CHAPTER III

REDUCING LOSSES TO EXISTING USES

Overview

In the 1970s, floodplain regulations, when applied alone, were largely ineffective in reducing flood losses to the 4.5 to six million[1] structures already located in the 100-year floodplain except after severe floods. But they encouraged some voluntary floodproofing by putting landowners on notice as to flood hazard protection needs and elevations. After disasters progress was made in prohibiting alterations and rebuilding in excess of a stated amount. Regulations were used to encourage relocation with flood insurance payments, disaster grants, and loans conditioned on compliance with standards. They were also imposed to establish moratoria on rebuilding until detailed flood maps and recovery and relocation plans were completed.

To further reduce flood losses to existing uses in the 1980s, regulations must be integrated into, or carefully coordinated with, broader community zoning, building codes, housing codes, sanitary codes, and other regulations that apply to existing uses. Amortization provisions should be adopted in some circumstances. Regulations should be coordinated with predisaster planning. In floodways, "substantial improvement criteria" in zoning and other regulations should be clarified and tightened. After a disaster, strict interim or long-term regulations should be applied. Implementation will require not only improvements in state and local regulations, but also federal technical and financial aid, and revisions in federal flood insurance and disaster assistance to act as incentives for private hazard reduction.

Concerted efforts to address existing structures are essential if long-term flood losses are to be reduced. Most existing structures were

TABLE 4

TECHNIQUES TO REDUCE LOSSES TO EXISTING USES

Adoption of Interim Regulations After a Disaster to Prevent Rebuilding Until Flood Studies, Postdisaster Planning, Acquisition, Other Measures are Undertaken

Adoption of Long-term, Upgraded Regulations After a Disaster

Adoption and Enforcement of Regulations with Nonconforming Use Provisions

- Regulations requiring floodproofing, etc., when structures are abandoned or damaged.
- Amortization provisions requiring short-term or long-term removal of nuisance uses in floodways, floodproofing

Floodproofing of Existing Structures

- Raising structures
- Temporary or permanent waterproofing
- Wet floodproofing
  - Structural design changes
  - Water resistant materials replacements
  - Operation of buildings, including allocation of space

Emergency Evacuation

- Flood forecasting
- Flood warning
- Evacuation planning

Public Acquisition and Relocation

- Purchase, "bargain" sales, land exchanges
- Removal of existing structures

Reduction of Storm Runoff

- Land treatment
- On-site storage requirement

Disaster Assistance and Flood Insurance Conditioned Upon Mitigation

- Floodproofing or relocation after a disaster
- Adoption of flood control measures

Flood Control Measures

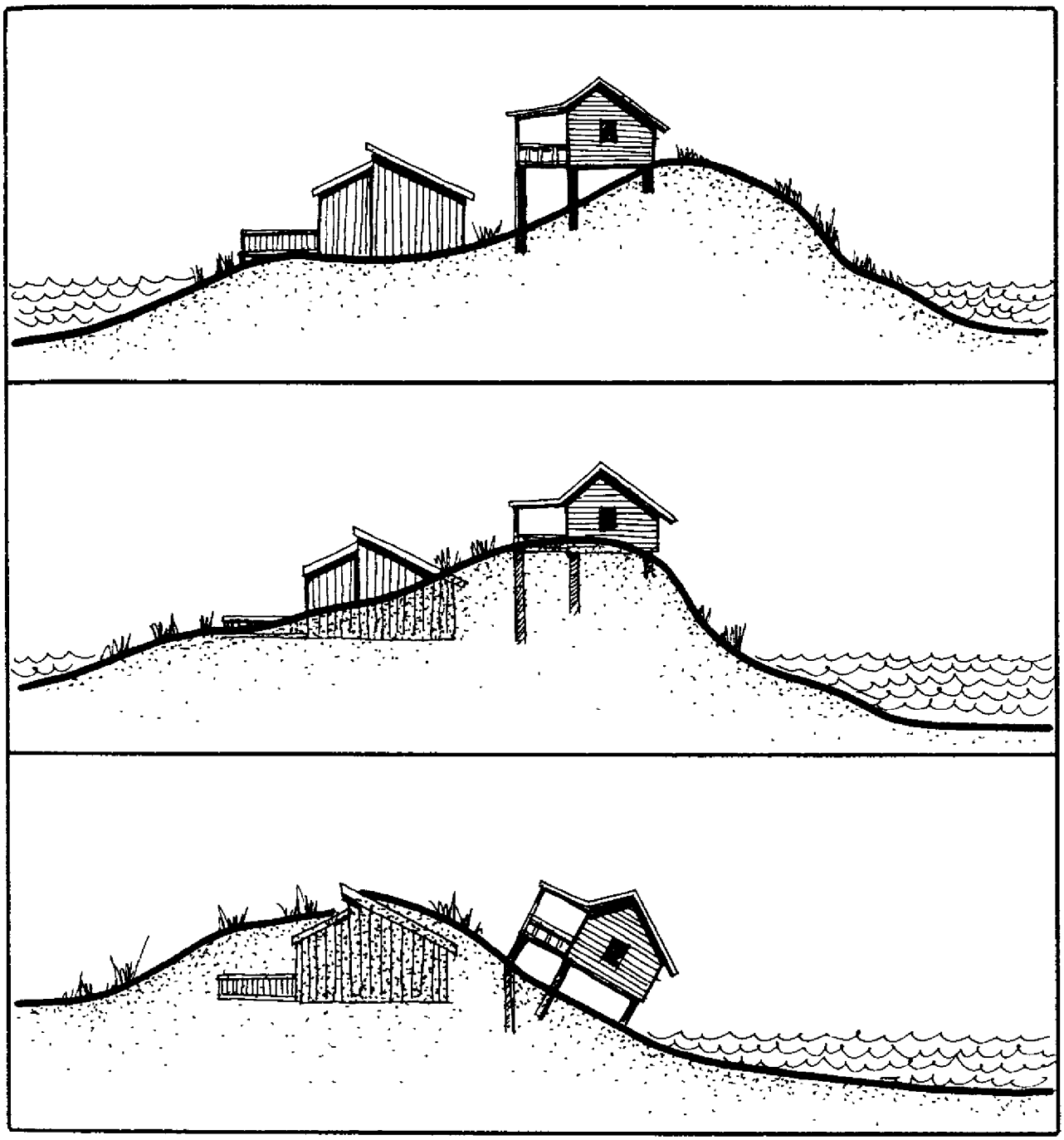
- Dams
- Dikes, levees
- Channel straightening
- Artificial dunes, beaches

built before state or local regulation of flood-prone areas and have little or no protection against flooding. In coastal areas, an estimated two to three million structures are located one to 10 feet below the 100-year still water flood elevation. In 1980, four coastal metropolitan areas (Houston/Galveston, New Orleans, Tampa/Fort Myers and Miami/Fort Lauderdale) alone accounted for 680,000 flood insurance policies, or 37.8% of the national total.[2] In many coastal areas the entire floodplain is developed.

Structures below flood elevations are often damaged by flooding, repaired, and damaged again. A study of repetitive flood insurance claims in 1979 revealed that at least 883 structures had two flood insurance claims within five years, with damage at least 25% of structural value.[3] From January 1, 1972 to August 31, 1979, three or more major flood disasters were declared in 351 communities.[4]

In urbanizing areas, flood threats to existing structures are increasing. Urbanization increases peak flows from two to six times for smaller floods.[5] Watershed development increases the rate of runoff and decreases infiltration. Floodplain development eliminates flood storage, thereby increasing flood heights. A regulatory "floodway" with development in fringe areas also increases flood heights up to one foot, thereby increasing damages to structures in the 100-year floodplain. In many riverside cities, sedimentation in reservoirs and stream beds is worsening flood conditions.

Combined flooding and erosion threats to existing structures are increasing on barrier islands (e.g., Cape May, New Jersey) due to landward movement of the islands at rates of 300 feet or more per century. Erosion and flooding problems are also becoming more serious in bluff areas (e.g., the California coast, the Lake Michigan shore), where struc-



MIGRATION OF BARRIER ISLANDS

tures built 50 years ago at some distance from the bluff are now at the edge due to recession.

Private flood losses are not the only problem resulting from the many damage-prone structures in the floodplain. Roads, sewers, water supply systems, and other public services constructed to serve these structures are severely and repeatedly damaged. Repair of a causeway to Dauphin Island, Alabama, damaged by Hurricane Frederic in 1979 cost federal taxpayers $39 million. Repair of roads and bridges damaged by flash flooding in Big Thompson Canyon, Colorado, cost federal taxpayers $28 million.

Loss of tax revenue, loss of jobs, and subtle pressures for publicly funded flood control works are other consequences. Moreover, the presence of extensive nonconforming uses often undermines regulations for new uses. It is difficult to enforce regulations for new uses in areas with dozens or hundreds of adjacent nonconforming structures.

Lack of success in applying regulations alone to reduce losses to existing uses has been due to these factors.

(1) Nonconforming use provisions have not been adequately enforced due to ambiguities in regulatory provisions and the unwillingness of many state agencies and local governments to impose additional burdens upon flood-damaged property owners.

(2) Nonconforming use provisions have not been sufficiently tailored to highly varied flooding problems and the flood protection needs of particular types of nonconforming uses.

(3) Government subsidies for flood control, disaster assistance, and flood insurance provide little incentive for private remedial flood protection.

Nonconforming Use Provisions

State regulatory programs do not require flood protection measures for existing uses except where substantial rebuilding or repair takes place or a damaged structure is abandoned. Local regulatory programs have generally adopted the minimum standards of the NFIP, which also do

not require modifications to existing uses unless "substantial improvements" take place.[6] Substantial improvements are defined to include "repair, reconstruction, or improvement of a structure, the cost of which equals or exceeds 50% of the market value of the structure either, (a) before the improvement or repair started, or (b) if the structure has been damaged and is being restored, before damage occurred."[7]

Although minimal, these provisions have also not been vigorously enforced because of political pressures and difficulty in determining when the triggering "50%" threshold has been crossed. In addition, the preflood value used as the basis for calculations is often difficult to obtain.[8]

After a flood, repairs or alterations are often made incrementally, with none exceeding 50% of the structural value in one year. Periodic additions to structures, none of which exceeds the 50% threshold, can double or triple structural values without provision of flood protection. Interior work, painting, and other finishing touches, which are expensive, are rarely included in calculations. Improvements to comply with health, sanitary or safety code specifications (e.g., a new roof, new plumbing) are also rarely included.

Local governments have been reluctant to regulate existing uses because some zoning enabling acts partially exempt existing uses.[9] However, an increasing number of states have specifically authorized local governments to terminate nonconforming uses under certain conditions.[10] For example, a Missouri statute authorizes counties to adopt "reasonable regulation for the gradual elimination of nonconforming uses from districts zoned for residential use."[11] A Minnesota statute authorizes county boards "to regulate and control or to reduce the number or extent of or the gradual elimination of nonconforming uses and occupancies."[12] Where properly authorized in states like these, local

regulations that control and amortize existing uses that are nuisance-like have been upheld by the courts.[13]

The problem, however, is more than legal; questions of equity and political acceptability are involved. It is one matter to require a landowner to elevate or otherwise protect a new structure where the elevation may add 5% to 10% to the cost of construction,[14] but it is another to require the protection of existing structures where the cost of elevation may exceed 40% of existing value.

Despite these problems, some communities have reduced the flood vulnerability of existing uses through innovative nonconforming use provisions.

Brattleboro, Vermont, imposed regulations on a mobile home park in a high-risk floodplain. The regulations require owners expanding their operation outside of the floodplain to remove one home from the high hazard area to gain approval for three added at higher ground. Some communities have effectively combined regulations with public education to encourage private floodproofing. In Wayne Township, New Jersey, an education program for landowners has resulted in more than 50 homes being privately elevated to or above the 100-year flood level. In one neighborhood, code enforcement has eliminated about 75 out of 300 structures. Floodproofing has been required for all renovations, improvements, and additions to structures. In Soldiers Grove, Wisconsin, the community development office has provided financial and technical assistance to individuals wishing to floodproof their structures. For example, one home there was elevated six feet on fill after the 1978 flood. Total cost was approximately $9,500 dollars, with one-half of this paid by the town and one-half by the landowner.

In 1974, the county council in Howard County, Maryland, established a floodproofing loan program. Owners were authorized to borrow up to

$6,000 for up to 20 years at an interest rate 1% higher than the average interest rate obtained at the most recent sale of Howard County obligation bonds.

In some areas, private industries have voluntarily floodproofed their structures, partly because of state and local public education efforts. The impressive experience of the Sprout-Waldron Division of the Koppers Company, Inc., of Lycoming County, Pennsylvania, is the subject of a film, slide presentation, and technical manual.[15] In 1972 the main plant, which has 1,250 employees, was flooded to a depth of two to six feet, with flood damages exceeding $3,300,000. The plant was shut down for three months and revenue losses exceeded $2 million. To reduce future damages, the industry developed a flood preparedness plan that combined waterproofing in certain plant areas with removal of damage-prone contents from others. In September 1975, Hurricane Eloise flooded the plant to a depth of one to four feet. That time flood damages were less than $231,000 and the plant was operating at over 80% of its capacity within 18 hours after the flood subsided.

Variations in Flood Loss Potential

Difficulties in reducing the flood damage potential of existing uses through a single nonconforming use formula are caused by variations in flooding threats, types of nonconformity, costs of remedial measures, and incentives for floodproofing or relocation.

Outer Fringe Areas

An estimated three to four million structures are located in outer fringe areas at elevations only one to two feet below the 100-year flood elevation. These include many structures along smaller streams and drainageways and at the periphery of major riverine and coastal floodplains. A 100-year flood may cause minor damage, particularly if the

water velocities are low, flooding is of short duration, and warning time is ample. But damages may be substantial for structures with basements containing heating and air conditioning systems, washers and dryers, recreation and storage rooms, or living quarters. In some instances, basements may collapse, endangering the lives of any occupants and damaging or destroying the remainder of the structure.

For structures in these outer fringe areas, damages may be reduced by temporary or permanent dikes and levees, stream channelization and straightening, floodproofing of structures and facilities, flood warning systems, and evacuation plans. At modest cost, small structures without basements may be elevated on fill, pilings, concrete blocks, or concrete foundations. However, elevation of larger structures or small structures constructed of stone, brick, masonry, or concrete is often prohibitively expensive.

Although the greatest potential for floodproofing occurs in outer fringe areas, the incentives are also smallest. Subsidized flood insurance payments give little incentive for private floodproofing. Flood insurance payments of up to $185,000 may be made for most residential structures and up to $60,000 for contents for communities in the regular flood insurance program. Structures are rarely damaged more than 50% of their value and, as a consequence, do not require floodproofing as a condition of rebuilding.

Commercial establishments in outer fringe areas have a greater incentive to mitigate flood damage because flood insurance payments for structural damage to a small business cannot exceed $250,000. The amount usually covers only a small portion of the structural damage that may occur to a large commercial structure. Coverage for damage to inventories cannot exceed $300,000 which is only a small portion of many inventories.

In addition, commercial and industrial establishments may lose substantial income when forced to close.

Fringe Areas Subject to Greater Flood Heights

An estimated several million additional structures are located in more seriously flooded areas, particularly along the coast. Some of these are behind low-lying dikes and levees that provide limited protection. Inundation of three to ten feet may be expected during a 100-year flood, with more frequent lower inundation from small floods. Although the anticipation of serious flood damages may create greater incentive for floodproofing, the technical and economic feasibility of elevating or floodproofing these structures to protect from a 100-year flood is less because of the depth of anticipated flooding and the increased hydrostatic pressures.

In a 100-year flood, residences in these areas often suffer structural damage approaching or exceeding 50% of their value, potentially triggering nonconforming use provisions. What is to be done with these structures? Some might be relocated, but not many in densely developed areas such as Miami. Elevation on fill or pilings may be possible for wood structures without basements. Dry floodproofing for such structures is rarely practical because hydrostatic pressures are substantial when inundation exceeds two to three feet. Wet floodproofing may be an alternative for brick, concrete, or concrete block structures.

Structures in Inland Floodways and Coastal High Hazard Areas

An estimated 300,000 to 500,000 structures are located in riverine floodways and coastal high hazard areas. Because of the severity and repetitive nature of floods, costs for disaster assistance and insurance to private structures and public facilities are greatest in these areas. Structures and fill in floodways are not only seriously damaged by flood-

ing, but they also increase flood heights and velocities on other lands. Structures in coastal high hazard areas and in floodways may be swept from their foundations, adding to the destructive force of flood waters.

Structures in these high hazard areas are often subject to nonconforming use provisions after a severe flood. Then relocation of existing structures is most attractive although not always practical. A flood insurance payment often compensates for only a portion of the loss. Dry floodproofing, however, is rarely sufficient. Studies by the Corps of Engineers show that it is very difficult to floodproof structures against a breaking wave of more than two or three feet, or inland flood velocities of 8 to 12 feet per second. Elevation on pilings and open works may be used in some instances, but damages to public facilities often continue and access may be cut off. Elevation is also impractical in severe erosion areas.

Federal Incentives and Disincentives

Federal flood hazard programs have provided little incentive for self-help measures. Federal flood control measures are typically 100% federally subsidized. Federal flood insurance at subsidized current rates provides slightly more incentive, but the federal government still bears much of the cost of flooding. A tightening of insurance rates to reflect actual risk, as now proposed by FEMA, would remedy this. Tight enforcement of the provisions of the Disaster Relief Act of 1974 would also help. That act requires that before receiving disaster assistance loans or grants, states and localities agree "that the natural hazards in the areas in which the proceeds of the grants or loans are to be used shall be evaluated and appropriate action shall be taken to mitigate such hazards, including safe land-use and construction practices...."[16]

Recognizing such problems in the late 1970s, FEMA undertook research and began to apply a variety of measures to reduce the flood loss poten-

tial of existing uses, particularly after disasters. In 1979, FEMA initiated a floodplain acquisition program pursuant to Section 1362 of the National Flood Insurance Act of 1978.[17] Section 1362 provides FEMA with the authority to acquire flood-insured properties that have been severely damaged three or more times or "substantially damaged beyond repair," and where the state or community agrees to accept and manage the property after federal acquisition.

The 1980 program began with acquisition of 94 properties: eight in Scituate, Massachusetts; one in Strathmore, New Hampshire; five in Gulf Shores, Alabama; six in Clay County, Minnesota; 20 in San Bernardino, California; 34 in Arnold, Missouri; four in Phoenix, Arizona; and 16 in Cowlitz, Washington. During 1980, FEMA also funded the relocation of 67 structures in Montgomery County, Texas, through "constructive total loss" payments for structures that could not be repaired or rebuilt due to county nonconforming use provisions.

FEMA was not alone in its concern with existing uses. During 1979, the U.S. Water Resources Council carried out two postdisaster recovery studies: one on postdisaster response[18] and another on floodplain acquisition.[19] WRC also examined federal response in various postdisaster situations.

Based on these studies and on urging from OMB, WRC, and FEMA, federal agencies increased enforcement of the postdisaster hazard mitigation requirements of the 1974 Disaster Protection Act. SBA and other loans were denied for rebuilding in specific places at Lake Elsinore, California, and Soldiers Grove, Wisconsin. A variety of federal funding was provided to facilitate acquisition of lands and relocate structures in Soldiers Grove and in Gulf Shores, Alabama.

In July 1980, OMB directed 10 agencies involved in disaster response to work together to assess mitigation possibilities within 15 days of a

presidentially declared disaster in order to improve coordination of postdisaster response, with FEMA as the lead agency.[20] A mitigation handbook has been prepared to assist the teams in their evaluations.[21]

Other federal programs to reduce losses to existing uses include construction of flood control measures and flood warning systems described below as well as funding for state and local efforts.

Effective State and Local Programs

Some communities and states have adopted programs for existing uses although effective efforts are quite rare.

Moratoria on Rebuilding

A number of coastal and inland communities adopted moratoria on rebuilding after flood disasters until relocation plans, flood control measures, or comprehensive floodplain management plans could be prepared and implemented. The best example is Rapid City, South Dakota, where the city planning commission adopted a moratorium on repair and rebuilding in the 10-year floodplain after the flash flood of 1972 killed 238 and damaged or destroyed 824 structures. The South Dakota Supreme Court sustained this moratorium. There are other examples.

- Larimer County, Colorado, adopted a six-month moratorium on rebuilding after flash flooding in the Big Thompson Canyon in 1976 caused $42 million in damage and took 136 lives.
- San Bernardino, California, adopted a moratorium preventing rebuilding in an area that was damaged by mud flows three times in January and February of 1979.
- Lake Elsinore, California, prevented rebuilding below an elevation of the 100-year flood plus five feet after a severe flood in 1978. Some of these damaged properties are now being acquired.
- Cowlitz County, Washington, adopted a moratorium on new development and rebuilding in the 500-year floodplain of the Cowlitz River and within the "mudline" of the Toutle River after severe floods and mud flows resulted from the Mount St. Helens eruption in 1980.

Upgraded Regulations

Some communities adopted more permanent, upgraded regulations for reconstruction and new development after a disaster. Heightened public awareness and information from the more detailed flood studies, which are typically undertaken after severe floods, made the upgraded regulations politically acceptable. Some typical examples follow.

- Del Norte County, California, adopted highly restrictive floodplain regulations for an area along the Klamath River, which had been flooded in 1927, 1953, 1955, and 1964. Flooding in 1964 destroyed the town of Klamath. These regulations prevented rebuilding and use of the land for permanent buildings. The California Supreme Court sustained the regulations.

- Clay County, Minnesota, prohibited rebuilding in the 100-year floodplain of River Oaks subdivision, which was severely inundated by the Red River twice in 1978.

- Scituate, Massachusetts, adopted a moratorium on rebuilding after a northeaster struck the New England coast on February 6 and 7, 1978. The storm destroyed or seriously damaged 700 structures. This moratorium was subsequently modified to permit rebuilding of structures pursuant to upgraded regulations requiring protection against waves to a height of 21 feet.

- Gulf Shores, Alabama, adopted a temporary moratorium on rebuilding after Hurricane Frederic damaged or destroyed 500 structures in September 1979. This moratorium was subsequently modified to permit rebuilding consistent with wave heights.

Regulations with Acquisition and Relocation

Several states and more than 100 communities acquired structures damaged by severe flooding. Arizona is relocating residents in 10 flood-prone communities, including Hollywood, Duncan, and Allenville, pursuant to a relocation program authorized by the Arizona legislature in 1978. This program includes exchange of public lands for private flood-prone lands and state financial aid for relocation. After the severe 1978 coastal storm, the Massachusetts legislature adopted a $1 million bond issue to help fund local acquisition of floodplain lands.

Some public uses have also been relocated. In 1978, the Minnesota Department of Natural Resources began removal of severely flooded campsites in Whitewater State Park. The state used HUD Disaster Assistance and state park funds for the now completed project.

Some state statutes specifically authorize local acquisition and relocation of existing uses under certain circumstances. For example, North Carolina authorizes a local government "to acquire, by purchase, exchange, or condemnation, such existing artificial obstructions (in floodways) if deemed necessary...for the purpose of avoiding flood damages."[22]

Most communities have acquired floodplain lands after a disaster or repeated floods under more general acquisition or redevelopment powers.[23] A combination of flood insurance payments and disaster assistance grants and loans has often been used to meet acquisition costs. Funding has usually been federal, although some acquisition, such as that in Baltimore County, has been funded by both bonds and general revenues. Building moratoria were typically adopted after the disaster to prevent rebuilding before acquisition. There are many examples of acquisition and relocation.

- Prairie du Chien, Wisconsin, is now acquiring 128 residential properties in a repeatedly flooded area along the Mississippi and relocating owners. Funding of $4.5 million is being provided by a HUD Community Development Block Grant and by the Army Corps of Engineers.

- Soldiers Grove, Wisconsin, is in the process of relocating its entire business district after repeated flooding. The most severe flood occurred in 1978, causing $52 million in damages. Funding from several federal, state, and local sources was used. A 190-acre new town site has been purchased and prepared for development to meet multiple objectives of energy conservation and flood loss reduction.

- Dallas, Texas, has acquired 180 properties in two damage-prone subdivisions with funds from bond issues, HUD open space and urban renewal grant programs, the Land and Water Conservation Fund, and other sources.

- Gulf Shores, Alabama, is combining regulations and acquisition for certain beachfront areas devastated by Hurricane Frederic.

National Park Service structure inundated and later destroyed by storm waves at Coast Guard Beach, Cape Cod, Massachusetts.

Photo source: Stephen Leatherman

> The city is acquiring five properties with funding from Section 1362 of the National Flood Insurance Act at an estimated cost of slightly over $1 million. Other properties are being acquired through the Land and Water Conservation Fund and through donation.

Many other communities have cleared structures from floodplain areas as part of urban renewal or open space programs. Denver, Colorado; Austin, Texas; and Pittsburgh, Pennsylvania are examples.

Flood Warning Systems

Flood warning systems to reduce losses to existing uses have been developed or are under development by many communities with the help of the National Weather Service (NWS).[24] The NWS has in effect a flood watch and flood warning system for all coastal and inland waters.

Some communities with flash flood problems have developed more specific warning systems. For instance, Gatlinburg, Tennessee, has developed a specific, supplemental warning system. The West Prong of the Pigeon River, which is subject to severe flash flooding, bisects much of downtown Gatlinburg. Lying at the entrance to Smoky Mountain National Park, the town has many hotels, motels, and restaurants in the flash flood area. A storm in the Smoky Mountains, 20 miles from downtown Gatlinburg, could send 10 feet of water into the town only 15 minutes after the first warning.

The Tennessee Valley Authority (TVA) and the town first studied structural solutions to the flood problem, but found none practical. Regulations were adopted to reduce losses to new uses. For existing uses, a sophisticated flood warning system and evacuation plan were later developed in cooperation with NWS. This system involves automatic rain and river gages, a computer model of the watershed, automatic data processing, and automatic alarms. Both TVA and the town funded the system.

A flash flood warning system combined with regulations has been adopted by Brattleboro, Vermont, which also has severe flash flood problems. A major nursing home is located in one flash flood area along Whetstone Creek. With help from NWS and SCS, the town has implemented a computerized warning system similar to that for Gatlinburg.

Other warning systems are found in Lycoming County, Pennsylvania; Keene, New Hampshire; and Four Mile Run in Alexandria, Virginia.

Regulations and Flood Control Measures

Dikes, levees, detention ponds, small dams, and stream channelization projects have been combined with regulations both before and after floods. Federal agencies have often assisted in these efforts.

- Littleton, Colorado, combined flood control measures, acquisition, and regulations to reduce flood losses after a flash flood in 1965 took 13 lives and caused $399 million in damages. The Corps of Engineers constructed an $86 million earthen dam to lessen flood damages in Littleton and downstream communities.

- San Bernardino, California, combined regulation of mud flow areas with acquisition and relocation of selected properties, the construction of mud flow retention walls, and the seeding of upstream canyon walls to reduce mud flows.

- Scottsdale, Arizona, near Phoenix, combined regulations with acquisition and limited flood control measures in a $30 million bond project for 4.5 miles of Indian Bend Wash. A dike was constructed to protect the flood fringe area.

- Riverside County, California, combined floodplain regulations with various types of levee and channelization projects to reduce stream, alluvial fan, and sheet flow flood problems. Flood control projects have been constructed primarily by the Riverside County Watershed Conservation and Flood Control District and by the Coachella County Valley Water District, with funding from bond issues.

- Palatine, Illinois, combined floodplain regulations with a program to maintain existing floodway channels, build five floodwater retention structures and one multipurpose flood prevention and recreation facility, improve the flow carrying ability of 1.8 miles of stream channel, and purchase 261 acres of floodplain.

- Rockville, Maryland, combined regulations requiring subdividers to provide onsite storage of waters with a local government program to construct onsite stormwater detention ponds.

Twenty-four of these ponds have been constructed with 18 more planned or under construction.

Despite their advantages, once flood control measures are proposed or constructed at public expense for one area of a community, local officials have often found it difficult to gain landowner support for nonstructural measures that require landowners to bear the costs of flood protection in other areas. Landowners may also resist regulation in areas partially protected (e.g., to a 25-year flood elevation) by dikes or dams.

Evacuation Maps and Plans

The National Oceanic and Atmospheric Administration (NOAA), with state and local help, has prepared flood evacuation maps for much of the East Coast. The maps show evacuation routes, safe sites, and various depths of anticipated flooding. They also show historic flood elevations for particular storms. Some communities have prepared more specific flood evacuation plans with help from the Corps, NWS, NOAA or FEMA. These assess flood hazards, identify evacuation routes and measures, and suggest flood preparedness measures. Plans have been prepared or are under preparation by Lee, Collier, and Monroe Counties, Florida; Baytown and Galveston, Texas; and other areas.

Footnotes

1. Sheaffer and Roland, Inc. (1978), estimated that 7.9 percent of the 57.3 million occupied housing units in the nation were in special flood hazard areas for a total of 4.5 million housing units. This study also estimated that 325,000 nonresidential units were located in flood hazard areas.

   The report concluded that:

   > In summary, experience to date indicates that the current approach to correcting nonconforming uses through zoning mechanisms is not effective. Nonconforming uses, particularly residences, are allowed to continue even when they are substantially damaged unless they are purchased (p. 10).

   Surveys of state and local programs conducted as part of the present study (see Appendix A and Appendix B) supported this conclusion.

2. Claim data from the National Flood Insurance Program.

3. *Id.*

4. See Platt (1979).

5. See footnote 47, Chapter I.

6. 41 Fed. Reg. 46,963 and 46,964 (1976).

7. *Id.*

8. See, for example, Miller (1980).

9. Zoning statutes specifically exempt nonconforming uses from municipal regulation (cities and villages) in at least 14 states, from county regulation in 15 states, and town or township regulation in 12 states. For a list of these states and more detailed references, see Strauss and Kusler (1976).

10. Zoning enabling statutes in 14 states specifically authorize the regulation and termination of nonconforming uses. Included are the enabling acts for municipalities in seven states, counties in 10 states, and towns or townships in five states. The enabling acts of the remaining states are silent as to the treatment of nonconforming uses.

11. Mo. Ann. Stat. § 64.620 (Vernon 1966).

12. See Minn. Stat. Ann., § 394.36 (West Supp. 1982) which provides in part:

    > Subdivision 2.--The board may by ordinance as herein provided prescribe such regulations not contrary to law as it deems desirable or necessary to regulate and control, or

reduce the number or extent of or the gradual elimination of nonconforming uses and occupancies.

13. In many instances, courts also have supported regulations which require the short-term abatement or alteration of nonconforming uses which are nuisance-like or threaten public safety. See Anderson (1968), sections 6.65-6.71 at 446-471 and cases cited therein. See Hadacheck v. Sebastian, 239 U.S. 392 (1915); Reinman v. Little Rock, 237 U.S. 171 (1915).

14. See footnote 6, Chapter II.

15. See Tressler (1979).

16. Section 406 of the Flood Disaster Relief Act of 1974, P.L. 93-288 (codified at 42 U.S.C.A. § 5131(c)(d) (West 1977).

17. Section 1362 of the National Flood Insurance Act of 1974, P.L. 90-44 (codified at 42 U.S.C.A. §§ 4001-4128 (West 1977). See also footnote 23.

18. Platt (1979).

19. Kusler (1979b).

20. Memorandum, Office of Management and Budget, July 10, 1980. Guidelines developed by FEMA and directed to 10 agencies provide, in part, the following post-disaster planning process:

> To accomplish the objectives of the post-flood recovery efforts, . . . departments and agencies should develop a common policy and enter into an interagency agreement that provides for Federal leadership and participation in interagency, interdisciplinary and intergovernmental hazard mitigation teams. The teams shall be led by a designated FEMA official in cooperation with affected State and local governments. At the time of presidentially-declared disasters, the teams will:
>
> -- assess the extent of damage;
>
> -- identify riverine floodway and coastal high hazard zones, in which Federal investment to repair or replace structures and facilities should be avoided and the relocation of people and structures out of these areas encouraged;
>
> -- identify floodplain fringe areas in which Federal assistance should seek to mitigate hazards through the floodproofing of structures, forecasting-warning-evacuation plans, floodplain regulations, and development and redevelopment policies;
>
> -- prepare expeditiously--normally within 15 days--a hazard mitigation report recommending specific recovery actions to be taken by each Federal agency and each non-Federal level of government; Federal agencies shall conform their recovery actions to the recommendations of the report to the fullest extent practicable.

21. Federal Emergency Management Agency (1981).

22. N.C. Gen. Stat. § 143-215.55 (1978).

23. See Ralph M. Field Associates (1981); Federal Emergency Management Agency (1981); and other references on floodplain acquisition in the bibliography of this report.

24. See Owen (1977), and Wright *et al.* (1976) who recommends the following elements in a neighborhood watershed flash flood warning system:

    1. Neighborhood Boundary Map
    2. Neighborhood Coordinator
    3. Watershed Rainfall Observation Stations
    4. Neighborhood Alert System
        a. Neighborhood Warning Signal
        b. Neighborhood Telephone Alert System
        c. Mass Media Alert System
    5. Stream and Road Patrols
    6. Neighborhood Damage Reduction
    7. Assistance from Larger Units of Government
    8. Record Keeping
    9. Training Program