

Beyond the ark: a new approach to U.S. floodplain management

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Floodplains occupy a significant portion of the United States. About 7 percent, or 178 million acres, of all U.S. land is floodplain, and, of course, the percentages are much higher along the coasts and major rivers, where most of the larger cities are located.(1) Floodplains are lands subject to periodic inundation by hurricanes, storm tides, heavy rains, and spring snow melt. They are the lowlands adjoining the channels of rivers, streams, and other watercourses and the shorelines of oceans, lakes, and other bodies of water.

Floodplains are shaped by water-related, dynamic physical and biological processes and include many of the nation's most beautiful landscapes, most productive wetlands, and most fertile soils. They are home to many rare and endangered plants and animals, as well as to sites of archaeological and historical significance. In their natural state, floodplains have substantial value. These complex, dynamic systems contribute to the physical and biological support of water resources, living resources, and cultural resources. They provide natural flood and erosion control, help maintain high water quality, and contribute to sustaining groundwater supplies. Therefore, proper management of floodplains is important to preserve their value and to reduce losses caused by flooding.

The United States is now at a pivotal point in floodplain management. A national status report on floodplain management was released last year by the Federal Interagency Floodplain Management Task Force, and federal agencies responsible for reducing the losses caused by floods are about to begin deliberations on future directions in floodplain management.(2) At the same time, the Clinton administration and Congress wish to reduce spending in light of the \$4-trillion national debt. Also, little money is available at state and local levels for flood-loss reduction measures and disaster relief.

The task force's status report, entitled *Floodplain Management in the United States: An Assessment Report*, is the first assessment of the status of the nation's floodplains in 25 years and the most comprehensive assessment and description of floodplain management policies ever undertaken (see the box on page 8). It is an excellent, useful, and even-handed report, but its documentation of all aspects of existing conditions is also its chief weakness because a discussion of existing conditions does not, in itself, adequately set the stage for consideration of possible future directions. Some issues and trends are much more important than others for suggesting informed future directions.

Substantial progress has been made in the last 25 years in U.S. floodplain management. This progress is especially evident in the increased public awareness of flood hazards and the ability of humans to predict potential flooding and to influence risk exposure. But floodplain management in the United States has gone about as far as it can go with its existing approaches. Prime dam sites have been exploited; major floodplains have been mapped; and minimal floodplain regulations have been adopted by more than 18,200 communities.(3) Increased funding for existing approaches is not the answer to many of

the remaining problems. Instead, a fundamental change is needed. The focus of floodplain management must change from consideration of property losses alone to the consideration of the many purposes of floodplains. Management should be extended to smaller rivers and streams and tailored to watershed conditions. Broad-brush approaches to mapping and regulation that reflect only flood elevations should be replaced, in many contexts, by approaches that also reflect water velocity, sediment regimes, and the changes in run-off that are caused by watershed development. Multiobjective mitigation plans and implementation strategies involving landowners, citizen groups, and local governments should not only improve guidance for future development of floodplain areas but also address the restoration of stream, wetland, and riparian zones. A recent report by the National Academy of Sciences calls for the restoration of 400,000 miles of rivers and streams.(4) It notes that, of the nation's total mileage of rivers and streams, only 2 percent are high- quality, free-flowing segments.(5)

There are many examples of such multiobjective protection and restoration efforts.(6) They have been variously called "greenway," "multiobjective river corridor management," and "environmental corridor management" programs.(7) More than 500 communities have implemented such programs for some or all of their rivers and streams. These programs have been characterized by innovative, problem-solving approaches and broad public involvement (see the boxes on pages 11 and 32).

A number of federal programs encourage such efforts, including the National Park Service's Rivers and Trails Program, the Army Corps of Engineers' floodplain management program, the Tennessee Valley Authority's floodplain management program, and the Federal Emergency Management Agency's community rating system. Some state floodplain, river, wetland, and open space programs also encourage such efforts. The California Urban Stream Restoration Program has been particularly successful in encouraging low-cost community stream restoration efforts with broad public involvement through technical assistance and small grants-in-aid to communities. Other examples include the Missouri stream restoration program, the Massachusetts greenway program, and the Maryland greenway program. Despite the success of such projects, no coordinated national legislation, policy, or program exists to support such efforts.(8)

At one time, structural changes--such as dams, levees, channel alterations, and shoreline protection--were the primary approach for addressing flood losses. Although such structural approaches have reduced flood losses, they often do so at great cost and with great environmental impact. Since 1968, considerable progress has been made in implementing nonstructural loss-reduction measures, such as regulations, warning systems, and evacuation plans. Of the 22,000 floodprone communities in the United States, more than 18,200, or 82 percent, have adopted floodplain management regulations and participate in the National Flood Insurance Program (NFIP). More than 2.6 million flood insurance policies are presently in force through this program. The Federal Emergency Management Agency (FEMA) has mapped 18,492 communities, and 2,463 restudies have been completed or are in progress.(9)

Despite these efforts, flood losses continue to increase. Per- capita damages have increased despite measures to reduce such losses, although the rate of increase has slowed. A 1987 study for FEMA estimated that 9.6 million households in 17,466 communities with a total of \$390 billion in property value were at risk from flooding. From 1916 to 1985, flood-related deaths averaged 104.4 per year. Per-capita flood-related deaths have decreased, but per- capita flood losses were 2.5 times as great from 1951 to 1985 as from 1916 through 1950, after adjustment for inflation.(10)

In fact, 1992 was the most expensive year in U.S. history for natural disasters, with total estimated losses from floods and hurricanes exceeding \$30 billion. In fiscal 1992, 46 presidential declared disasters and 2 emergencies occurred--the largest number in recent history. Of these, 2 were related to contaminated water supplies and 38, or 83 percent, were flood-related.(11) The paid flood insurance claims for three of these events were huge: \$115 million for Hurricane Andrew's flooding in Florida; \$30 million for Andrew's flooding in Louisiana; and \$30 million for Hurricane Iniki's damage in Hawaii.(12) However, damage caused by wind was much more costly, as is typical of most hurricanes. Hurricane Andrew was the most damaging and powerful hurricane to hit the U.S. mainland this century, and yet it could easily have been worse. However, deaths were exceptionally low: fewer than 70 in Florida and none in Louisiana. This low mortality can be attributed to the effectiveness of the evacuation and warning program, which evacuated an estimated 2.7 million people. Andrew's record-low barometric pressure, sustained winds of 115 to 140 miles per hour, and gusts of 145 to 170 miles per hour resulted in a storm surge of up to 17 feet on Key Biscayne Bay and up to 12 feet in other places.

Although these were unusual storms, they do raise issues such as the cost-effectiveness of various approaches to floodplain management; how cost-benefit ratios are to be calculated; and to what extent floodplain occupancy should continue to be subsidized by the federal government through NFIP. Soaring costs and deficits require, at a minimum, a careful re-evaluation of the effectiveness of various approaches, particularly those that blatantly subsidize continued occupation of high-risk areas at taxpayers' expense and achieve only single-purpose goals. In light of high deficits, how can federal, state, and local governments best reduce future flood losses and respond to floods and other hazards?

Structural and nonstructural efforts to reduce losses have been at least moderately effective in addressing certain situations, but they were not designed to address other situations and do not do so. Several major gaps in existing programs must be addressed. First, despite the expenditure of \$873 million for federal mapping of floodplains, approximately 100 million acres, or one-half of the nation's floodplains, have been mapped.(13) Unmapped floodplains generally are not subject to regulatory standards by communities or states. Much of the land not subject to management lies along smaller rivers and creeks or along smaller lakes.

In addition, more than 31 percent of flood insurance claims were paid for flood damage outside the mapped "100-year" floodplain.(14) This means that development in these

areas is covered by federal insurance but is not subject to regulations to guide new development. To remedy this problem, watershed planning and multiobjective river corridor management for these smaller streams and rivers are needed. This is where development is currently unregulated for flood-hazard reduction purposes and where the greatest changes in hydrology are occurring because of urbanization. It is also where community and local organizations can do the most.

Even in mapped and regulated floodplain areas, however, serious deficiencies exist. Much of the mapped floodplain does not have calculated flood elevations but only a general outline of flood risks. As a result, communities do not have the tools they need to guide and protect new development.

Even where flood studies are under way, it typically takes five years or more to complete a study and adopt regulations. Often, much of the floodplain is developed by then, putting buildings and people at risk.

Another gap in current programs concerns high-risk and unusual hazard areas that have been mapped and regulated but whose maps and regulations inadequately address the special problems. Such areas include alluvial fans; floodplains adjacent to rivers or streams with moveable (erodible) channels; combined flooding/erosion areas, both inland and coastal; areas with long-term fluctuations in ground-and surface-water elevations, such as those adjacent to closed basin lakes; ice jam flooding situations; and subsidence areas. In some parts of the United States, such as the West, most of the flood-risk areas are of such a "special" nature.

Despite the massive NFIP and large expenditures for mapping, only limited efforts have been made to prepare special maps for or to apply regulatory standards to special high-flood hazard areas. When the mapping program was first developed more than 20 years ago, the high costs caused a uniform national approach to be developed to map and regulate all hazard areas, even high-risk ones. In addition, mapping efforts have generally assumed "existing" watershed conditions, despite broad recognition that urbanization causes dramatic increases in future flood peaks.

The time has come for a shift in mapping philosophy from one overall approach for the whole nation-based primarily upon historical flood events --to much more specific mapping of certain areas to reflect geomorphological factors and particular hazards and to anticipate future development. Such mapping is essential to provide local communities with the tools they need to convince citizens that there is a reasonable, credible, and accurate way of identifying and managing the flood hazards on their properties and to develop multiobjective local regulatory and management efforts. Such mapping will be expensive, but it need not be carried out on a nationwide basis and could be undertaken on a cost-share basis with states and communities.

Another gap in existing floodplain programs is mitigating the losses to existing structures, starting with structures that have experienced repetitive loss and substantial damage. The assessment report and FEMA data indicate that, in the 1980s, 30,000

structures (2 percent of NFIP-insured structures) filed 2 or more claims of \$1,000 or more and thus accounted for about 30 percent of the claims paid, or \$747 million. In that same period, about 18,000 buildings suffered damages of more than 50 percent of their value, accounting for more than \$438 million in claims paid.(15) Despite hopes that present regulations would lead to a gradual upgrading or elimination of existing substandard structures, only limited progress has been made through the regulation approach alone. A multiobjective mitigation program designed to prevent or reduce future flood damage to these few structures through elevation or relocation has tremendous savings potential.

The lack of financial incentives and landowner assistance to relocate or upgrade substantially damaged structures is illustrated by the situation in Florida's Dade County, which includes Miami. In this area, more than 3,000 homes were substantially damaged by the winds of Hurricane Andrew. (16) insurance will provide funds to rebuild the homes to their "before-hurricane" conditions. The catch is that these homes are in a flood hazard area. Rebuilding at their former level will not reduce the risk of their being significantly damaged by up to four feet of water in the next flood.

It would cost an additional \$30,000 each to elevate the structures. Because the residents' entire savings were lost in the hurricane and their places of employment may also be out of business for an indeterminate time, their ability to pay for or to arrange mortgages for this work is almost nonexistent. Insurance policies, even flood insurance policies, do not provide monies to mitigate against future disasters. Similarly, disaster relief funds can only be used for rebuilding.(17)

It is now more than nine months since Hurricane Andrew, and many of the 3,000 homes remain unrepaired. Modest federal mitigation grants or low-interest loans could help reduce future federal and private outlays when floods do occur.

Present programs also fail to protect the natural and cultural functions of floodplains. The task force's assessment report discusses the natural and cultural functions of floodplains in some depth and concludes that the existing federal, state, and local floodplain management programs do not adequately protect the pollution-control, habitat, flood storage, recreational, and other natural functions. The report does not, however, adequately examine the reasons why the programs neglect these functions. One reason is that such functions are not mentioned in federal standards for floodplain regulations, and only a relatively small number of communities have incorporated additional provisions into their regulations. In some instances, the availability of subsidized federal flood insurance may have promoted development in highly sensitive or valuable areas, such as wetlands and riparian habitat in the West. Secondly, federal and state floodplain management agencies have generally not promoted the protection of natural and cultural functions because of their narrow flood-loss reduction objectives, a lack of expertise concerning such functions, and a lack of multiobjective approaches for both reducing flood losses and promoting natural and cultural functions. A third reason is that floodplain management has for a long time been narrowly conceived of as managing "excess water" rather than as a part of a broader water resources management that encompasses point and nonpoint source pollution control, storm-water management,

water supply, erosion and sediment control, recreation, aquatic habitat protection, and wetland protection and management.

Cost-Effective Management

To address all of these problems, floodplain management should be approached as part of multiobjective watershed (water resources) management with adequate protection for natural and cultural functions. Improving the monitoring and enforcement of existing approaches is necessary, but it will address only a portion of the gaps.

Community, citizen-based efforts are essential to closing these gaps, and yet communities are not being provided with adequate incentives and help. The U.S. floodplain management program needs to be more integrated with other programs that affect floodplains, more localized, more comprehensive, and more unified on a watershed and local government level.

At the federal level, less emphasis should be placed on new massive programs and new expenses and more should be placed on shifting the federal role from managing the nation's floodplains to being a facilitator for state and local programs that address the gaps in existing efforts. To address flood losses and better protect natural and cultural functions, the administration, Congress, states, and local governments need to provide a rational, multiobjective framework for watershed-level efforts that are facilitated by federal agencies and states. Federal agencies and states should have continued roles in providing technical assistance, grants in aid, and other assistance to facilitate the accomplishment of federal, state, and local goals, including flood-loss reduction, wetland protection, good water quality, and recreation, while avoiding single-purpose programs. FEMA's community rating system, which provides lower insurance rates for communities with floodplain management efforts that exceed federal standards, is a positive example of such a measure.

Federal subsidies should also be revised to better promote individual responsibility and multiobjective approaches. Nonstructural approaches adopted over the last 25 years--as well as NFIP--tend toward that goal. Nevertheless, this goal is undermined by continued disaster assistance and federal subsidies for beach nourishment, beach erosion control, flood control, and flood insurance for certain high-risk areas where the low insurance rates and regulations do not accurately reflect the risk. These subsidies continue to bias local and state decisionmaking toward structural solutions, even when such decisions are not consistent with individual responsibility, cost-effective use of the floodplain, or achievement of natural and cultural functions.

Federal cost-benefit ratios for flood control and other water resources projects also deserve a hard look, particularly in regard to the calculation of benefits for preventing future flood losses, protecting natural and cultural functions, and providing long-term sustainable use of natural systems. Present procedures are applied in a manner that produces high benefit-Cost ratios where intensive development has already occurred or is allowed in the floodplain.

In addition, Congress should provide incentives for multiobjective floodplain and watershed planning and management that anticipate future conditions. Preference should be given to state and local governments, watershed planning, open space, floodplain management, and post-disaster assistance programs that integrate floodplain management into future-oriented environmental programs, such as river management, greenways, trails, point and nonpoint source pollution controls, erosion controls, and wetland management. Such incentives and funding could include adopting a special multiobjective river corridor management act that gives small grants to communities and citizen groups that undertake multiobjective programs and implementing new wetland and watershed management initiatives for states and local communities as part of the Clean Water Act reauthorization. Support for multiobjective programs should be included in public works budgets and in the new "job corps" and economic stimulus package of the Clinton administration.

Coordination among federal, state, and local governments should also be improved. An interagency mechanism is needed to permit and encourage the federal agencies to play a more active and coordinated role in establishing and implementing multiobjective floodplain and water resources management policies. For all of its faults, the U.S. Water Resources Council served this role, and its reestablishment or the formation of a new coordinating and policy- setting body is needed.

Improved joint training and technical assistance are also needed. Two of the principle barriers to effecting change in national floodplain management policy are compartmentalism and lack of training. Federal multidisciplinary teams that include representatives of federal agencies, states, local governments, and nonprofit interest groups would particularly benefit from joint training because it would increase cooperation. Priority topics should include mapping and regulation of high-risk and unique hazard areas, facilitation of local government multiobjective watershed efforts, evaluation and protection of natural and cultural functions, restoration of floodplain systems, and nonstructural ("soft") engineering alternatives.

Data gathering, monitoring, and oversight of federal flood- loss reduction programs should be improved in relation to one another and to other resource management programs. Federal flood- loss reduction programs should be evaluated in terms of the overall objective of reducing flood losses and protecting natural and cultural functions rather than achieving the programs' individual statutory mandates. For example, NFIP must be viewed in the context of larger federal disaster and flood-loss reduction efforts-- not as a separate program that balances its own books even though the taxpayers' costs for disaster assistance continue to rise. Post- disaster policies should also be re-evaluated to determine whether they are reducing, rather than simply perpetuating, future losses.

Shifting floodplain management to emphasize community-based multiobjective and watershed-based efforts tailored to local conditions will not be easy. Existing institutions have enormous bureaucratic inertia, and many interest groups as well as agency staff tend to favor the status quo. Uniform, broad-brush national approaches for mapping,

regulation, and management are less time-consuming for federal agency staff to administer, and measures that increase the federal workload without increasing federal staff will encounter strong opposition. Some federal agency staff also fear the loss of control. They are accustomed to initiating and implementing flood-loss reduction measures and are reluctant to share responsibility and power with states and local governments. In addition, various federal statutes authorize strong, direct federal roles rather than assistance to local governments.

Floodplain managers also often lack the multidisciplinary expertise needed for the protection and restoration of natural and cultural functions, such as wetland protection. In addition, there are concerns that local government and citizen-based programs will be dominated by local real-estate and other special interests and will not meet regional or national needs and that local, citizen-based efforts will lack the expertise to address highly technical flood, pollution control, and wetland restoration efforts. Community-based watershed approaches involving detailed data gathering, computerized geographic information systems, and other sophisticated analysis techniques can also be very expensive. Various land-use planning efforts for watersheds and other areas have often proved to be of limited value if separated from implementation.

All of these arguments, however, do not justify continuing the status quo. Experience over the last 30 years has shown that, despite the expenditure of huge sums of money, the federal government alone cannot "solve" flood problems.

New, community-based efforts can be practical and implementation-oriented. They need not be prohibitively expensive, as indicated by many successful efforts already implemented across the nation (see the box on page 32). Community efforts can be financed by combining funds from a variety of programs meant to address such activities as nonpoint and point pollution control, storm-water management, outdoor recreation, community redevelopment, and wetland and habitat protection and restoration, as well as flood-loss reduction. Landowners, citizen groups, and local governments must be brought more fully into the process as partners to address not only flood control but also other community economic and environmental needs.

Community-based initiatives need not place huge new demands on federal staff or budgets if coordinated use can be made of the many experts throughout the federal agencies, including the Army Corps of Engineers, FEMA, the Soil Conservation Service, the National Park Service, the Environmental Protection Agency, and the U.S. Geological Survey. Strong, continued federal and state involvement in such community efforts is needed to provide technical assistance and training and to reflect regional perspectives.

It is true that floodplain management must be revised technically to continue to reduce flood losses and meet broader, multiobjective goals. But, more importantly, floodplain management must become a more complete and real local, state, and federal partnership.

EVALUATING THE EFFECTIVENESS OF FLOODPLAIN MANAGEMENT

The Federal Interagency Floodplain management Task Force's assessment report concluded that it was difficult to evaluate the effectiveness of floodplain management because of a lack of specified goals, baseline data, and monitoring. Nevertheless, the report reached a number of significant observations that were outlined in the summary and executive summary:

- * Public recognition of flood hazards is now widespread.
- * Judicial support for regulations is also widespread, which increases the liability of landowners who undertake activities that increase flood hazards on other lands.
- * Some reduction has occurred in floodplain development.
- * A reduction in losses to new development has occurred because of regulatory standards.
- * A shift from federal domination toward a more equal federal, state, and local partnership has occurred.
- * There is now greater awareness that no single floodplain management strategy is appropriate for every area.
- * There has been success in reducing loss of life, but there has been no decline in overall flood losses.
- * Floodplain regulations have not arrested deterioration of natural and cultural functions.
- * A truly unified floodplain management program is not in place.

The report also outlined a number of opportunities for increasing the effectiveness of floodplain management. These include

- * setting flood-loss reduction goals to be achieved by a certain date;
- * improving the database;
- * conducting new research;
- * integrating strategies for flood-loss reduction and for restoring and preserving natural resources;
- * improving coordination and integration in floodplain management;
- * increasing cooperation among all persons, programs, and agencies with an interest in reducing flood losses;
- * developing methods for better management of high-risk flood hazard areas;

- * adopting broader watershed-based and river corridor management approaches;
- * improving the incorporation of local conditions in floodplain management approaches;
- * helping rural and economically disadvantaged areas;
- * improving incentives to encourage the best mix of management measures and better enforcement of floodplain regulations;
- * improving awareness and education, including more training and education for government officials; and
- * improving techniques for restoring and preserving the natural and cultural resources of floodplains.