

**AN ASSESSMENT OF URBAN FLOODPLAIN MANAGEMENT
IN THE UNITED STATES
The Case for Land Acquisition
in Comprehensive Floodplain Management**

by

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Introduction

This paper evaluates the experience of the United States in reducing hazards to life and property from urban flooding and in preserving the natural values of riverine environments. It shows that national programs to curb losses, initially through construction of flood control structures and then through a combination of flood control, uniform building standards, and flood insurance, have had some success in reducing flood losses. Less progress has been made, however, in protecting the natural environment.

If further gains are to be made in slowing increases in flood losses and maintaining environmental quality, national policies must be reoriented to encourage local governments to use public land acquisition and relocation of existing development to prevent additional floodplain development and repeated flood losses. Some modifications in federal policies could ease the adoption and implementation of land acquisition and relocation programs by local governments.

Brief History of U.S. Flood Management Policy

Flooding is a serious national problem in the U.S. It affects over half of the communities and an estimated 7-9% of the land area of the contiguous 48 states (White 1975). Since 1925, over 4,000 persons have lost their lives in floods (U.S. Water Resources Council 1977), and the threat to life from flash floods has been increasing (Kusler 1982). Federal flood control projects and other measures taken by state and local governments have prevented some flood losses that otherwise would have occurred, but even with those efforts losses have been increasing. Estimates of average annual flood losses in constant 1967 dollars, for example, rose from \$1 billion in the mid-1960s to 2.2 billion in 1977 (U.S. Water Resources Council 1977). Property losses from flooding in 1985 topped \$5 billion (Platt 1986).

The federal government's efforts to reduce flood losses have proceeded through two phases. The first phase (1917-1965) focused on structural flood control measures. The second phase (1966-1987) has focused on building regulations and insurance, in addition to flood control. In this section we will describe each of those phases. In the following section we will assess how well these measures are working to reduce flood losses and achieve other public policy objectives.

The Flood Control Era

The federal government's participation in the construction of flood control works (dams and reservoirs, levees, dikes, diversions, bypasses, channel improvements) began in 1917 after a series of floods on the Mississippi River. During the next thirty years, a series of Congressional acts

- Authorized the U.S. Army Corps of Engineers to reduce property damage from flooding by constructing protective works;
- Established the Tennessee Valley Authority, in part to control flooding of the Tennessee River and its tributaries;

- Expanded the Bureau of Reclamation's authority to enable it to construct flood control projects;
- Authorized the Department of Agriculture to construct flood control projects and upstream watershed projects; and
- Assigned the National Weather Service responsibility for flood warnings.

The Flood Control Act of 1936 established the principle of cost sharing with local interests, but cost-sharing requirements were reduced sharply in subsequent flood control acts passed in 1937 and 1938. By the end of the 1960s, the federal government had invested over \$10 billion in flood control works and "...local communities, believing themselves to be adequately protected from floods through federal intervention, took little interest in the use of land within their own floodplains" (Platt 1979, p. 8).

In the absence of local intervention to protect floodplains from urban encroachment, federal construction of various protective works made possible continued and even more intensive use of flood hazard areas (White et al. 1958; Burby and French 1985). Inevitably, flood losses continued to rise. During the first half of the 1960s, catastrophic property losses from a series of hurricanes and coastal storms stimulated interest in a complete reevaluation of federal flood control policy and subsequent efforts to bring about effective local participation in flood hazard mitigation.

The Building Regulation and Flood Insurance Era

A second era in federal flood hazard management policy began in 1966. In that year the report of the Task Force on Federal Flood Control Policy, commissioned by the federal Bureau of the Budget, strongly recommended that local planning and land use management decisions give "proper and consistent" recognition to flood hazards. In order to strengthen the local role in floodplain management, among its sixteen recommendations the Task Force urged: (1) improvements in basic knowledge about floods and flood hazards through expansion and refinement of floodplain mapping and other measures; (2) coordination and planning of federal and state activities affecting floodplains; (3) improvements in technical services to floodplain managers; and (4) changes in policy for flood control project survey and for cost sharing to provide for greater state and local government contributions (Task Force on Federal Flood Control Policy 1966). In transmitting the Task Force report to Congress, President Johnson emphasized that the success of a "unified national program for managing flood losses" rested on state and local governments and on property owners in flood hazard areas.

The Task Force report and a companion report on flood insurance by the Department of Housing and Urban Development (U.S. Senate Committee on Banking and Currency 1966) recommended the establishment of a federal flood insurance program to (1) meet insurance needs in flood-prone areas; (2) shift the costs of floodplain occupancy (flood control structures and disaster relief costs) from the federal government to the private beneficiaries of flood-prone locations; and (3) encourage the enactment of local land use and building regulations to reduce the susceptibility of new construction to flood losses. To ease participation by the owners of existing floodplain structures, who would be faced with extremely high insurance costs, the Department of Housing and Urban Development study recommended that insurance for existing structures be

subsidized, but that actuarially sound rates be applied to new construction to reflect fully the potential for property damage from flooding. To prevent the availability of flood insurance from inducing a boom in floodplain development, the study also recommended that local governments be required to adopt and enforce floodplain regulations as a condition for participation by their residents in a federal flood insurance program.

In 1968, Congress acted on the recommendations of the Bureau of the Budget and Department of Housing and Urban Development studies by enacting the National Flood Insurance Act. As recommended by both studies, the act conditioned eligibility for flood insurance on community adoption of building regulations to reduce the susceptibility of new construction to flood damage. To speed participation in the flood insurance program, in 1969 Congress amended the legislation to create an "emergency phase," which allowed property owners to purchase flood insurance even before studies were conducted to establish actuarially sound premium charges. Even so, community participation in the program, which was voluntary, was slow in coming. When some of the worst flooding in the nation's history occurred in June 1972 (Hurricane Agnes, with property damages in excess of \$2 billion, and the Rapid City, South Dakota flash flood, with damages in excess of \$100 million), Congress learned that fewer than one-fifth of the flood-prone communities in the nation had chosen to participate in the National Flood Insurance Program (NFIP) by adopting the required building regulations.

To correct that weakness, Congress enacted the Flood Disaster Protection Act of 1973, which made local government participation in the program virtually compulsory. The act required state and local governments, as a condition for future federal financial assistance for property acquisition or construction in flood hazard areas (which included federal assistance for sewerage systems), to participate in the flood insurance program. The act also established severe sanctions for owners of floodplain property if their local government chose not to participate. Besides not being able to purchase flood insurance, floodplain property owners would not be eligible for federal disaster assistance for any flood-related damages; they would not be eligible for loans (such as home mortgages) from any federally supervised, regulated, or insured agencies or institutions; and they would no longer be eligible for direct federal grants and loans (such as assistance from the Small Business Administration).

Three additional actions strengthened the trend in federal policy away from primary reliance on flood control structures to reduce flood losses and toward a mix of measures that included both flood control structures and state and local government building and land use regulations: the Water Resources Development Act of 1974; the Disaster Relief Act of 1974; and Executive Order 11988 on Flood Plain Management, issued by President Carter in 1977.

Section 73 of the Water Resources Development Act required the Corps of Engineers and other federal construction agencies to give full consideration to building and land use alternatives to flood control structures when evaluating ways to reduce flood losses. The Disaster Relief Act of 1974 required that as a condition for disaster loan or grant assistance from the federal government, local governments evaluate the natural hazards of the locale where the funds are to be applied and take steps to mitigate those hazards through various means such as land use and construction regulations. Executive Order 11988 required federal agencies to avoid construction of federal facilities in flood hazard areas and to give adequate consideration to potential flood hazards in

the regulations and operating procedures used in licensing, permitting, loan, and grant-in-aid programs that they administer.

How Successful Are Flood Hazard Management Policies?

In spite of some difficulties in implementation, the Flood Disaster Protection Act of 1973, Water Resources Development Act of 1974, Disaster Relief Act of 1974, and Executive Order 11988 issued in 1977 provide a strong federal mandate for effective flood hazard management at all levels of government. The success of those policies can be evaluated from the top down (a federal government perspective) and from the bottom up (a state and local government perspective). The view from the top suggests that flood hazard management policies in the U.S. generally have been successful in achieving Congressional objectives to reduce flood losses, increase local government participation in managing flood hazard areas, and shift costs from the federal government to local governments and floodplain occupants. The view from the bottom suggests that progress is being made in reducing losses to new development occurring in flood hazard areas, but that further progress still needs to be made in protecting existing development from flooding and in preserving the natural values (e.g., flood storage, aquifer recharge, water quality, wildlife habitat) of urban floodplains.

A View from the Top

Reducing flood losses. Reducing annual flood losses and associated federal disaster relief costs is a key objective of federal flood hazard management policies. Available evidence suggests that federal investments in flood control structures and the regulations promulgated through the National Flood Insurance Program (NFIP) have, in fact, reduced losses compared to those that would have occurred without those programs (even though losses remain high). The U.S. Army Corps of Engineers, for example, estimated in the mid-1970s that its flood control program was preventing about \$1 billion per year in flood damages (White 1975). The Federal Insurance Administration projected that regulations required for local government participation in the NFIP would reduce average annual flood losses by \$738 million by 1990 (Sheaffer and Roland, Inc. 1979). Actual annual flood losses, however, have continued to rise, as noted above.

Obtaining local participation. A second federal objective has been to secure local government participation in the NFIP and adoption of required minimal building regulations (essentially elevation of new construction to the level of the 100-year flood and prohibition of new development in floodways where it would cause more than a one-foot increase in flood heights). In that regard, federal policies have been very successful. In 1985, over 17,500 local governments (well over 90% of the flood-prone jurisdictions in the nation) were taking part in the NFIP (Platt 1986), and most (but not all) were enforcing required building elevation and floodway protection requirements. Nonparticipating communities consisted primarily of small rural places with little development at risk from flooding (Wetmore 1986).

Shifting costs. Achievement of a third federal objective, shifting costs to the private sector, can be measured in terms of the extent to which property owners have purchased flood insurance and the proportion of the costs of the insurance program that is covered by premiums. Those measures provide mixed

signals. Unpublished Federal Insurance Administration data indicate that in 1980 there were over 7 million structures at risk from floods with 100-year recurrence intervals (because of overcounting, the actual figure may be closer to 5 million structures (Wetmore 1986)). Between 1968, when the flood insurance program began, and 1980, insurance sales increased substantially each year, and in 1980 just over 2 million flood insurance policies were in force. Thus, insurance sales had penetrated somewhere between 28% and 40% of the estimated potential market. In that year, however, the program was far from self-supporting. The average annual combined loss expense ratio for the NFIP was 264%, meaning that the program paid out \$2.64 for each \$1.00 it earned in premiums.

In an effort to make the program self-supporting, since 1981 the Federal Insurance Administration has raised insurance rates substantially, cut coverage, and raised deductibles. By 1985 those efforts had reduced the loss expense ratio to 95%, and the program showed a profit of \$16 million. That gain was achieved, however, at the cost of insurance sales, which since 1980 have stagnated at just over 2 million policies in force (News and Views 1986). Thus, the flood insurance program has achieved one national objective by becoming more self-sufficient, but it will not shift flood disaster costs entirely to floodplain property owners, because flood losses to some three to five million uninsured structures in flood hazard areas will continue to be absorbed, in part, by federal, state, and local disaster relief programs.

Preserving natural values. A fourth national objective for flood hazard areas is environmental quality and the preservation of the natural values of floodplain lands. The National Environmental Policy Act of 1970 made environmental quality a goal for every federal agency. The National Flood Insurance Act was designed, in part, "...to guide the development of proposed future construction, where practicable, away from locations which are threatened by flood hazards..." (P.L. 90-448, Section 1302 (e)). Executive Order 11988 was issued to "...to avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains..." (U.S. Water Resources Council 1978). In the case of environmental quality, however, federal policy has failed to halt the continuing degradation of urban floodplains.

Environmentalists have long opposed federal flood control structures because of the environmental damages associated with them. In addition, by reducing property owners' fears of flood losses, flood control structures have been found to induce floodplain development, which further damages the natural environment (see Burby et al. 1985). The NFIP has had a similar effect. Although it certainly is not the sole or even the most important factor stimulating development of flood hazard areas, flood insurance does ease the development of hazardous areas by reducing property owners' and lenders' fears of experiencing the adverse consequences of flooding (Miller 1975; Miller 1977; Miller 1983; Kusler 1982; Burby et al. 1985).

Local floodplain regulations, which were intended by Congress to counterbalance the expected development-stimulating effects of flood insurance, have, in fact, had little effect on the location of new development within or outside of flood hazard areas. Burby et al. (1985), for example, examined factors associated with the number of floodplain building permits issued in 1978 and in 1982 in two national samples of communities. In each case, they found no association between measures of the strength of local floodplain management

programs and the number of floodplain building permits that had been issued. (See also U.S. General Accounting Office 1982.)

A View from the Bottom

When viewed from the bottom, the success of flood hazard management policies is more problematic. State and local government officials rate progress in protecting new development from flood damages highly, but they are more sanguine about improvement in protecting existing development from damage or in preserving the natural values of floodplains. We obtained those and other state and local government perspectives on flood hazard management policy in 1983 from questionnaires returned by the NFIP coordinators working in a random sample of 956 local governments and from flood management officials in each of the 50 states. We asked these officials about the goals of state and local flood hazard management, programs formulated to achieve those goals, cooperation obtained from the private sector, and whether programs were effective in achieving local goals. (For additional details about the study, see Burby et al. 1985).

State and local goals and priorities. State and local flood hazard management goals reflect national priorities, as would be expected of a governmental activity in which policy has flowed from the top down. Protecting new development from flood damage is the most frequent policy objective (being pursued by all 50 state governments and by 60% of the 956 local governments we queried) (see Table 1). Fewer state and local governments are trying to reduce flood damages to existing development and fewer still view environmental protection as a state or local policy goal. Increasing the development potential of flood hazard areas is the least likely objective of state and local policy.

Addressing flooding problems is a priority concern of state government bureaucrats working in flood management agencies. For others in state government, however, flooding is less likely to be viewed as a serious concern, and at the local level, fewer than one in five of the governments we queried rated flooding as a serious problem (see Table 1). Those data are similar to findings reported by Rossi et al. (1982), based on a survey of 2,000 political and community leaders in twenty states and 100 communities. They concluded: "The major thrust of the findings here is quite straightforward: for the most part, political decision makers in the states and local communities do not see environmental hazards as a very serious problem, least of all in comparison to the many other problems that these governmental units are expected to be doing something about."

State and local flood hazard management programs. State governments have developed flood hazard management programs that are designed primarily to assist local governments and the private sector with measures to deal with flooding problems. As shown in Table 2, the four types of activities in which state governments said they were most involved in 1983 were technical assistance to local governments, planning and coordination, post-disaster assistance, and flood warning and public information. A minority of the states viewed more assertive roles such as regulation of flood hazard areas, construction of flood control works, and acquisition of flood hazard areas or relocation of development, as their primary functions. The relatively passive role of state government in the U.S. reflects its fairly recent emergence as an important factor in dealing with flood problems (Bloomgren 1980).

Table 1

STATE AND LOCAL GOVERNMENT POLICY GOALS AND PRIORITIES, 1983

Goals and Priorities	State Governments (n=50)	Local Governments (n=956)
Policy Goals Adopted:		
Reduce flood losses to new development	100%	60%
Reduce flood losses to existing development	90%	40%
Preserve natural values of flood hazard areas	76%	38%
Increase development potential of flood hazard areas	4%	8%
Policy Priority (Rate flooding as serious problem)		
State agency personnel	96%	--
State governor and staff	62%	--
State legislators	40%	--
Local government officials	--	17%

Four types of local government programs, which we term program classes, were observed:

- Class 1: programs that meet minimal requirements for participation in the National Flood Insurance Program, but which are not designed to meet any local goals.
- Class 2: programs designed to comply with NFIP requirements and also meet local goals through the use of zoning and subdivision regulations.
- Class 3: programs designed to contribute to the local goal of protecting property from flooding by using sophisticated measures such as building elevation requirements or floodway regulations.
- Class 4: programs designed both to protect property and contribute to the local goal of protecting the natural values of flood hazard areas, and that use additional measures such as public acquisition of floodplain property or relocation of floodplain development.

As shown in Table 2, most local governments in the U.S. have adopted flood hazard management programs that go beyond the minimum measures needed to comply with the requirements for participation in the NFIP (Class 1 programs), but

Table 2

STATE AND LOCAL GOVERNMENT FLOOD HAZARD MANAGEMENT PROGRAMS, 1983
(percent of governments that have adopted programs)

Programs	State Governments (n=50)	Local Governments (n=956)
State Program types:*		
Technical assistance to local governments	74%	---
Planning and coordination	68%	---
Post-disaster assistance	66%	---
Flood warning/public information	56%	---
Regulation of flood hazard areas	38%	---
Construction of flood control works	20%	---
Relocation/land acquisition	6%	---
Local program types:		
Class 1: Minimal program complying with NFIP	---	17%
Class 2: Any local goal and use of zoning/subdivision regulations	---	12%
Class 3: Goal to protect property from flooding and use of elevation or floodway regulations	---	53%
Class 4: Goal to protect property and preserve natural values and use of land acquisition or relocation of development	---	18%

*Roles mentioned by state officials as one of two in which their state was most involved.

very few have adopted Class 4 programs that employ measures such as public land acquisition and relocation, that will result in the preservation of the natural values of flood hazard areas and protection of existing structures from damage.

Compliance by the private sector. The primary targets of flood hazard management policies are the actions of private property owners, land developers and builders, and the current and potential future owners and occupants of floodplain structures. To gauge the extent to which those groups are complying with policy objectives, we used five criteria:

1. The proportion of new construction (in the sample of 956 communities) that was taking place outside of flood hazard areas designated by the NFIP.
2. The proportion of communities in which local floodplain managers estimated more than half of the new construction occurring in flood hazard areas between 1978 and 1983 avoided filling designated floodways.
3. The proportion of communities in which local floodplain managers estimated that more than half of new construction occurring in flood hazard areas between 1978 and 1983 was elevated to or above the level of the 100-year flood.
4. The proportion of communities in which local floodplain managers estimated that more than half of the new subdivisions developed between 1978 and 1983 made adequate provision for storm drainage.
5. The proportion of communities in which local floodplain managers estimated that half or more of existing development located in flood hazard areas has been floodproofed.

In the case of the first criterion, we found that for most new construction (94%), developers and builders were avoiding flood hazard areas (Table 3). In fact, in about two-thirds of the 956 communities we surveyed in 1983, no new development had occurred in flood hazard areas during the previous year. Where floodplain development had occurred, in two-thirds of the communities local floodplain managers (i.e., the designated local NFIP coordinators) reported that a majority of structures were being elevated to or above the level of the 100-year flood (criterion 2), and that developers were avoiding filling floodway channels (criterion 3). The lowest level of compliance with policy objectives was observed for provision of adequate storm drainage in new development (criterion 4) and floodproofing existing structures at risk from flooding (criterion 5).

Local officials' overall evaluations of program effectiveness. In light of local goals, classes of programs being used, and cooperation being obtained from the private sector, we asked local floodplain managers to rate the overall effectiveness of flood hazard management in their jurisdictions. Forty-eight percent of the local officials surveyed rated flood hazard management as very effective in *preventing flood losses to new construction*. Fewer (33%) rated flood hazard management as very effective in *preserving the natural values of flood hazard areas*, and only 21% rated flood hazard management as very effective in *reducing the exposure of existing development to flooding*. Thus, the focus of the NFIP on new construction is clearly reflected in perceived

accomplishments at the local level: new construction tends to be protected from flood damage through local efforts. Other federal goals, however, are not being attained as fully. Local programs have had much less success, for example, in reducing flood damage to existing development and in protecting the natural environment. Those goals are not stressed by the NFIP or by many local governments, as we noted earlier (see Table 2).

Table 3
PRIVATE SECTOR COMPLIANCE WITH POLICY OBJECTIVES, 1983

Compliance Indicator	Percent
1. Proportion of structures constructed in 1982 that were located outside of designated flood hazard areas of national sample of 956 communities	94%
2. Proportion of communities in which at least half the new construction occurring in flood hazard areas between 1978 and 1983 <i>avoided filling designated floodways</i>	68%
3. Proportion of communities in which at least half the new construction occurring in flood hazard areas between 1978 and 1983 was <i>elevated</i> to or above the level of the 100-year flood	66%
4. Proportion of communities in which at least half the subdivisions developed between 1978 and 1983 made adequate provision for <i>storm drainage</i>	53%
5. Proportion of communities in which at least half the existing development located in flood hazard areas had been <i>floodproofed</i>	23%

The Need for More Attention to Land Acquisition and Relocation

In looking more closely at the effectiveness of flood hazard management programs at the local level, we found that program performance was correlated with both the class of measures employed and the type of community in which they were used. Programs that go well beyond NFIP requirements by seeking to preserve environmental values and include land acquisition and relocation of development tend to be rated as most effective. But effectiveness also varies with two key community characteristics--the extent of existing floodplain development and availability of alternative, flood-free sites for development. Programs that are formulated with those characteristics in mind in many cases will be more effective than programs that are not carefully tailored to the local context. In this section, we present evidence to support those assertions.

The Evidence

We hypothesized that Class 4 programs--programs that employ land acquisition or relocation and seek to achieve both flood damage prevention and environmental goals--will be more effective in achieving both of those goals than Class 1, 2, or 3 programs. We also hypothesized that each of those program classes will be more effective in communities where the floodplain has yet to be developed extensively and alternative flood-free sites for community growth are available (we term those Type A communities) than in communities where the floodplain has already been extensively developed and sites for development outside of the floodplain are limited (we term those Type D communities). We expected program success in other communities to fall somewhere between those two extremes.

For the most part, our hypotheses are confirmed by the field data summarized in Table 4. In addition, those data suggest five additional conclusions about local flood hazard management programs.

1. In virtually every case, flood hazard management programs have been more successful in dealing with flood damages than in protecting the environmental values of floodplains.
2. To be very effective in dealing with flood damages, programs need to regulate building elevations and to prohibit floodway encroachment (Class 3 programs). Class 1 and Class 2 programs typical of communities that have not had flood insurance rate studies to provide the data necessary for regulating building elevation and floodway encroachment are not nearly as effective as Class 3 programs.
3. Programs to reduce flood damages will be even more effective if they include public acquisition of flood-prone property or building relocation (Class 4 programs), particularly in communities with limited flood-free sites for new development (Type C and Type D communities in Table 4).
4. Protecting the natural values of flood hazard areas is particularly difficult in Type D communities, where none of the program classes performed well.
5. Where extensive flood-free sites are available (Type A and B communities), programs that include land acquisition (Class 4 programs) can be very effective in protecting the floodplain environment, as shown in Table 4. Of course, acquisition programs may not preserve the floodplain in its natural state. However, even when the acquired property is devoted to active recreational uses such as golf courses, some natural values such as flood storage and groundwater recharge, will be preserved that would have been lost if the floodplain been developed for residential or commercial uses.

The fact that program performance varies considerably, depending on the characteristics of the communities, also suggests that using uniform national standards for local floodplain management, like those employed by the NFIP, is not an efficient approach to achieving hazard management objectives.

Table 4

**SUCCESS IN ACHIEVING LOCAL FLOOD HAZARD MANAGEMENT GOALS,
BY TYPE OF COMMUNITY AND PROGRAM CLASS, 1983***

		Percent of Communities in Which Program Was Rated as Very Effective in Terms of:					
Goals:		<u>Reducing Flood Losses</u>			<u>Protecting Natural Values</u>		
Type of Community	Program Class:	2	3	4	2	3	4
Type A communities		15%	56%	63%	11%	37%	50%
Type B communities		29%	47%	60%	17%	33%	58%
Type C communities		18%	58%	72%	23%	38%	20%
Type D communities		25%	37%	58%	19%	16%	17%

*Because Class 1 programs are not designed to achieve local goals, but merely to comply with federal requirements, they are not evaluated here.

Program classes are defined in Table 2.

Community types are defined as follows:

Type A: limited existing floodplain development; extensive flood-free sites for community growth.

Type B: extensive existing floodplain development; extensive flood-free sites for community growth.

Type C: limited existing floodplain development; limited flood-free sites for community growth.

Type D: extensive existing floodplain development; limited flood-free sites for community growth.

Communities with limited existing floodplain development and limited flood-free sites were defined as communities with values on those factors below the median for the sample of communities studied; communities with extensive floodplain development and extensive flood-free sites were defined as communities with values on those factors at or above the median for the sample of communities studied.

Examples of Programs Involving Land Acquisition and Relocation

Profiles of selected floodplain acquisition and relocation programs are provided in the appendix to this report. After studying a number of acquisition and relocation programs, Kusler (1979) came to the following conclusions about their common elements:

1. Communities are likely to consider land acquisition and relocation of existing development in three circumstances: (1) immediately after and as a response to a flood disaster (Rapid City, South Dakota, is an example); (2) after finding that flood control structures are technically not feasible, too expensive, or too damaging to the natural environment and are therefore unacceptable as a solution to repeated flooding of floodplain structures (Baltimore, Maryland; Baytown, Texas; Scottsdale, Arizona; and Clinchport, Virginia are examples); and (3) after deciding to achieve environmental or economic objectives in managing flood hazard areas (Charlotte and Raleigh in North Carolina and Milwaukee and Soldiers Grove in Wisconsin are examples).
2. Communities that have acquired floodplain property are usually interested in achieving a broad range of objectives in addition to flood hazard mitigation. Those objectives include community economic development, provision of urban parks and open space, stormwater management, and neighborhood revitalization.
3. Acquisition is almost always in fee. Easements are considered too complicated and too limited in the benefits they confer.
4. Finding adequate funding for acquisition and relocation programs has been a serious problem and has delayed implementation of programs in most communities, where a single source of federal or state funding could not be arranged, and communities had to search out and negotiate for financial assistance from a number of agencies.
5. If acquisition is to be undertaken after a flood occurs, local officials must act quickly before reconstruction begins. Some communities have adopted tight regulations or moratoriums to prevent redevelopment until funds for public acquisition of property have been arranged.
6. Acquisition tends to be used selectively in conjunction with land use regulations and other techniques to acquire a portion of the floodplain. The entire floodplain is rarely acquired.
7. Local officials are reluctant to force property owners to sell or relocate. Most programs depend on voluntary sale or dedication of property by private landowners.
8. Most floodplain property that has been acquired is devoted to open space and park uses.
9. Citizen involvement, public education, and the use of local task forces have been key components in floodplain acquisition efforts.

10. Local officials view federal policy as supportive of flood control works and reconstruction following disasters, but not relocation or acquisition of areas subject to flooding to prevent further development of dwellings and other structures.

Conclusions and Policy Implications

Flood hazard management in the U.S. involves a partnership of the federal government with state and local governments. From the federal perspective, that partnership is dealing with flood hazards rather well. Potential flood losses have been reduced as a result of federal flood control and insurance programs, thousands of local governments have been persuaded to adopt regulatory programs to reduce the susceptibility of new construction to flooding, and some federal relief and reconstruction costs have been shifted, through insurance, to the private sector. From the local perspective, flood hazard management programs are successfully reducing the susceptibility of new construction to flood damage, but programs are rarely viewed by local officials as very successful in preventing damage to existing structures in floodplains or in protecting the natural values of floodplains. Those shortfalls create a need for innovation in flood hazard management policy.

An analysis of communities in which Type 4 floodplain management programs are employed shows that local officials give program effectiveness a high rating in those communities. Type 4 programs emphasize public acquisition of flood hazard areas or relocation of existing development. Kusler (1979) has identified a number of reasons why acquisition and relocation are more effective than other floodplain management measures:

1. Unlike floodplain building regulations, land acquisition and relocation (1) can be used to prevent all damageable uses of the floodplain; (2) are usually permanent and not subject to local political whim; (3) contribute to objectives other than flood damage prevention; and (4) may be more palatable politically, since landowners are compensated.
2. Unlike flood control works, land acquisition and relocation (1) are likely to be less costly (although they may be expensive); (2) are less subject to physical constraints on their applicability; (3) do not require as intensive continuing maintenance; (4) do not threaten catastrophic losses when flood events exceed design standards; and (5) protect rather than harm the natural environment.
3. Unlike insurance, acquisition and relocation (1) do not encourage floodplain development; and (2) provide greater certainty that flood losses to existing floodplain development will be reduced.
4. Finally, unlike disaster relief, acquisition and relocation provide a permanent, rather than stopgap, solution to flood problems.

The advantages of floodplain land acquisition and relocation of flood-prone structures are not enumerated to suggest that other flood hazard management tools should be abandoned. In fact, a mix of hazard mitigation tools is clearly needed (e.g., see Handmer 1985a and 1985b). Those advantages do suggest, however, that acquisition and relocation should receive more attention in federal policy than they do at present.

Few local governments have experience with acquisition and relocation as floodplain management tools (fewer than one in five local governments were using them as of 1983). Without federal encouragement and assistance, their use at the local level is likely to be less frequent than is optimal because other measures (e.g., building regulations and flood control structures) that are directly tied to federal programs do receive such support. In attempting to deal with flooding problems, localities tend to turn first to those measures that are encouraged through federal policies.

Three modifications in federal policy could speed local government adoption of land acquisition and relocation measures.

1. **As a condition for the sale of federal flood insurance, local governments should be required to prepare comprehensive plans for flood hazard areas.** Land use planning will encourage local governments to consider a range of objectives for flood hazard areas and a range of policies for achieving those objectives (Whipple and Hufschmidt 1976). At present, a number of communities (e.g., 45% of those we surveyed in 1983) undertake floodplain management without planning.
2. **Technical assistance programs offered by the Federal Emergency Management Agency, Floodplain Management Services Program of the U.S. Army Corps of Engineers, and Technical Services Program of the U.S. Soil Conservation Service should be expanded to include assistance in planning and carrying out land acquisition and relocation projects.** In addition, federal assistance for state-run technical assistance programs should be expanded. In earlier research (Burby and French 1981), we found that lack of qualified personnel was a key barrier to developing effective local floodplain management programs. Technical assistance programs are one means by which the federal government can overcome that barrier. In addition, if programs include workshops, guidebooks, and other educational tools, localities can be taught a number of ways to increase the feasibility of land acquisition and relocation (e.g., Ralph M. Field & Associates 1979; Handmer 1985a and 1985b).
3. **A grant-in-aid program with funds earmarked for the acquisition of floodplain property should be established, either as a new program or by modifying and expanding existing programs that have been providing partial funding for floodplain land acquisition projects.** The federal government operates a number of programs that have provided partial financing for the acquisition of floodplain property (e.g., Section 1362 Program of the Federal Insurance Administration; Land and Water Conservation Fund of the Department of the Interior; Community Development Block Grant Program of the Department of Housing and Urban Development; Section 73 Program of the U.S. Army Corps of Engineers), but because those programs are spread across a number of agencies and often are designed for other purposes, local governments must have considerable skill in "grantsmanship" to take advantage of available federal aid (David and Mayer 1984).

Acquisition of floodplain property is an innovative technique which in combination with other floodplain management tools has proven to be effective in reducing flood losses and protecting the natural environment. In comparison with other flood hazard management tools, relatively few local governments are

using acquisition and relocation in managing their floodplains. An aggressive federal program that pays as much attention to acquisition as is currently given to flood control and regulatory measures, however, could speed the adoption of acquisition and relocation programs.

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APPENDIX

Appendix

PROFILES OF SELECTED FLOODPLAIN ACQUISITION AND RELOCATION PROGRAMS

Baltimore, Maryland. Baltimore County has initiated a program that will acquire 246 properties located within the floodways of six watersheds at a cost of \$17 million. Land use regulations have been adopted that virtually prohibit future floodplain development.

Baytown, Texas. Properties subject to repeated flooding of about 750 acres because of land subsidence caused by past extraction of oil and groundwater are being acquired with funds provided by Section 1362 of the National Flood Insurance Act.

Charlotte, North Carolina. Mecklenburg County has undertaken an ambitious greenway acquisition program to preserve floodplains along more than 20 streams. Over 40% of the 1,050 acres acquired to date have been dedicated by land developers as a condition for county approval of site plans and subdivision plats. The completed greenway network will incorporate more than 4,000 acres and nearly 60 miles of trails.

Clinchport, Virginia. The Scott County Redevelopment Authority, with funding from the Tennessee Valley Authority, has acquired more than 53 properties in the floodplain.

Lilydale, Minnesota. Ramsey County has acquired about 320 acres and relocated 116 families from the floodway. State funds and a regional bond issue provided the \$4.4 million needed for the project.

Littleton, Colorado. In 1971, the city proposed to buy 750 acres of the South Platte floodplain as an alternative to channelization proposed by the U.S. Army Corps of Engineers. A variety of funding sources has been used, including a local bond issue, open space monies from the U.S. Department of the Interior, redevelopment money from the U.S. Department of Housing and Urban Development, and funds from the Corps of Engineers and State of Colorado. The 200 acres acquired to date are used as a park.

Milwaukee, Wisconsin. Milwaukee County has sought to acquire most of the floodplains in the county for parks and parkways. Local, state, and federal urban renewal and open space funds have been used to pay for the program.

Raleigh, North Carolina. The city began a greenways program in 1976 to acquire property along major streams. Although some acreage has been purchased by the city, most of the land acquired has been dedicated by land developers, who are allowed to transfer density to flood-free sites in exchange for deeding floodplains to the city. Twenty miles of trails have been constructed as of 1986. The eventual open space network will encompass approximately 235 miles of stream.

Rapid City, South Dakota. After a devastating flood in 1972, which caused 238 deaths and damaged or destroyed 824 structures, the city acquired 1,400 parcels located in the floodway and amended zoning regulations to prohibit all new development in the 100-year floodplain. The acquisition program was funded by \$48 million in federal urban renewal funds.

Scottsdale, Arizona. After local opposition developed to a Corps of Engineers proposal to solve flooding problems along the Indian Bend Wash by constructing a seven-mile-long concrete channel, the city used land use regulations and land acquisition to create a floodway greenbelt. Developers are allowed to build in the floodway fringe on fill elevated to the level of the 100-year flood and are given density bonuses in exchange for dedicating floodway land to open space uses. In addition, 50 families were relocated from the floodway.

Soldiers Grove, Wisconsin. The Village of Soldiers Grove relocated its central business district from the floodway of the Kickapoo River. Public acquisition of floodway properties allowed owners to obtain modern, energy-efficient replacements in more economically viable locations, helping revitalize the village's economy without the threat of floods. The project was financed with a combination of local, state, and federal funds.

Sources: Kusler (1979), David and Mayer (1984), Burby et al. (1985); and Brunner and Furueth (1986).