual mobile homes not in mobile home parks, or subdivisions.

Other requirements more generally germane to riverine than coastal flooding conditions are included in the FIA regulations, but are omitted here.

(d) Coastal High Hazard Areas. Because of the special dangers inherent in locating in riverine floodways or immediately adjacent to the open ocean, the FIA requires additional flood plain management measures for floodways and coastal high hazard areas. For purposes of this paper, only coastal high hazard areas will be discussed. The "coastal high hazard area" is defined in FIA's regulations as

> "the area subject to high velocity waters, including but not limited to hurricane wave wash or tsunamis. The area is designated on a FIRM as Zone V1 - 30." [24 C.F.R. 1909.1, 41 Fed. Reg. 46969, Oct. 26, 1976]

Flooding that occurs from tropical or other storms tends to be of short duration, but areas immediately adjacent to the ocean may be subject to inundation by higher than normal tides because of barometric pressure differentials, storm surges, the velocity of wind-driven waves, erosion that undermines building foundations, and battering by storm-driven debris. Very severe hurricanes, such as Hurricane Camille that struck the Mississippi coast in August 1969, can elevate sea levels more than 20 feet, while lesser hurricanes can raise sea levels 10 - 15 feet above normal.

FIA recognizes that wave action can occur in certain portions of a coastal community, and designates such areas as V Zones. For designation purposes, a V Zone is generally an area where the still storm-water elevation [elevation of the astronomical tide plus storm surge] and other conditions such as bottom configuration and unobstructed distance over which wind-driven waves travel, will support a three-foot or higher wave. The three-foot wave is chosen as the minimum height wave that will cause damage to structures. Under current

procedures, FIA uses the still storm-water elevation in designating the 100-year flood elevation in the coastal high hazard or V Zone, and does not incorporate wave height in its flood insurance rate maps.

The flood plain management measures minimally required by the FIA in coastal high hazard areas, in addition to elevation and floodproofing standards for new construction and substantial improvements described in subparagraph (c) above, include require that new construction and substantial improvements within Zones V1 - 30 are:

(1) located landward of mean high tide;

(2) elevated above the 100-year flood level on adequately anchored pilings or columns, securely anchored to such pilings or columns, and certified by a registered engineer or architect that the structure is securely anchored to adequately anchored pilings or columns "in order to withstand velocity waters and hurricane wave wash."

(3) provided with space below the lowest floor free of obstruction or constructed with "breakaway walls" that will collapse under abnormally high tides or wind-driven water without jeopardizing the main structure.

(4) prohibit the use of landfill for structural support.

(5) prohibit mobile homes within Zones V1 - 30 except existing mobile home parks and subdivisions.

(6) prohibit man-made alteration of sand dunes and mangrove stands within Zones V1 - 30 which would increase potential flood damage.

Given the dynamics of wind, waves, currents, tides, erosion, and storm forces, the rationale for the additional requirements for coastal high hazard areas is readily apparent. Location landward of mean high tide will place a structure landward of the reach of the ordinary daily and monthly tidal cycle. However, areas immediately adjacent to the ocean may be subject to storm surges, higher than normal tides, scouring by waves that undermines foundations, and the additional hazards due to the velocity of wind-driven waves, including battering by debris. Structures located immediately landward of mean high tide could readily find themselves in the midst of a holocaust of wind, waves, and debris. Setbacks of new construction inland of the active zone fronted by the primary dune or beach ridge are decreed by most communities that have addressed coastal flood plain management.

Elevation on pilings or columns to or above the 100-year flood level is a measure to "withstand velocity waters and hurricane wave wash." The rationale is simply to provide the strength, stability, and space needed to permit coastal flood waters to flow and roil about and under the structure without undermining, toppling, or breaking up the building. Attention should be given to the depth as well as the height of the pilings, to the materials used, and to anchoring of the structure to the pilings. Pilings should be driven below sea level sufficiently to prevent the building from toppling if the soil beneath the structure is scoured by storm waves. As to the height of the pilings, FIA requirements currently do not incorporate wave height in the calculation of the 100-year

flood level. Hence, architects and engineers should consider additional elevation on structures that they are designing, both to superimpose wave height on still-water flood levels and to take advantage of significantly reduced flood insurance actuarial rates above the 100-year flood level. The closer one builds to ocean, the greater the strength must be built into the structure to withstand potential storm forces. Materials that can withstand those forces without failing, adequately braced and anchored, can reduce the susceptibility of a structure to storm losses.

Space below the structure free of obstruction or constructed with "breakaway walls" that will collapse under the forces of storm waters or waves is to reduce the surface area exposed to rising waters and to waves that could be battered and jeopardize the entire building. Similarly, buildings in the coastal high hazard zone should not be elevated on landfill, because of the scouring action of storm-driven waves that could erode the landfill and completely undermine the structure.

Mobile homes are particularly susceptible to damages in the coastal high hazard area. In addition, their floating characteristics make them potentially lethal battering rams if lifted off their pads by rising storm waters and driven before the winds into nearby structures. Hence, the prohibition of mobile homes in the coastal high hazard area. The exception of existing mobile home parks and subdivisions from the prohibition relates to pre-existing rights and the limits of the community's police powers under the Fifth Amendment of the Constitution, prohibiting the taking of property without just compensation.

The prohibition of man-made alterations of sand dunes and mangrove stands in a community's coastal high hazard zone which would increase potential flood damage is a regulation that went into force in December 1976. The requirement recognizes the fragility of sand dunes and their importance as the first line of defense against hurricanes and other storms. The inclusion of mangrove stands in the provisions governing coastal high hazard areas may be unfortunate, although well intended. Under current criteria for defining coastal high hazard zones, only an insignificant number of Florida's mangrove stands will be included in the regulation. Mangroves are invariably found in relatively still, protected estuarine areas, such as the landward side of barrier islands, and are never exposed to the open ocean. Review of flood insurance maps shows that the designated coastal high hazard areas, Zones V1 - 30, rarely encompass the areas where mangroves grow. It would appear that if a prohibition against alteration of mangrove stands were to be effective, either the prohibition should not be limited to coastal high hazard areas but should include special flood hazard areas (A Zones) to landward or the criteria for delimiting coastal high hazard areas should be redefined.

Given the population, environmental, and other dynamics of the coastal flood plain, one of many troubling social, economic, and political factors is the high demand for coastal property, often despite owners' knowledge of storm history and the risks inherent in locating in coastal high hazard areas. Relatively few studies have investigated peoples' decision processes in the face of low-probability, high-hazard events such as coastal flooding. However, a recent study by the Wharton School of Finance surveyed the experience, expectations and decisions made by people in coastal and riverine flood plains. Some results of that study follow.

Experience, Expectations, and Decisions in Coastal and Riverine Flood Plains -- The Wharton School Field Survey.

Relatively little is known about the decisions that people make and the information that they have and use in making decisions about low-probability events such as hurricanes and coastal storms. Insights into those decision processes can be useful to policy makers for shaping policy, regulations, and other matters for which they are responsible. Working with Dr. Howard Kunreuther and Mr. Norman Katz of the Wharton School of Finance of the University of Pennsylvania, the author was particularly fortunate to have access to data on such processes that had not previously been interpreted to contrast coastal and riverine characteristics.

In 1973, the Wharton School undertook a study* of the factors that induce people to protect themselves voluntarily against low-probability events, specifically floods and earthquakes. The Wharton flood survey data comprise a total of 2055 interviews (1413 in coastal communities, 642 in riverine communities) in 43 flood prone communities throughout the United States, 28 of which were coastal communities. Approximately half of those people interviewed in the course of the flood survey had purchased flood insurance, permitting comparison between the decisions, experience, and expectations of insured and uninsured individuals.

The data collected by the Wharton investigators were gathered in 1973 before the Flood Disaster Protection Act of 1973 came into full force and effect. [The Act is dated December 31, 1973]. Thus we find that all of the communities in the Wharton flood survey were in the "regular" flood insurance program and had entered the National Flood Insurance Program voluntarily, not pursuant to the community participation requirements of the Flood Disaster Protection Act of 1973. Moreover, among those surveyed, decisions to purchase flood insurance were predominantly voluntary. Twelve percent (12%) of the total flood sample were required to obtain flood insurance as a condition of financing, largely due to SBA post-disaster loan conditions.

Previous uses of the Wharton field survey data had compared both flood and earthquake survey data, and had not sought to discern between coastal and riverine flooding. This report focuses solely on the flooding data, dividing those data into three categories: (1) the entire coastal flood survey (28 communities); (2) the entire riverine flood survey (15 communities); and (3) the data specifically pertinent to 11 of the 15 coastal communities included in this study.

The results permit comparisons between coastal and riverine and study area flooding experience and respondents' expectations of future damages. They permit an assessment of individuals' awareness of flood hazards, the seriousness with which they view riverine and coastal flooding, their anticipation of federal aid for disaster losses, their attitudes toward adoption of protective measures, and a number of other variables. They indicate sharp contrasts between a variety of coastal and riverine flooding characteristics that are particularly germane to this study.

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* The study was an NSF-RANN project, "Reducing Losses from Selected Natural Hazards -- Role of the Public and Private Sectors" (NSF Grant ATA73-03064-A03), directed by Dr. Kunreuther.

The Wharton flood survey of coastal and riverine communities shows that coastal property owners tend to hold and use their properties longer than their riverine counterparts; and the longer owners reside in the coastal high hazard area the less likely they are to view coastal flooding as a serious problem. In riverine areas the probability of viewing the hazard as a serious problem increases as one resides longer in the area. Coastal residents are more likely to rebuild their house on the same site if it is destroyed by a flood than are riverine owners. Past experience with flooding is the most important factor in alerting property owners to the seriousness of the hazard and hence plays a key role in inducing voluntary purchase of flood insurance or adopting voluntary flood protection measures. Yet strikingly high percentages of owners surveyed by the Wharton team had not experienced coastal flooding in their present homes -- greater than 80% in all of the coastal communities surveyed.

Study of as large a sample of individuals in both coastal and riverine flooding contexts provides useful insights in determining policy direction and assessing the political acceptability of a strengthened or weakened flood insurance program. Review of the Wharton field survey data shows some interesting contrasts and patterns in homeowner experience with the coastal and riverine flooding contexts.

Population Characteristics. Earlier in this paper we noted the increasing densities of population in coastal communities of the United States. The following conclusions relate to the population characteristics of the specific communities in the Wharton field survey. The conclusions are derived, in statistical terms, by using weighting factors corresponding to the objective probability of selection from the sample universe.

Houses. Riverine houses in the communities surveyed were older on average than coastal houses. Yet coastal properties tended to be held and lived in longer than riverine houses. Coastal homeowners were significantly more likely to rebuild in the same place if their home were destroyed by a severe disaster, and were less likely to move in the next five years than their riverine counterparts.

Values. Also noted earlier in this paper was the market preference for coastal properties near the oceanfront, for recreational and other purposes. One would expect that high demand for the limited coastal area and the development that can be sustained on coastal frontage would yield high property values. Consistent with that expectation, the Wharton survey found that as one approached the higher hazard portions of the coast, houses and properties became more expensive, the reverse of the general riverine experience. The survey also revealed that housing values tended to appreciate faster in coastal and riverine high hazard areas than in less hazardous regions.

Structural and Contents Damages. Whereas most riverine flooding is characterized by rising waters, coastal flood damages can result from any one or a combination of wind, coastal storm surges, wave action, scouring of foundations, and battering by debris. The Wharton flood survey found that the percentage of coastal owners in A Zones [special flood hazard areas] and V Zones [coastal high hazard areas] who had suffered structural damage was slightly greater than A Zone riverine owners (20% vs. 16% riverine). But on average per capita coastal total damages in A and V Zones were more than double comparable riverine zones ($12,300 vs. $5,400 riverine). Both coastal A and V Zone houses and riverine A Zone houses have approximately the same experience with contents damage (20.4% vs. 20.5% riverine), but per capita contents damage for those who had damage

was more than 3 times as high in coastal A and V Zones than in riverine A Zones ($7,300 vs. $2,300).

Field Survey Characteristics. The following conclusions came from a detailed analysis of the Wharton field survey flood data.

Uninsureds' Expectations of Federal Aid. A commonly held understanding, backed by some studies, is that people often live on flood plains ignorant of the hazard and expecting federal disaster relief if they are damaged by a disaster. Recall the statement of the Task Force on Federal Flood Control Policy in 1966:

> "Studies of flood plain use show that some flood plain encroachment is undertaken in ignorance of the hazard, that some occurs in anticipation of further Federal protection, and that some takes place because it is profitable for private owners even though it imposes heavy burdens on society. . . . Moreover, the chief encouragement he now receives under Federal programs is the prospect for relief or future Federal protection."
> [A Unified National Program for Managing Flood Losses, op. cit., at p. 11].

In both riverine and coastal surveys, the Wharton School survey found consistently low expectations of Federal aid for future damages among uninsured homeowners (76% expected no federal aid for damages under $10,000, and about 60% expected none for damages over $10,000). Generally, the less damage anticipated, the less likely uninsured respondents expect to turn to the Federal Government for financial assistance, with a striking 100% of the uninsured respondents in the author's study area anticipating no Federal assistance if they expected future damage to be under $10,000.

Post-Disaster Sources of Recovery Funds. The following composite of three tables prepared by Dr. Kunreuther and his Wharton colleagues indicates the sources of relief used by insured and uninsured individuals after both riverine and coastal flood disasters.

In Table 3.A., for those who were uninsured and had past damage between $500 and $2,500, 91% of their total damage was covered by savings and another 35% by government loans. On average, insurance covered 6% of their damage presumably wind losses or vehicle damage. Yet these uninsureds received enough money from different sources so that recovery funds amounted to 140% of their damage. Insured homeowners fared even better [Three forms of insurance -- flood, wind, and vehicle -- were reported in the survey and are included in the figures reported here]. Their primary source of recovery was also savings (88%); insurance was second with 78%, and total funds received from all sources were estimated to total 169% of their average damage. Note, however, that in damage categories above $10,000, neither insured nor uninsured victims tended to recover fully financially, considering all forms of insurance reported, government loans, savings, and bank loans as sources of post-disaster recovery funds. And as between the insured and uninsured, insured victims tended to recover less fully than uninsureds in the highest damage categories. No explanation of these results can be gleaned from the survey. One conjecture is that those who carried flood insurance tended to underestimate the damages they expected and were underinsured.

Table 3.B. indicates the percentage of homeowners in each damage category who actually used particular sources of funds and the average percentage of damage that these sources provided for those owners. Here the proportion of uninsured homeowners who used government loans to repair flood damage rose from 15% in the lowest damage class to 43% in the middle damage range to 70% in the highest group.

Table 3.C. indicates relative importance of particular sources for those homeowners who used them. Thus, of the 15% of uninsured flood victims in the lowest damage category who relied on federal relief, the loans obtained averaged 233% of their damage. These percentages decrease somewhat for higher damage groups, but are still considerably above the corresponding figures in Table 3.A.

Role of Past Experience. Past experience was found in the Wharton study to be the most important variable in alerting individuals to the seriousness of a natural hazard. Perceived seriousness of the problem and whether an owner knew someone who had already purchased flood insurance, were the two most important factors in an individual's voluntary decision to purchase flood insurance. The overall Wharton data indicated that there was a 55% difference in the probability of having insurance between those who considered the hazard as a serious problem and who knew someone with insurance, and those who viewed the hazard as an unimportant problem and did not know anyone with an insurance policy.

Perceptions of coastal and riverine flood problems brought some interesting contrasts. Overall, those who were insured tended to see flooding as a serious problem, and those who were not insured did not. The principal contrast, shown below in Table 4, is in the perception of the insureds. 75% of Riverine insureds viewed riverine flooding as serious vs. 53% of all coastal and 51% of those insured in the Study Area. Lower frequency of coastal flooding and the high demand for recreational, aesthetic, and other benefits of coastal areas, may be factors in explaining such a discrepancy between riverine and coastal flooding perceptions.

Table 4: Perception of the Flood Problem

	Sample Size	Serious	Minor	Unimportant	Row % Total
Insureds					
Coastal	774	53%	30%	17%	100%
Study Area	199	51%	35%	14%	100%
Riverine	329	75%	13%	12%	100%
Uninsureds					
Coastal	639	26%	29%	45%	100%
Study Area	105	22%	21%	57%	100%
Riverine	313	28%	23%	49%	100%

Table 3. Recovery for Past Most Serious Disaster

I = Insured -I = Uninsured	$500 to $2,500		$2,500 to $10,000		More than $10,000	
	I	-I	I	-I	I	-I
A. Funds as Percent of Damage (Averaged over all Victims)						
Source of Recovery Funds						
Insurance	78%	6%	68%	5%	30%	14%
Government Loans	0	35%	20%	27%	8%	42%
Savings	88%	91%	30%	43%	12%	30%
Bank Loans	3%	8%	6%	3%	1%	5%
Total	169%	140%	124%	78%	51%	91%
Sample Size	22	73	27	93	16	57
B. Percent of Victims Using Various Sources						
Insurance	82%	10%	93%	15%	81%	44%
Government Loans	0	15%	22%	43%	25%	70%
Savings	68%	82%	74%	82%	81%	77%
Bank Loans	5%	10%	7%	8%	6%	14%
Some Source	95%	88%	100%	97%	82%	97%
Sample Size	22	73	27	93	16	57
C. Funds as Percent of Damage (Averaged over Victims using Source)						
Insurance	96%	61%	74%	30%	37%	31%
Government Loans	0	233%	90%	62%	34%	59%
Savings	128%	110%	40%	53%	15%	38%
Bank Loans	62%	88%	83%	35%	11%	36%
Total	177%	160%	124%	80%	59%	93%
Number with Some Source	21	64	27	90	14	55

[As used throughout the Wharton materials, "Coastal" refers to the 28 coastal communities surveyed by the Wharton team; "Riverine" refers to the 15 riverine communities in the Wharton survey; and "Study Area" means the 11 coastal communities in the author's FIA study that are a subset of the "Coastal" group. Where feasible the author has prepared tables in both tabular and graphic form, to enhance interpretation of the data].

Past Damages. Past experience with flooding to respondents' present homes was the most important factor in individuals' perception of seriousness of flooding problems. Among uninsureds there were relatively few who had suffered significant amounts of past damage in Coastal and Riverine areas. Overall about 81% of both Coastal and Riverine uninsured respondents sustained no damage, and 96% of uninsureds in the study area had not. More uninsured Coastal respondents tended to sustain damages greater than $5,000 than their Riverine counterparts. As shown in Table 5, the sharpest contrasts were between insured Coastal and Riverine respondents. Whereas 77% and 80% of the Coastal and Study Area insured respondents, respectively, had sustained no damage, only 41% of the Riverine insureds had not. The amounts of damages sustained follow in the same pattern as the uninsureds: heaviest Riverine damages are in the range below $5,000; Coastal damage experience tends to increase above $5,000.

Table 5: Past Damage to Present Home

	Sample Size	None	$1 to $1000	$1001 to $5000	$5001 to $10000	More than $10000	Row % Total
Insureds							
Coastal	598	77%	5%	4%	4%	10%	100%
Study Area	169	80%	3%	8%	4%	5%	100%
Riverine	218	41%	16%	20%	11%	12%	100%
Uninsureds							
Coastal	406	81%	5%	4%	5%	5%	100%
Study Area	45	96%	-	4%	-	-	100%
Riverine	182	82%	8%	6%	3%	1%	100%

If individuals were aware of a coastal flood hazard before moving they were more likely to treat the hazard as a serious problem than those who were not aware before moving. Furthermore, those who had lived in the coastal area, particularly the high hazard zones, were less likely to view the flood problem as serious than those who had just located in the area. [These phenomena were also noted spontaneously by a number of realtors to whom the author spoke in the course of his study. High percentages of the individuals seeking coastal properties are coming from other areas of the country. Several realtors noted that many of these are concerned about coastal flooding conditions, and inquire about the availability of flood insurance and measures taken to reduce the susceptibility

of the property they are buying to coastal flood damages]. The reverse appeared to be true in riverine areas: the longer one resided in the riverine area, the greater the chance that the flood hazard would be viewed as a serious problem.

Expectations of future damage. Expectations of future damage varied according to flooding experience and provided contrasts between the Riverine, Coastal, and Study Areas. By experience is meant post-flood damage to any house the person has resided in. In Table 6, the pattern noted previously between Riverine and Coastal respondents is present, that is, homeowners in Riverine areas expect less damage than those in coastal areas for both the experienced and inexperienced groups.

Note in Table 6 that 88% of those who have experienced coastal flooding in the Study Area expect greater than $10,000 damage in the next severe disaster. For the entire field survey only 66% of those with past flooding experience in coastal areas and 55% of those who had experienced riverine flood damage expect more than $10,000 damage.

Table 6: Distribution of Expected Damage to Property from a Future "Severe" Disaster.

	Sample Size	None	$0 to $10000	$10001 to $30000	More than $30000	Don't Know	Row % Total
Experienced							
Coastal	221	7%	27%	43%	17%	6%	100%
Study Area	41	2%	10%	59%	29%	-	100%
Riverine	235	4%	41%	34%	12%	9%	100%
Inexperienced							
Coastal	1192	18%	20%	30%	23%	9%	100%
Study Area	263	14%	19%	25%	28%	14%	100%
Riverine	407	35%	23%	24%	12%	6%	100%

Attitudes toward Rebuilding in Coastal and Riverine areas after one's home is destroyed and the reasons therefor also vary with experience. The attitudes as between all Coastal areas and the Study Area proved to be quite congruent in this portion of the field survey, and both contrast sharply with Riverine attitudes, as shown by Table 7. Homeowners living in Coastal areas were more likely to rebuild on the same site than Riverine homeowners if their house were destroyed by flood, thus exposing their properties to further damages. However, as between those who had experienced past damages and those who had not, the experienced were less likely to rebuild than inexperienced homeowners. It is striking to note, nonetheless, that there were over five times as many coastal respondents who had not experienced damage as were experienced,

while a significantly smaller proportion of the riverine respondents had not experienced flood damages.

Table 7. Attitudes toward Rebuilding on the Same Site If the House Were Destroyed

E = Experienced -E = Inexperienced	Coastal		Study Area		Riverine	
	E	-E	E	-E	E	-E
Would Rebuild	42%	63%	50%	62%	19%	34%
Would Not Rebuild	58%	37%	50%	38%	81%	66%
Sample Size	203	1051	40	236	214	366
Reasons Would Rebuild						
Desirable Area	29%	41%	40%	42%	14%	21%
No Fear of Recurrence	2%	8%	2%	7%	3%	7%
Financial Reasons	9%	11%	8%	10%	2%	4%
Other Reasons	2%	3%	-	3%	-	3%
Reasons Would Not Rebuild						
Fear Recurrence	32%	16%	20%	13%	56%	38%
Other Reasons	26%	21%	30%	25%	25%	27%
Column Percent Total	100%	100%	100%	100%	100%	100%

A few more examples may be desirable as we look at contrasts in the behavior and attitudes of Riverine and Coastal respondents toward mitigation and relief programs.

Government Responsibility for Personal Losses. Whether out of independence, lack of flood damage experience, lack of awareness of government disaster relief or subsidized insurance, or some other reason, people living in Coastal flood hazard areas tended on average to expect less government responsibility for paying personal damage losses than their Riverine counterparts. People in the Study Area expected even less than the average of all Coastal areas surveyed. These differences in expectations existed whether the individuals were experienced or inexperienced, insured or uninsured, and are presented in Table 8.

[Table 8 on following page]

Table 8. Attitude Toward Government Responsibility for Personal Losses

	Sample Size	All or Most	Little or None	Row % Total
Coastal				
Experience	216	33%	67%	100%
No Experience	1171	26%	74%	100%
Insured	759	26%	74%	100%
Uninsured	628	30%	70%	100%
Study Area				
Experience	38	16%	84%	100%
No Experience	258	18%	82%	100%
Insured	193	16%	84%	100%
Uninsured	103	21%	79%	100%
Riverine				
Experience	234	53%	47%	100%
No Experience	406	35%	65%	100%
Insured	328	46%	54%	100%
Uninsured	212	37%	63%	100%

Protective Measures. Another set of contrasts was provided using field survey data that indicated percentages of individuals who had adopted protective measures. In Table 9, below, slightly over one-quarter of all Coastal and Riverine flood respondents had taken protective measures, with a substantially lower percentage of Coastal respondents taking action than Riverine. Yet Coastal respondents who did take action typically spent more than their Riverine counterparts. Similarly, more insureds took action and spent more than uninsureds. However, inexperienced homeowners who adopted protective measures spent more than their experienced counterparts.

Table 9. Homeowners' Adoption of Protective Measures

E = Some Experience
-E = No Experience
I = Insured
-I = Uninsured

	Overall	-E	E	I	-I	Coastal	Riverine
Sample Size	2055	1599	456	1103	952	1413	642
Percent Taking Action	27%	23%	40%	31%	22%	22%	36%
Percent Knew Cost of Action	19%	17%	30%	23%	15%	16%	26%
Average Amount Spent per Action	$1,370	$1,500	$1,110	$1,460	$1,210	$1,620	$1,030

Although time and budget did not permit a deeper analysis of the Wharton School flood survey materials, nevertheless some measure of the differences between riverine and coastal flooding contexts was made. The quantities are statistically significant and tend to corroborate the hypothesis that coastal and riverine flood loss characteristics are distinctly different (both physically and in people's anticipations of and reaction to the different experiences). They further indicate a need to know more about the demand side of the market for insurance, an area that has been explored relatively little in the existing literature. As noted by the Wharton study team:

> ". . .[O]ur findings suggest that in developing institutional mechanisms for shifting risks involving low-probability events, considerably more emphasis must be placed on the demand side of the market. We know a great deal about why markets fail due to imperfections affecting the supply side (the insurance companies) but we are only beginning to learn about the imperfections of individuals in processing information and making decisions."

As noted earlier, the principal federal institutional mechanism for shifting flood loss risks to those at risk is the National Flood Insurance Program. The next sections review the author's findings with respect to the operation of the National Flood Insurance Program, derived from his field research during this study.

Impacts of the National Flood Insurance Program in Fifteen Coastal Communities.

Since inception of the National Flood Insurance Program a strikingly high percentage of communities participating in the regular program have been coastal communities. Within the eighteen coastal states from Maine to Texas, nearly 60% of the communities currently in the regular program are coastal, and these, in turn, constitute over 30% of all communities in the regular program nationwide. [See Table 10]. Criticism leveled against the National Flood Insurance Program regarding its effectiveness in promoting wise use of flood plains, some of which has stemmed from coastal communities, makes it desirable to investigate the effects of the Program on non-federal regulatory efforts, building construction practices, and lending institution policies. Specifically, the Federal Insurance Administration asked the author to study fifteen communities on the Atlantic and Gulf of Mexico coasts, and in southern California, and to address four basic questions:

1. Does the National Flood Insurance Program support non-federal efforts to reduce flood damages which are more restrictive than the Program's requirements?

2. How do the Program's actuarial rates and flood plain management regulatory requirements affect demand for property and construction practices?

3. What is the effect of the National Flood Insurance Program on property values?

4. What is the effect of the National Flood Insurance Program on lending practices?

In the following pages each of these questions are addressed in order.

Does the National Flood Insurance Program support non-federal efforts to reduce flood damages which are more restrictive than the Program's requirements?

The first criticism from which this question arose was made by Rhode Island, but has not become a general issue elsewhere to date. Briefly, state coastal authorities in Rhode Island found the emergency program's regulations "totally inadequate" and stimulated shorefront development. They asserted that the regular program regulations were less than compatible with sound coastal management objectives insofar as the Program tacitly affirms development in coastal high hazard areas. Finally, the state Coastal Resources Management Council asserted that communities imposing more restrictive regulations than required by the FIA must do so without positive leverage exerted by the National Flood Insurance Program in all of its regulatory, financial, and insurance aspects.

The interactions of the flood insurance program with state coastal zone management efforts in Rhode Island were summarized by Malcolm Grant of the University of Rhode Island's Coastal Resources Center at Kingston, R.I. in February 1976:

> "In terms of our experience with the federal Flood Insurance Program, quite frankly as far as barrier beaches are concerned, it has been

TABLE 10

Atlantic and Gulf of Mexico
Coastal Communities in
the Regular Phase of the
National Flood Insurance Program
as of April 15, 1977

Coastal State	Coastal	Total	Percent Coastal
Maine	0	1	0%
New Hampshire	0	1	0%
Massachusetts	18	24	75%
Rhode Island	15	21	71%
Connecticut	1	5	20%
New York	13	26	50%
New Jersey	43	77	56%
Delaware	9	15	60%
Maryland	3	5	60%
Virginia	4	16	38%
North Carolina	12	25	48%
South Carolina	9	18	50%
Georgia	3	15	20%
Florida	86	94	91%
Alabama	2	12	17%
Mississippi	12	18	66%
Louisiana	11	24	46%
Texas	44	84	52%
Total	287	481	60%

Source: Author, using FIA community participation data as of April 15, 1977

Total Communities in NFIP Nationwide	15,259
Total Communities in Regular Phase Nationwide	897
Total Floodprone Coastal Communities Nationwide	1,514+

anything but good. There was a definite coincidence of increased development pressure in the early 1970's once the flood insurance program was introduced in the state. We found that in the barrier beaches, especially with the emergency program, the structural standards that were imposed on the community were totally inadequate to discourage the type of development that the act was designed to discourage. In fact it had the opposite effect and stimulated development such as shorefront homes. We find that the standards under the regular program are an improvement, but still are substantially less than what would be compatible with sound coastal management objectives. We have found that certain of our coastal communities, in responding to the federal program, have come up with some very good regulations, but they have only done so by substantially exceeding the federal requirements. We feel that the program can be of much greater assistance to us in managing areas that the coastal council has only limited jurisdiction over, but as far as the open ocean shoreline, we have the velocity problem and it has created a great number of problems." [Source: "The Ocean's Reach, Digest of a Workshop on Identifying Coastal Flood Hazard Areas and Associated Risk Zones", New England River Basins Commission, February 1976, at pp. 8 - 9].

In fairness to the National Flood Insurance Program, the coincidence of increased development pressure once the Program was introduced cannot be entirely placed on the Program. Early efforts in Rhode Island at the state level to control development on the barrier beaches and dunes were made through state insurance laws and the Rhode Island Department of Health requirements for percolation tests and on-site sewage disposal systems. When changes were made in the state insurance and sewage disposal laws relaxing the restrictions previously imposed, thirty-one building permits for residential construction on South Kingstown's Green Hill Beach alone were issued. The demand for building permits on Green Hill Beach existed for several years before South Kingstown entered the National Flood Insurance Program. Owners interviewed by the author have uniformly stated that they were well aware of the hazards of building on Green Hill Beach and wanted to do so whether or not they had flood insurance.

However, the other facets of the Rhode Island experience stand basically unchallenged as to that state. A question remains whether the Rhode Island experience (1) is prevalent, and (2) exists elsewhere.

Prevalence of the Rhode Island experience. The Rhode Island experience is not prevalent in other coastal regions of the country, apparently for two reasons: (1) most other state coastal zone management programs have not advanced to the stage reached by Rhode Island; (2) most other states and communities have made no attempt to restrict development in coastal high hazard areas to the extent that Rhode Island has. No state or local official with whom the author conferred reported similar development pressures that he or she could attribute to the National Flood Insurance Program.

In many coastal areas one finds a great market demand for ocean-related living and recreation, a demand that peaked in the mid- to late-1960's and early 1970's, before the recession. The demand existed well before the National Flood Insurance Program was in force. Moreover, the development response to the risks of hurricanes has been predominantly an engineering response, certainly not foregoing development on desirable land for the natural flood protection

benefits of beaches, sand dunes, and vegetation. The development response to the low-probability, high-damage-potential event is to view the low probability as an investment opportunity, and the high damage potential as a strength factor to be engineered into the structure.

Experience elsewhere. While the Rhode Island experience is not prevalent, their experience is repeated elsewhere:

> First, there is a distinct pattern that both states and communities treat the FIA minimum flood plain management requirements as maximum requirements. Of the fifteen communities studied, only South Kingstown, R.I. has enacted a comprehensive coastal flood plain management ordinance that substantially exceeds the FIA minimum requirements. Five of the study communities are in compliance with the FIA minima; nine are substantially complying with the FIA minima, but are in technical noncompliance over certain provisions.
>
> Repeatedly throughout the study state and local officials stated that they needed the "clout" of the Federal Insurance Administration in order to enact even the minimum FIA flood plain management requirements. Without that federal leverage only a very small percentage of communities will venture beyond the FIA minima.
>
> Secondly, some states, such as South Carolina, have not moved to implement (or adopt) a state coastal zone management program, but seek assistance or leverage from FIA over coastal flood related problems, e.g., South Carolina's attempt to enjoin a developer from leveling and removing sand dunes on accreted land and to restore the property to its original condition on Isle of Palms. The experience of both South Carolina and Rhode Island indicates a need for an active, affirmative role by FIA to support good flood plain management beyond encouragement of more restrictive standards by others, and beyond the current FIA minimum requirements.
>
> Thirdly, there are examples other than in Rhode Island where the availability of flood insurance has a direct cause/effect relationship between financing and development. The strongest of these found to date was in Galveston. These are discussed more fully in the section on the effect of the National Flood Insurance Program on lending practices.

In sum, there are forces inherent in the regulatory, financing, and insurance aspects of the National Flood Insurance Program that do not support non-federal efforts toward more restrictive requirements than the Program's. That they are not more prevalent may be attributable to the stage of development most coastal zone management, and other federally mandated programs are in, as well as the prevalent lending and development practices elsewhere in the country.

However, there are a number of positive aspects and potentials about the National Flood Insurance Program that were noted during the course of the study. These include: the enforcement of existing regulations and a perceived willingness of many local officials to enforce more stringent FIA regulations; and an unexpectedly high acceptance of the Program by the financial community.

Enforcement. If the National Flood Insurance Program were not well received one of the areas where it might fail would be in enforcement of the existing regulations, especially through variances, violations, or other means by which the regulations might be circumvented. Throughout the study communities a remarkable and unexpectedly high degree of enforcement of the existing regulations was found, corroborated by state and local officials, lending institutions, realtors and developers, and community records. Although nine of the study communities are technically in noncompliance with the Program's requirements, there appears to be substantial compliance with the existing regulations. Of course, one can point to technical violations in the various study communities, but these appear generally to be the exception. The spirit of the existing building regulations for flood plain development was being enforced to a higher degree than anticipated. The keys to the enforcement are the availability of financing and lending institution support of flood insurance. Several instances have been reported to the author by lending institutions, developers, and realtors, wherein the FIA minimum building requirements help to secure the investments because they reduce the property's susceptibility to flood damages.

With the exception of the four Florida Gulf coast communities, few flood elevation variances have been granted. Attitudes differed markedly toward the community building regulations and variances. The principal variables were past experience with hurricanes and fear of losing community eligibility in the National Flood Insurance Program with its resulting loss of federally-assisted financing. For instance, in Waveland, Mississippi, severely damaged in August 1969 by Hurricane Camille, where the experience is freshly imprinted in people's memories, Mayor Longo stated simply: "If they don't want to comply with the elevation requirements, they don't get a building permit." In contrast, in those communities that have not experienced recent hurricanes and where the pressure to develop available coastal properties is considerable, developers and realtors tended to argue for the right of the property owner to develop his or her property without government (particularly federal) restriction. In such instances, local officials were nearly unanimous in stating that without a federal requirement for community participation in the National Flood Insurance Program, their community would not be able to support the building requirements politically.

Variances. The only significant pattern of variances to the FIA minimum building requirements found in any of the communities studied was on the west coast of Florida, and these were in strict compliance with the FIA criteria for variances. The four Florida Gulf coast communities (Redington Beach, Madeira Beach, Treasure Island, and St. Petersburg Beach) are developed on the order of 85% to 98%, and have had extensive contacts with the FIA over criteria for variances. The pattern in these communities has generally been to grant no flood elevation variances in their formally identified coastal high hazard zones, and to grant variances for residences located on lots of less than one-half acre where the subdivision is developed more than 90%. These four communities vary in their interpretation whether flood elevation variances can be granted for commercial development or multi-family residential development -- two have granted a limited number of commercial variances, two have not. The FIA variance criteria leave room for both interpretations. In each case, there is evidence of close attention to the minimum FIA flood plain management criteria -- and no more.

Where variances are being granted there is a growing, although not prevalent, trend that homeowners are comparing the costs of elevating their homes versus the annual cost of flood insurance, and deciding to elevate. There is also some evidence that failure to elevate affects the later saleability of a home, encouraging developers to comply with the minimum flood elevation requirements. These are discussed in the section below on the effect of actuarial rates on demand.

Response to FIA's minimum requirements. An unexpected facet of the finding that most communities will not go beyond the FIA minimum requirements voluntarily is a perceived willingness of most of the local officials interviewed to support more stringent regulations if FIA requires them. The basic motivation for this is the importance of federally assisted financing to each community.

In the communities studied there was a remarkable degree of support for the National Flood Insurance Program despite a number of administrative complaints. One hears fairly consistent complaints about the quality of the technical information and about the flood rate maps, particularly at the margin of flood zones, about the length of time it takes to get a response to a written inquiry, the complexity of the Program and their difficulty in understanding and implementing it at the outset, etc., but running through those complaints is a consistent thread that the National Flood Insurance Program is a good program and they want it to work effectively for them.

Financial Community Response. Federally assisted financing is basic to the force of the National Flood Insurance Program. Community eligibility in the Program and the availability of federally assisted financing are the basic authorities of the Program, and potentially its greatest vulnerability. The author's previous work expressed concern that there are few, if any, formal linkages between federally assisted financing and sound coastal flood plain management. That observation remains true, but must be qualified for it does not take into account the strength of the market forces that support this Program. Thus, in this study it was important to assess the degree of support or lack of support from the financial community in evaluating the effectiveness of the Program.

Financial institution learning period. The principal institutions financing coastal residential and commercial development in each of the study communities were sought out. In most communities these were local savings and loan associations. Almost every institution reported a similar pattern -- a difficult initial learning period characterized by confusion, lack of maps and difficulties in using those that they had in the office without field checks, and difficulties by clients in obtaining coverage. After a turbulent adolescence, and by the time the community entered the regular flood insurance program, lending procedures involving flood insurance settled into a routine and normal part of processing loans.

This learning experience was found in all of the communities studied, and was volunteered by individual lenders so often that it is a basic finding. Corroboration in Florida came from a federal savings and loan examiner who reported that in his experience throughout Florida the federal savings and loan associations have strictly complied with the flood insurance requirements. He also reported the pattern described above and said that during the initial period his examinations revealed a number of difficulties that savings and

loan associations were having with compliance. With experience and better understanding of the requirements flood insurance becomes routine and automatic in loan processing.

Impact of flood insurance on financing. Undergirding all of the responses from financial institutions was that flood insurance has had no discernible negative impact on demand in their experience. It is one of several factors raising the cost of financing to the consumer, but most importantly from a business perspective, it is having no negative impact on demand that they could discern. While four or five of the lenders affirmed that flood insurance makes money available where it previously was not, almost all stated that they felt their loans secured by real estate located in flood plains were more secure than before.

Consumer response. Several lending institutions reported consumer responses to flood insurance requirements. Some consumers inquire about flood insurance, are told what it was for and why it was required, shrug their shoulders, and proceed to the next item of business. However, some lending institutions and some realtors reported that increasingly prospective home owners seeking coastal properties are inquiring about potential flooding and hurricane hazards, the availability of flood insurance, and measures taken to protect property. In such situations, the availability of flood insurance and the community building requirements complying with FIA regulations generally serve to reassure the prospective purchaser.

How do the Program's actuarial rates and flood plain management regulatory requirements affect demand for property and construction practices?

Concern about the effect of actuarial rates and flood plain management requirements on demand for property are at least threefold: (1) Do they depress demand for coastal property? (2) Do they increase demand for coastal property? or (3) Do they alter demand for coastal property, i.e., alter basic decisions regarding development or use of the property?

1. Do existing actuarial rates depress demand for coastal property? No evidence was found during the study to conclude that current actuarial rates depress demand for coastal property. Actuarial rates are used in all of the study communities except San Diego County (which is in the "emergency" program). Thus, the cost of flood insurance for new construction in these communities is the actuarial rate. Realtors and lenders in each community reported that they could discern no decrease in demand for coastal properties attributable to the cost of flood insurance.

The period of 1972 to present, when most communities entered the regular flood insurance program, was marked by the peaking of the real estate "boom" of the mid- to late-1960's and the depressing effects of the recession. Those forces overwhelmed any possible depressing effect of the actuarial rates. However, the most common experience that realtors and lenders reported was that where coastal sales took place the prospective owner generally lacked knowledge about flood insurance, and if he or she inquired about it at all, accepted it once the requirement and the rationale were explained. As one realtor stated: "It's just one more factor of many that are increasing the cost of housing. The people want the properties and they'll pay the cost of the flood insurance."

Actuarial costs of flood insurance. Instances were noted in both Rhode Island and in Galveston where developers had purposely elevated structures two or more feet above the 100-year flood level in order to take advantage of the lowest actuarial rates. One Galveston developer stated: "I have the best of all possible worlds. Not only has the flood insurance program made money available for development on the west end, but by spending a couple hundred dollars for extra length of pilings, I elevate the house two feet above the 100-year flood level and I can get flood insurance for $25.00 per year."

The relationship between actuarial rates and elevation is shown below in Table 11.

Table 11

Assumptions - $35,000 coverage on one-family residential structure, one story, no basement, FIA Zone A8.

Elevation of first floor above or below 100-year flood level	Rate per $1000 coverage	Annual cost of insurance *
+3 ft. or above	$0.10	$25.00
+2 ft.	$0.20	$25.00
+1 ft.	$0.70	$39.50
100-year level	$1.60	$71.00
-1 ft.	$3.10	$108.50
-2 ft.	$5.50	$207.50
-3 ft.	$9.30	$340.50
-4 ft.	$14.80	$533.00
-5 ft.	$23.40	$834.00
-6 ft.	$28.60	$1,016.00

* Includes expense constant.

Actuarial rates and variances. A review of the costs of flood insurance was made in the four Florida Gulf coast communities that have granted more flood elevation variances for single family residences than any of the other study communities. Review of the variance applications showed a pattern of requests for 4 ft. variances for the typical single family, one-story residences in the A15 Zone. The cost of flood insurance for such structures with first floor levels 4 ft. below the 100-year flood level is $10.00/$1000 coverage. Average policies for the four communities range from $26,200 in Madeira Beach to $33,400 in Redington Beach, as of July 31, 1976. Structural flood insurance costs on new construction would thus range on average from $262/year in Madeira Beach to $334/year in Redington Beach. If the homeowners built at the 100-year flood level, the cost of the flood insurance would be $1.90/$1000 coverage, or an average cost in the range of $50 - $63 per year, an average difference

of $212 - $271 per year in the four communities. Additional flood insurance savings -- to a minimum policy cost of $25.00 per year -- would be realized by home owners if they were to elevate their homes above the 100-year flood level, as illustrated in Table 11, above.

Obviously, for those asking for the variances the actuarial rates are not prohibitive, and have not decreased demand. Both the Wharton field survey data and the author's previous study in Rhode Island found that property owners who voluntarily buy flood insurance consider flood insurance to be a bargain. The Wharton data and the author's previous finding were basically corroborated during this study, and no evidence was found that the cost acts to depress demand or to cause property owners to locate elsewhere.

2. Do existing actuarial rates increase demand for coastal property? The key variable whether the flood insurance increases demand for coastal property appears to be local lending practices, with an indirect assist from the flood plain management requirements. If local lending institutions previously refused to take mortgages in flood hazard areas before the community entered the National Flood Insurance Program, but changed their lending practices after the community entered, there is an immediate and direct cause/effect relationship to demand for property in the former exclusion area. The experience of both Rhode Island and Galveston, Texas demonstrate this point, and their cases are discussed below, under the effect of the National Flood Insurance Program on lending practices.

Although lending institutions in 5 of the 15 study communities had previously restricted lending in coastal flood hazard areas, the author believes that that ratio is not generally representative in all coastal states. A significantly larger fraction than two-thirds of the lending institutions can be expected to have exercised no such restrictions before their community entered the National Flood Insurance Program. This untested surmise is based on the level of coastal development observed, the tendency of coastal inhabitants to downgrade the seriousness of coastal flooding found by the Wharton School survey on lenders' perceptions of financial risks in the face of low-probability coastal flooding events, and the financial "momentum" of coastal development noted by several lenders.

3. Do existing actuarial rates alter demand for property? There is limited evidence that some people will voluntarily alter their decision whether to elevate their home or to request a flood elevation variance because of actuarial rates, but this practice is not prevalent in the study communities. A few examples were cited during the study of individuals who elected to elevate their house after determining the cost of flood insurance vs. the cost of elevating. When amortized over the life of a mortgage the additional cost of elevating the structure can be competitive with the additional cost of flood insurance that will result if the owner does not elevate. No figures are available to estimate what fraction of homeowners will make such a decision, but the author believes that it is small.

4. Do existing actuarial rates affect construction practices? Throughout the study communities the author observed much new construction elevated on pilings, fill, or other materials such that the first floor was above the 100-year flood level. Developers and realtors generally reported that these building practices are now quite routine in their communities. Anecdotes

were told of builders' experiences where the failure to elevate affected the saleability of the house because of the cost of flood insurance. Shortly thereafter they changed their construction practices and now all of their buildings comply with the FIA minimum requirements.

Where lending institutions had restricted mortgages in flood hazard areas, lending institutions may be bringing pressure to bear on builders to comply with the minimum FIA requirements as a condition of obtaining financing. This was reported to be the case by one developer in Galveston and may be happening elsewhere. No hard information is available to estimate whether this phenomenon is prevalent. If it is, it would be one of the most significant market forces that could be brought to bear on behalf of coastal flood plain management.

5. Do existing flood plain management requirements depress demand for coastal property?

No evidence was found of any decrease in demand attributable to the existing regulations.

6. Do existing flood plain management requirements increase demand for coastal property?

There is some evidence that the flood plain management requirements may help to increase demand in those communities where lending institutions have restricted flood hazard area financing. Where lending practices were changed when flood insurance became available to secure loans, lending institutions in Rhode Island and Galveston reported that they consider that the flood plain management requirements are additional security on the loans. Thus, insofar as the flood plain management requirements reduce the susceptibility of the mortgaged structure to flood damages, they play an important role in making financing available in those communities where lending institutions had previously excluded certain areas from mortgage financing.

7. Do existing flood plain management requirements affect construction practices?

Clearly, yes. The building codes of 13 of the study communities, and the zoning ordinance of one, had been amended to comply with the minimum FIA flood plain management requirements. Evidence is strong and observable that the study communities are complying substantially with the existing requirements for new construction.

8. Do existing FIA flood plain management requirements affect where coastal flood plain development is taking place?

Clearly, no. The FIA regulations prior to the recent changes were almost exclusively vertically oriented, i.e., one could build wherever one wished in a coastal flood hazard area so long as the structure was elevated. The new regulations extend somewhat beyond the former, but are still basically vertical in orientation. That policy will mitigate some damages, but is too narrow a range of flood plain management options to be sound in all coastal flooding conditions. This point is addressed more fully below in Future Directions for Coastal Flood Plain Management.

What is the effect of the National Flood Insurance Program on property values?

Where, as in Galveston, there is a direct cause/effect relationship between the availability of flood insurance and the availability of financing for development, the effect of the National Flood Insurance Program is to increase property values of theretofore undeveloped land. In such communities financing freed by the availability of flood insurance is the key to new development.

Where, as appears to be most prevalent in the coastal zone, lending institutions have not restricted financing in coastal flood hazard areas, the values determined by real estate market supply and demand will prevail, adjusted by the additional costs of complying with the flood plain management requirements.

Costs of Compliance. No consistent pattern of cost to comply with the FIA elevation requirements emerged from interviews with developers. The impact of cost on the buyer depends in large measure on the developer's assessment of his market. In the lower price ranges it is fairly common to decrease the quality of materials, fixtures, and equipment placed in the house in order to keep the selling price in the desired range. In higher priced houses, the additional cost is more likely to be passed on to the buyer without any decrease in quality of materials, fixtures, and equipment.

The primary impact of flood proofing appears to be on structures selling for less than $40,000, where the quality of materials, fixtures, and equipment is more likely to be decreased than to increase the cost of the structure. No developer reported any discernible adverse effect on demand for higher priced housing.

5. What is the effect of the National Flood Insurance Program on lending practices?

There were basically two types of lending practices followed by financial institutions in coastal high hazard areas before the National Flood Insurance Program: those that financed properties in such areas, and those than did not because of the threat of storm damages.

In most coastal communities the National Flood Insurance Program has not affected the basic investment decision on availability of financing. In such communities the principal change in lending practices wrought by the Program is the requirement of flood insurance as a condition of financing. The evidence is very strong that the financial community accepts and enforces flood insurance. The view of the financial community as a (perhaps the) prime enforcer of flood insurance was quite unexpected and may be the most significant finding of the study.

The author reported previously the restricted lending practices for coastal flood hazard areas in Westerly, Charlestown, and South Kingstown, R.I. and during this study inquired in each community for similar examples. New evidence of such restricted lending practices was found in Galveston, Texas.

In Westerly, Charlestown, and South Kingstown, R.I., real property sales and development had continued despite the voluntary withdrawal of all the local banks from the first mortgage market in the coastal high hazard areas that had suffered severe damages during the 1938 and 1954 hurricanes. The clearest impact of the National Flood Insurance Program in these communities was that

it changed the place where financing was being obtained, and changed financing in the high hazard areas from second mortgages and savings, much of which was from out of state, to first mortgages in the local Rhode Island banks. Lending institutions in Rhode Island have almost unanimously reversed their previous lending policies in coastal high hazard areas, and take first mortgages on properties in the previous exclusion area, secured by flood insurance.

There are two savings & loan associations in Galveston, and they effectively control the greatest part of residential financing in the city. Before the city entered the National Flood Insurance Program both associations had a general policy not to finance properties in the low-lying, unprotected, and flat area west of the Galveston seawall. One association adhered to the policy strictly; the other was a bit more liberal if a client was particularly creditworthy. The no-financing policy effectively curtailed subdivision development in the area with the exception of one subdivision where a Houston savings & loan association was willing to finance.

Both Galveston firms reversed their lending policies in the area when Galveston entered the National Flood Insurance Program. One of the lenders stated: "The flood insurance was great for us. It caused us to make loans where we wouldn't make them before. If we were cut off, we would have to revert to the old policy." All of the local realtors and developers interviewed during the study affirmed that flood insurance made financing available and directly led to opening the west end of the island to development. One of the largest developers there said: "Flood insurance was a big shot in the arm for the industry. Until it became available and freed up financing, the industry was at a standstill because of the economy and the lack of financing." Both could not be stronger statements of the market forces supporting flood insurance.

How prevalent the restrictive coastal flood hazard area lending practices were before the National Flood Insurance Program could not be measured during this study. That such practices were found in one-third of the study communities feels extraordinary, in light of a number of other factors previously mentioned. A smaller fraction seems more likely.

Implications of the National Flood Insurance Program for Coastal Communities.

Viewed in the historical perspective of federal strategies for flood loss management, the National Flood Insurance Program strikes a balance between no federal involvement and complete federal assumption of both flood control and disaster relief costs, between structural flood control works to reduce the scope of flooding and multiple combinations of flood plain management regulations to reduce susceptibility to flooding. At issue is not whether the Program can work, but whether it will be allowed to work. Although less than a decade old, the Program has shifted from voluntary community participation to mandatory participation, and has now turned to a hybrid of mandatory and voluntary participation pursuant to 1977 amendments to §202(b) of the Flood Disaster Protection Act of 1973.

At this juncture it is too early to predict what impact amendment of §202(b) will have in coastal communities. One conclusion of the Wharton School survey was that in dealing with low-probability, high-risk hazard phenomena such as floods there is a threshold below which people will not concern themselves with the hazard. This phenomenon appeared to be quite pronounced in coastal

communities -- the longer people live in coastal areas the more likely they are not to consider coastal flooding a serious problem. In contrast, however, nearly 30 percent of all communities currently participating in the "regular" flood insurance program are coastal communities along the Atlantic and Gulf of Mexico seaboards, almost all of which entered the Program voluntarily. Unless extraordinary political pressure is brought to bear by local constituents to leave the National Flood Insurance Program, the author estimates that relatively few coastal communities bordering the Atlantic and the Gulf of Mexico will revoke their participation in the Program.

Implications for coastal high hazard zone management. One impact of repeal of the community participation requirements is fairly predictable based upon the author's study -- it will be increasingly difficult both for the Federal Insurance Administration and for local communities to strengthen their flood plain management regulations beyond the minimum requirements now in force. During the study, local officials commented frequently that they had to rely upon the federal flood plain management requirements as the basis for amending local building regulations. They will lose some of that "clout" henceforth unless sentiment is strong within the community to remain in the Program.

From the outset of the National Flood Insurance Program its minimum flood plain management requirements have been predominantly building requirements, directed principally to elevation of structures and use of flood resistant materials to reduce susceptibility to flood damages. Recent changes in FIA's regulations are an initial turn from the almost exclusively vertical orientation (elevation of structures) of previous regulations toward a combined vertical and horizontal orientation, and are particularly relevant to coastal high hazard areas. These include:

1. Prohibition of man-made alteration of sand dunes and mangrove stands within coastal high hazard zones which would increase potential flood damage [24 CFR 1910.3(e)(8)];

2. Community issuance and review of permits for development in flood-related erosion-prone areas, to determine whether the proposed development will be reasonably safe from such erosion and will not cause or aggravate erosion hazards [24 CFR 1910.5(a)]. If the proposed development is in the path of flood-related erosion or increases the erosion hazard, the community is to require the development to be relocated or adequate protective measures to be taken so as not to aggravate existing erosion hazards. [24 CFR 1910.5(a)(3)].

   After delineation of the erosion hazard zone, the community is to require a setback of all new development from the ocean, bay, or other waterfront area, to create a safety buffer consisting of a natural vegetative or contour strip, which may be used for open space purposes. [24 CFR 1910.5(b)(2)].

3. Encouragement of the formation and adoption of comprehensive management plans for flood-prone, mudslide-prone, and flood-related erosion-prone areas. While not mandatory, communities participating in the National Flood Insurance Program are to

> evaluate a diverse range of enumerated planning considerations or standards which singly or in combination could significantly reduce flood and erosion loss susceptibility. [24 CFR 1921 - 1926].

The changes made in FIA's regulations are sound in terms of coastal flood loss management, balancing the demand for development in coastal areas with the need to recognize the physical and environmental hazard potentials of development in those areas. Some gaps remain -- FIA's regulations do not address vital areas needed for habitat, natural system productivity, or the physical integrity of the coast, where no development should take place, nor discern between types and degrees of hazards (scouring, battering, flooding, and wind) as one moves inland from the shoreline -- and certain refinements of FIA's regulations would be desirable. However, the Congress having spoken forcefully in amending §202(b), the predominant strategy called for over the next two to four years may be to acknowledge and improve upon the gains that have been made, and work to encourage as high a degree of community participation and compliance with the current regulations as possible.

Should it be deemed possible to strengthen FIA's flood plain management regulations without inducing a mass exodus of communities from the Program, there are specific management concepts and proposals that should be considered for adoption by FIA and adaptation to its needs in coastal areas. One such proposal is that of model minimum hurricane-resistant building standards recommended in July 1976 by the Texas Coastal and Marine Council. Consistent with the Flood Disaster Protection Act's basic stance not to prohibit flood plain development, but to promote wise use, the Council's model building standards for graduated hazard element zones recognizes the basic destructive forces of wind, flooding, battering, and scour that accompany hurricanes in coastal areas. It sets forth methodologies for delineating four zones graduated according to the number of hazard elements at work in each zone, and proposes specific building performance standards for each hazard element.

As in other coastal areas of the country, Texas is confronted with high growth demand in its coastal high risk areas. Management choices could range from prohibition of all development to wholly unregulated development. An alternative available in those areas where development is to be permitted is to design and build for the forces that will be encountered.

> "Development in Texas' coastal areas is increasing, and this trend will continue. [T]he coast offers many economic and aesthetic amenities. Since hurricanes are inevitable, it is desirable to development hazard-prone areas in a fashion that will (a) avoid as many hazards as practical; (b) withstand those forces that cannot be avoided when economically feasible; (c) absorb the inevitable losses; and (d) <u>most important</u>, reduce the loss of life as much as possible.
>
> "One viable way to accommodate growth in high-risk areas is to develop and implement minimum building standards that will reduce the hurricane risk to life and will reduce the risk to property to an acceptable level and in an equitable manner." [Texas Coastal and Marine Council, <u>Model Minimum Hurricane</u>

Resistant Building Standards for the Texas Gulf Coast, Austin, (1976), at p. I-1].

In preparing its model building standards, the Council discussed hurricane-related processes impacting the Texas coast, described the nature and magnitude of the destructive forces associated with hurricanes, designed an analytical procedure for establishing "hazard zones", prepared a set of minimum performance criteria for structures in each hazard zone, and finally drafted a minimum model building standard which complements the Southern Standard Building Code.

Central to the model building standards proposed is the concept of Graduated Hazard Element Zones. Graduated hazard element zones reflect four different levels of exposure to the physical forces of a hurricane:

Zone A - Scour
- Battering with debris
- Flooding
- Wind (140 mph)

Zone B - Battering with debris
- Flooding
- Wind (140 mph)

Zone C - Flooding
- Wind (140 mph)

Zone D - Wind (140 mph)

In graduated hazard element zones development in oceanfront areas subject to all hazard elements would be required to construct to withstand the storm-induced intensities of those hazards. Construction outside the range of wave battering and scour but subject to surge and wind hazards would be designed for the latter two hazards. Where subject only to wind hazard the structure would be designed to meet a wind standard for that area.

The Texas Coastal and Marine Council proposed certain physical exposures for determining in which zone a particular site is located:

"1. Zone A. Areas of washover and scour:

a. Narrow, low segments of barrier islands and peninsulas that are generally breached as a result of elevated water levels during hurricanes or tropical storms will be classified as Zone A. . . .

b. A zone extending between Gulf beaches and a line at least 300 feet inland from the maximum elevation immediately adjacent to the beach (e.g., dune crest or crest of sand and shell ramp) will be classified as Zone A.

c. A zone along low-lying (less than 10 feet) unprotected (non-bulkheaded) bay shorelines, extending at least 200 feet inland from the highest elevation near the shoreline will be classified as Zone A.

d. Areas within 200 feet of unprotected (nonbulkheaded) navigation channels on peninsulas and barrier islands will be classified as Zone A.

e. Areas with a sand substrate subject to hurricane flooding greater than 3 feet in depth and with expected water current velocities greater than 3 feet per second for one hour or more during the rise or fall of the surge will be classified as Zone A.

"2. Zone B. Battering.

In the absence of washover channels and extensive scour, battering from waterborne debris will be expected to occur and will comprise the basis for defining Zone B under the following situations:

a. On barrier islands and peninsulas a zone of flooding extending inland from the most landward foredune or ridge line to the boundary of Zone C, or on low-lying bay shorelines having primarily clay substrates, a zone extending inland from the shoreline at least 500 feet regardless of building density.

b. In areas where hurricane flooding is expected to be greater than 4 feet, building density is not greater than one major structure per acre, and fetch is considered to be the distance a wind of constant direction travels without interruption or diversion over a water surface.

"3. Zone C. Wetting.

In the absence of the above conditions, but where still water hurricane flood levels are in excess of one foot, the area will be designated as Zone C.

"4. Zone D. Wind Only.

Zone D is concerned only with wind forces on structures, primarily the dynamic loads. . . . Zone D is arbitrarily defined as an area in which the wind at the C-D boundary is 140 mph, but diminishes to 100 mph as an inverse function of distance inland from the C-D boundary, to a minimum of 100 mph. . . ."

The model minimum hurricane resistant building standards proposed by the Texas Coastal & Marine Council, while adapted specifically to conditions found along the Texas coast, have considerable potential for adaptation to other coastal areas of the Gulf of Mexico and the Atlantic Ocean. For lack of legal authority FIA might have to eliminate a Zone D (wind only zone) if the graduated hazard elements concept were to be adapted to its use. Nevertheless, the remaining three zones, the methodologies for delineating them, and the model hurricane-resistant building standards should be considered for use in the National Flood Insurance Program.

Graduated actuarial rates. Concurrently with consideration of graduated hazard element zones, FIA should consider graduated actuarial rates geared to the hazard element zones, with appropriate adjustments or incentives for compliance with hurricane resistant building standards. Currently rates charged

for structures in coastal high hazard zones (V Zones) are an arbitrary 50% in addition to the rate charged in special flood hazard areas (A Zones). Field observations indicated very convincingly that the current rates do not affect developers' or individual property owners' decisions where to locate. Graduated rates, discounts, and other considerations that will more likely act as incentives and disincentives to development in the coastal high hazard areas should be included.

Implications for financing and lending practices. Based on the findings reported earlier, and assuming continued community participation, one would expect a period of turmoil in each of the communities as officials begin to comply with the new regulations, an agitation that will settle once local ordinances are amended and the local community adjusts to the changes. Almost all of the lending institutions reported experiencing a learning period when their communities entered the Program, and after gaining experience with the Program, processing of flood insurance requirements became "routine and automatic." The same learning process will be required if the communities amend their ordinances to comply with the new FIA regulations.

Lending institutions have been one of the prime enforcers, if not the prime enforcers, of flood insurance requirements in coastal communities. A critical issue for the National Flood Insurance Program will be the perception lending institutions have as to community flood plain management regulations. Lending institutions in some areas will perceive the new requirements as additional security on their real estate loans insofar as the regulations reduce the potential for damage to or destruction of mortgaged properties. These will be found predominantly in areas where lenders excluded certain areas from first mortgages before flood insurance was available because of past storm damages experienced, e.g., Rhode Island and Galveston. Such lending institutions can be expected to be a force to keep their community participating in the National Flood Insurance Program.

Lending institutions in several of the communities studied have recognized that compliance with the building and elevation requirements of the FIA may effect savings for their clients -- the annualized cost of elevating is often less than the annual cost of flood insurance, particularly as one elevates above the 100-year flood level -- and may affect saleability of the property. With or without community participation in the Program, these phenomena will continue, and will prove to be an effective economic force in a limited number of cases. One cannot predict how prevalent that will be, but it might prove to be an effective counterpoint in communities that are considering leaving the Program.

Finally, the regulations should have little or no diminishing effect upon demand for coastal property or for financing. No evidence was found during the study that flood insurance or its current flood plain management requirements diminished demand for coastal properties or for financing.

Implications for Technical Information.

1. Maps. One of the strong features of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973 is the technical information on flood hazards that is authorized to be developed and made available to flood-prone communities. The Congress allotted a fifteen year period ending July 31, 1983 to identify areas of special flood, mudflow,

and flood-related erosion and to complete risk studies within such communities. The Congress has also appropriated the necessary funds to permit the studies and mapping to be performed.

Considerable controversy has developed nationwide over the flood hazard boundary maps developed by FIA, and, to a lesser extent, its flood insurance rate maps. In some instances, the controversy focuses on the quality of the maps and the methodologies used to delineate flood hazard areas. Perhaps more common is the controversy over the area identified as flood-prone, sometimes encompassing areas targeted by developers and financial interests for development.

All of the Atlantic and Gulf of Mexico communities included in this study were participating in the "regular" flood insurance program. Each had had detailed risk studies performed in their community, and had received flood insurance rate maps with zones and 100-year flood levels depicted. Each had completed any negotiations with or appeals to FIA concerning the maps, and had incorporated the maps into their local zoning ordinances or building codes by reference. No questions were raised by the various community and interest groups over the quality of the information. The general consensus was that the studies were adequate and the maps fairly depicted the local flood hazard areas.

However, the most common complaint heard about the National Flood Insurance Program during this study related to the difficulty lenders and realtors had in using the flood insurance rate maps, particularly at the margin of zones. Considerable difficulty was being experienced in determining whether or not individual properties were in a given flood hazard zone. The current maps, which are basically plats of a community on which flood hazard zones and flood elevations are superimposed using curvilinear lines to depict the margins of the zones, present problems in some communities over where the lines go, often for lack of reliable reference points. One solution being tested by FIA is to list streets and addresses included in specific zones.

Looking to the future, it can be anticipated that FIA will be pressed to deal with additional flood plain management and environmental factors, forerunners of which are the sand dune and mangrove regulations. Current flood insurance rate maps serve the specific purposes of delineating flood hazard zones, flood elevations, and assigning flood hazard factors to each zone. As FIA is pressed to deal with more comprehensive management considerations such as it now encourages in §1910.22 of its regulations, a very basic decision will have to be made whether FIA's maps will depart from essentially single-purpose to multiple-purpose cartography.

If a decision is made to depict more information on its rate maps than at present, one means may be maps using aerial photography. FIA has experimented with aerial photograph flood hazard boundary maps intermittently for four years. None of the results to date are of sufficient quality to warrant adoption. However, there is sufficient promise from these and the results of other agencies to believe that such maps could effectively serve multi-purpose needs and be cost competitive with present FIA mapping procedures.

FIA should be encouraged to continue its experimentation with aerial photograph maps. Further, FIA should convene a multi-disciplinary conference:

(1) to discuss the relation of mapping to FIA's flood plain management, environmental, and other goals; (2) to recommend the information that should be depicted on such maps and mapping standards that should be applied, and (3) to recommend the most appropriate and cost-effective mapping technique to achieve those goals and standards.

2. Wave Action Effects. Current flood insurance studies calculate 100-year flood levels in coastal areas, but for a number of reasons have not superimposed wave heights on the still water elevation (i.e., astronomical tide, storm surge, and setup), nor has wave runup been included in the calculations. One result is that waves and their associated effects are not taken into account in the first floor elevations required for structures in coastal high hazard zones. Thus, buildings constructed at the current 100-year flood levels in coastal high hazard areas are actually protected to a significantly lesser degree than previously believed.

In response to a request by the FIA, the National Academy of Sciences/National Research Council has recommended a method to be used for estimating the wave crest elevation associated with storm surges crossing the open coast and the shores of bays and estuaries of the Atlantic, Gulf of Mexico, and Great Lakes coasts. [The method is not recommended on the Pacific coast where the wave hazard to be calculated is primarily a function of astronomical tide and tsunamis, not the occurrence of storms, according to the Academy report]. The proposed method includes means for taking account of varying unobstructed distances over which wind blows (fetch), barriers to wave transmission, and the regeneration of waves apt to occur over flooded land areas.

The methodology is recommended by the Academy for immediate use in FIA's coastal flood insurance studies. If adopted, the results of such studies will have profound implications for the flood insurance program, particularly in its flood plain management requirements and actuarial rates. The National Academy report, Methodology for Calculating Wave Action Effects Associated with Storm Surges (1977), does not address whether or how estimates of the extent of runup or amount of overtopping should be incorporated in flood insurance studies. Nor does it address the problem of the effect of storm wave action on buildings and structures or on land features. Both problems were outside the time, scope, and funding available for the study. These problems merit further study by the Academy, and the results of such study should be available to FIA before any attempt to amend its regulations is made. If FIA requests the Academy to study the problem of storm wave action effects on buildings and structures, it would be particularly appropriate to request the Academy's evaluation of the concept and methodologies proposed by the Texas Coastal & Marine Council for graduated hazard element zones and hurricane resistant building standards. Other hurricane resistant building standards, such as the South Florida Building Code, should also be included for evaluation in such a study.

In the historical context of flood loss management strategies, the National Flood Insurance Program is positioned between the extremes of complete assumption of flood losses by property owners located on our coastal and riverine flood plains, and complete federal assumption of the costs of flood control measures and disaster assistance relief. If allowed to work, the Program has

great promise to reduce susceptibility of structures to flood losses, and to reduce federal disaster relief assistance. If not allowed to work, flood loss management strategies might regress to the extremes of federally financed flood control structures, which have repeatedly proven inadequate as a sole flood loss management strategy, or to a strategy of no government involvement, one that was clearly rejected over 40 years ago. Of the federal strategies in force, the National Flood Insurance Program has the greatest potential for accomplishing our national flood loss management goals. It must be allowed to work.

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