

FLOODPLAIN PLANNING AND MANAGEMENT FOR EXTREME FLOODS

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Abstract. A brief overview of the issues related to the upper Mississippi River flood of 1993 is presented as the context for understanding one federal agency's (Corps of Engineers) responses to the policy and programmatic recommendations in the aftermath of the flood. Generally what is lacking for good decision making is basic information, rather than research. What is needed is to better quantify impacts so that better choices among options can be made. Public policies are frequently being made in the absence of good information; theories are being substituted for hard information. Better information, in the form of data about flood damages; degree of inundation; severity and frequency of flooding is basic to all rational decision. Research, however, is needed to improve and refine existing methods rather than creating entirely new approaches or models. With the exception of riverine ecosystem modeling, much of the research and analysis that is required to act on the recommendations of the "Galloway Report" is to improve the administration and effectiveness of existing programs. The type of policy research and analysis that is needed is significantly different from the traditional technical hydrologic, hydraulic, and engineering R&D that one would expect. Policy choices concern themselves with relative differences in socioeconomic impacts; with issues of equity, political feasibility, and programmatic efficiency. Issues of tax policies, project cost-sharing policies, and the economic consequences of alternative legislative fixes are at the heart of policy analysis. The technical or scientific research that is needed falls in three areas: ecosystem analysis, economic evaluation of ecosystem outputs, and hydrologic/hydraulic modeling of integrated river systems.

1. INTRODUCTION

Flood control and flood damage mitigation is an age-old endeavor, and when associated with irrigation can be traced back to the ancient hydraulic civilizations of Mesopotamia and the Nile. The engineering of flood control structures has always been concerned with flood magnitude and frequency and the large uncertainty surrounding the reliability of hydraulic structures designed for such events. It was understood that there would always be residual flood damage risks associated with any hydraulic structures primarily because their size or capacity was designed on the basis of an implicit risk-cost effectiveness criterion. In other words, flood control was never intended to be flood prevention. It has always been understood that it was simply not economical to build structures to control the largest recorded flood, or even larger,

probabilistically derived events.

Even today, there is an explicit understanding that federal, state, and local flood damage reduction policies recognize that there must be some socially acceptable and economically based risk-bearing threshold. One such threshold identified by the National Flood Insurance Program (NFIP), is the one-percent chance flood (1 % chance that such flood will be exceeded), which is also commonly referred to as the 100-year flood. Engineers and water resources planners use many different flood risk and engineering reliability thresholds depending on the nature of the hazard; population at risk; potential economic damage; frequency and magnitude of the hazard; and potential for mitigation. Therefore, even with a well-designed and well-executed conventional flood control and damage reduction strategy, economic damages and loss of life would be expected to grow because of three primary factors (Shabman, 1988):

- Growth in population, with greater density in floodplain margins and urban areas susceptible to riverine flooding.
- Increase in inflation, wealth, and assessed value of land, structures, and contents in flood-prone areas.
- Physical alterations of waterways and watersheds which change the characteristics of floods/hydrographs.

Hence, residual flood damages are a statistically anticipated aspect of flood damage reduction strategies. The emphasis of the past two decades has been to devote more attention to floodplain management -- a combination of measures that reduce the human vulnerability (population at risk) and economic damage susceptibility while restoring natural floodplain values – i.e. ecosystem function. The Upper Mississippi River flood of 1993 served to catalyze, once again, the serious consideration of a rather well-known, accepted, and time-honored set of floodplain management principles. Gilbert White as part of his doctoral dissertation in 1942 (White, 1945) first expounded these ideas as a coherent and complementary set of ideas. White's concept of flood management consisted of an

"... integration of engineering, geographic, economic, and related techniques" and that the "solutions will not involve a single line of public or private action but will call for a combination of all eight types of adjustments, judiciously selected with a view to the most effective use of floodplains."

The eight types of adjustments that White discussed were:

- elevation of occupied portions of the floodplain above maximum flood levels;
- reducing floods through upstream watershed management measures;
- flood protection by levees and floodwalls, channel improvements, and reservoirs;
- emergency actions, flood warning, and evacuation;
- structural adjustments to current buildings;
- land use controls to curb damage-prone areas;
- public relief and disaster assistance programs; and
- flood insurance.

Gilbert White's premise was that while floods might be considered "acts of God," flood

losses are the result of the acts of man. The problem then becomes one of adjusting the human habitat in the floodplain environment with effective resource management (Schad, 1988). The eight elements of White's floodplain management strategy are well understood and accepted by virtually every practitioner, federal, state, and local agency planners, and has been reinforced and refined in a 30-year series of prestigious national commission reports that addressed the flood-related policies of the United States. Yet, flood losses continue to rise and there is still considerable room for improvement, according to the most recent "Galloway Report" (U.S. Interagency Floodplain Management Review Committee, 1994) regarding the future of floodplain management policies that were in place prior to the devastating upper Mississippi River flood of 1993.

The "Galloway Report" accepted the premise that the residual risks of conventional flood control policies and flood damage reduction programs were increasing despite the incremental accumulation and implementation of numerous perfectly sound and acceptable principles and programs. The recommendations supported the view that a better coordinated and comprehensive floodplain management strategy would have to be more vigorously pursued to reduce the very large losses suffered by the populace. On the other hand, Shabman (1988) shows (Figure 1) that when average annual flood damages are viewed as a percentage of national wealth (GNP), the ratio has hardly changed over the past fifty years, while the flood damages avoided have increased over time. This indicates that despite the seemingly ad hoc implementation of flood damage reduction policies, they do seem to be working as intended. Yet the federal programs that are in place to compensate the victims for their losses seem to be paying out much more than ever before. Perhaps the fact lies in the nature of the compensation programs rather than in flood protection or damage reduction strategies. These conservation programs, rather than flood damage reduction strategies, appear to serve as "moral hazards"--i.e., creating behavioral patterns that undermine the principal objectives of the flood control programs.

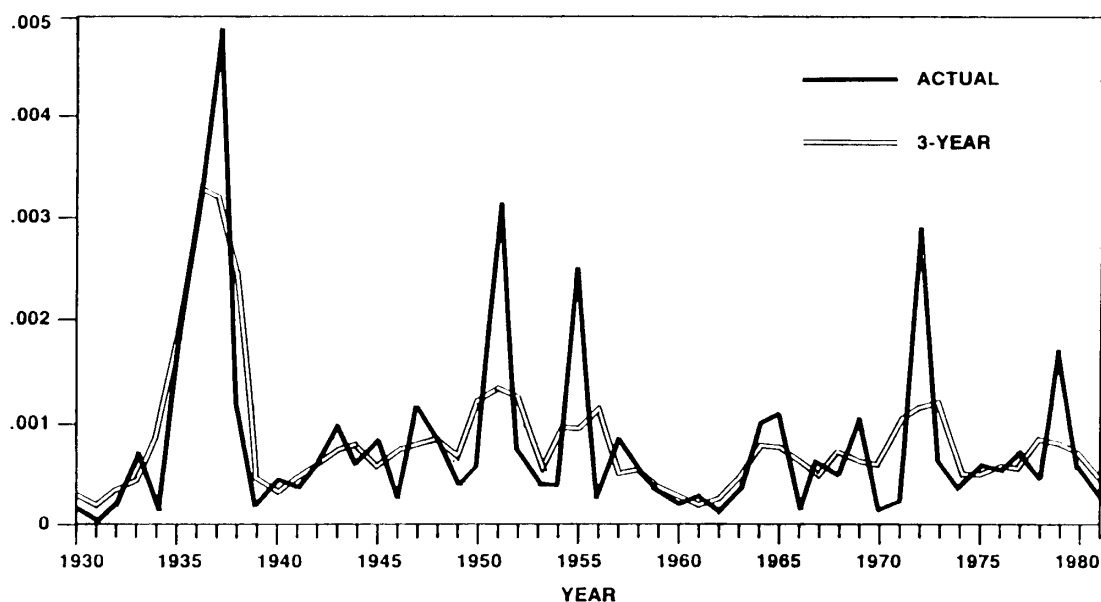


Figure 1. Flood Damage (Three Year Moving Average) as a Percentage of GNP (after Shabman, 1988)

It is interesting to note here that a set of influential recommendations for policy changes regarding programs for reducing flood losses were proposed by the National Water Commission (1973), twenty years earlier. The key issues and proposals shown in Table 1 (at the end of the paper) are virtually the same as those highlighted by the Galloway Report (Table 2). A comparable set of recommendations are also offered in a report prepared by a Federal Interagency Floodplain Management Task Force in 1992, a year before the great Mississippi River flood of 1993.

Certainly, considerable progress has been made in many areas, especially at the local level with the introduction of floodplain mapping and zoning in over 18,000 communities, as required by the National Flood Insurance Program (NFIP). After each disastrous flood and national commission study, each Administration ultimately adopts some of the more obvious institutional changes and cost-effective solutions. Still, the damages continue to grow each time there is a flood and more voices are heard exposing an ever-widening base of discontent with virtually every aspect of the policies that are currently in place. The two key issues most frequently brought up are: (1) that the flood disasters are a drain on the U.S. Treasury and budget and (2) that present flood control policies rely too much on structural measures which are not only ineffective, but have significantly damaged the floodplain ecosystems, particularly riverine wetlands.

These two public policy complaints complement each other in the sense that they both lead to the same implications regarding a major shift in the directions of flood damage reductions. They require that repeatedly damaged properties be relocated and that all subsidies covering agricultural damage be withdrawn. These properties would then be allowed to revert to their natural state, enhancing ecosystem restoration goals. Of course, the key issue of compensation for dwellings and property is at the heart of the public policy dilemma. There are numerous subsidiary issues that fall under the responsibilities of various federal, state, and local entities as shown in Table 2. No single federal agency plays a deciding or dominant role in flood damage reduction policies. Indeed, the key overarching public policy issue is which level of government, federal, state or local, has the primary responsibility for implementing wise land-use policies that promote and enhance the feasibility of nonstructural flood damage reduction measures.

Ultimately, these are not research issues in the traditional science and engineering domains, unless policy research and analysis is considered comparable to hydrologic research. Much of policy analysis is unprovable and untestable--since the analysis rests on intangibles, relative differences, impacts, and consequences among different options, which serve as the basis for choosing one alternative over another. These are not deterministic solutions based on axioms, theories, and causal relationships. Policies are predetermined courses of action, target-directed outcomes that society chooses rather than analytically derived optimal, efficient solutions. Policy analysis provides the relative rather than absolute worth of a preferred course of action. Rational (scientific) analysis provides the optimal course of action based on a limited set of normative decision criteria (benefit-cost analysis). Hence, it is difficult to speak of research needs in relation to policy and program analysis, which is by far the largest part of the analytical implications of the "Galloway Report." For most of the needs of the hierarchy of federal, state, and local agencies center on the following policy issues:

- What is the appropriate level of government to deal with floodplain management'? (Local government land use planning, state subsidies, federal uniform rules.)
- What role should the federal government play in flood damage reduction? (tax policies, grants, regulations, interstate flood control, research, information, etc.)
- What is the federal interest and objectives in floodplain management--and how should it be expressed? (maximizing economically efficient development, minimizing environmental damage.)
- How to account for and compensate downstream residents for upstream watershed changes that alter flood characteristics?
- Should government compensate victims of flooding who knowingly ignored available self-protection and self-insurance programs?
- Should the rules associated with benefit-cost analysis and economic efficiency be changed to favor government actions and programs that favor non-structural measures'?

2. THE UPPER MISSISSIPPI RIVER FLOOD OF 1993

First, some myths and misunderstandings about the Flood of '93 should be addressed, as this is an issue of basic information and interpretation rather than research. The fact that the flood damages associated with the large Upper Mississippi River flood were estimated to be \$12-16 billion (U.S. IFMRC, 1994) did not mean that the flood control measures in place were not effective, nor that, hydrologically speaking, it was the largest recorded flood. Some additional facts must be presented to provide a context for the subsequent discussion.

According to the "Galloway Report":

- Agricultural damage, not related to direct riverine flooding, but directly to extended periods of saturated soils preventing spring planting of crops and subsequent damage to harvest accounted for more than half the damage, i.e. > \$ 6-8 billion. More than 70 percent of the crop disaster assistance payments were made to counties in upland areas where ground saturation prevented planting or killed the crops. (These agricultural losses would not have been affected by changes in floodplain management policies. Rather, reforms to existing agricultural crop insurance policies appear to be the best solution.)
- Nearly half of the approximately 100,000 homes damaged suffered losses due to groundwater or sewer back up as opposed to riverine flooding.
- Flood control projects (reservoirs, levees, and existing floodplain management programs) worked as designed and prevented more than \$19 billion in potential damages (\$8 billion from levees and \$11 billion from reservoirs in the Missouri and Ohio River basins).

Another comprehensive assessment of the Upper Mississippi River 1993 flood disaster was conducted by the U.S. Army Corps of Engineers (1995) under a Congressional authorization (House Resolution 2423, 3 Nov. 1993) and funded as part of the Fiscal Year 1994 Energy and Water Development Appropriations Act (PL 103-126). In its report to Congress, the Corps addressed the following natural river system impacts on the basis of its modeling and analysis:

- Corps reservoirs performed well, reducing floodwater elevation by several feet along most of the mainstem Missouri and Mississippi rivers.

- Most Corps levees performed as designed and prevented significant damage.
- The flood affected over 6.6 million acres in 419 counties of the affected area.
- For the 120 counties adjacent to the Upper Mississippi Lower Missouri rivers, urban flood damages substantially exceed agricultural losses, including damage due to urban drainage and stormwater runoff.
- Navigation locks and dams did not cause an increase in the stage heights of the 1993 flood.
- The return period of the flood varies widely all over the region ranging from a 20-year flood to over a 500-year event.
- The best estimate for a return period at St. Louis is about a 125-year event.
- Hydraulic model routings of 1993 flood stages through the mainstem Mississippi River near St. Louis *without the present agricultural levees* would have reduced those stages by 2-4 feet under present agricultural practices. The flood stage at St. Louis was 49.8 feet.
- If the agricultural levees along the upper and middle Mississippi River were raised and strengthened to prevent overtopping in the 1993 event, the flood stages near St. Louis would have been about 6 feet higher, on average.
- Reversion to natural forested (non-agricultural) floodplains *can cause increases in flood stages, similar to the effects of levee construction.*
- Restoration of wetlands may reduce local flooding in the uplands by up to 25 percent, but *would have little effect on flood state reduction in the lower floodplain reaches* because most depressional reaches were already full during the antecedent period to the 1993 flood event.

3. RECOMMENDATIONS OF THE GALLOWAY REPORT

The Galloway Report (U.S. Interagency Floodplain Management Review Committee (IFMRCS)) can be viewed from several perspectives -- as it has by numerous supporters and critics. On its face value, it is a legitimate, necessary, and worthy attempt to improve the national response to a large devastating flood by promoting sound floodplain management principles: making more effective use of existing federal programs and rearranging the respective roles and responsibilities of federal, state, and local governments. Another view is that the federal government, in its extended period of declining fiscal resources and budgetary crises, could not afford to continue to subsidize evermore frequent and costly flood disasters into the foreseeable future. Substantial changes had to be made to reduce federal disaster payments and induce local governments to shoulder a greater share of the responsibility, for the fundamental elements of floodplain management -- zoning and land use regulations. Finally, a significant segment viewed this as an opportunity, to upgrade the role of natural ecosystem values of floodplains, arguing for the restoration of large portions of the currently leveed floodplains to their natural forested wetlands state. Possibly the largest, though, least influential sector, the farmers, urban dwellers, and commercial enterprises, were satisfied with the status quo.

The Corps of Engineers is involved, in some way, in virtually all of the major findings and recommendations of the Galloway Report affecting the programs of the Corps either directly or indirectly, because the recommendations require a much higher degree of administrative coordination among federal agencies and a greater level of collaboration in problem solving. However, it should be noted that of the \$ 6.8 billion in federal disaster assistance, about 80

percent went to farmers as part of federal crop disaster assistance and subsidies. Overall, it is already obvious that the great majority of recommendations will have to be accommodated within existing agency programs and declining budget authorities. Nevertheless, significant changes can and will be made, albeit falling short of the ambitious and far-reaching recommendations of the Galloway Report (IFMRC Report). The IFMRC recommendations are summarized in Table 2.

The key planning and management related issues and recommendations that are currently being addressed by the Corps with respect to the Corps' direct and near-term interests focus on the following IFMRC recommendations related to:

- Changes in the comprehensive evaluation guidelines of federal water resources projects, in order to accommodate environmental quality (EQ) objectives along with national economic development (NED).
- Funding, through existing authorities, programmatic acquisition of needed lands from willing sellers.
- Introducing cost-sharing provisions for state, local, and tribal participation in pre-system, recovery, response, and mitigation activities.
- Increasing environmental attention in federal operation and maintenance and disaster recovery activities.
- Developing a coordination strategy for guiding multiple federal programs dealing with watershed management.
- Giving full consideration to all possible alternative ways of reducing vulnerability to flood damages especially nonstructural solutions.
- Exploiting science and technology to support monitoring, analysis, modeling, and the development of decision support systems and geographic information systems for floodplain activities.

4. PROGRESS TO DATE

In the complex policy formulation and decision making setting that the resolution of the IFMRC recommendations are taking place, it is realistic to expect that there would be a gap between the desired goals and objectives and actual accomplishments, even if there were not serious budgetary constraints. The "*... policymaking process operates by a very different logic than that prescribed by scientific rationality*" (Ingram, 1988, p. 49). This succinct statement also explains, in large measure, the difference between policy analysis and scientific research. In her paper on political perspectives related to flood control policy formation, Ingram (1988) lists four basic rules of political behavior that are likely to affect the degree of policy implementation in the wake of a large disaster such as the 1993 flood:

- Crises creates consent. Crises should be considered a constant in water policy. Crises must be used creatively and effectively to alter the contemporary allocation of responsibilities among federal, state, and local entities.
- Congress is a powerful actor in water policy. Congress can thwart even powerful Presidents and their concerns as well as those of their constituents must be dealt with and not side-stepped. They will write the fundamental policies through legislation.

- Provisions of legislation emerge from mutual accommodation. Political feasibility, results in "strange bedfellows" in water policy. The political fact of life is to design preferred policies so that they are politically feasible.
- Politics extend beyond lawmaking. Most of the important value questions associated with flood control policies have been settled in the implementation rather than legislative processes. Politics and policies are subject to change and Congress often leaves the difficult issues subject to interpretation.

Much the same points are made by Rogers (1993, p.172) in his examination of U.S. water resources policies:

"The political process constantly weighs such imponderables as the value of the present against the future. In the world of water policy, the political process is the ultimate stage in a movement built up through technical, economic, or even physical developments. Politics socialize those efforts, engaging them in all the mysteries of society, and all the actions of human beings."

As it stands, the scorecard for implementing the Galloway Report recommendations is fairly meager to date, as all the recommendations are undergoing a very thorough Administration vetting and deliberate congressional reaction. An interagency "implementation committee" was organized and has reviewed, in detail, every recommendation of the Galloway report with specific proposals for implementing those recommendations. Generally speaking, the majority, of proposals either require some degree of increased coordination and collaboration among federal agencies or administrative changes in procedural or technical guidelines related to planning or management. Those changes can and are being implemented by the federal agencies according to an agreed on schedule.

The more difficult and inherently substantive changes, requiring legislative initiatives or additional funding, are moving along much more slowly, simply because Congress does not subscribe to many of the views, assumptions, and recommendations in the Galloway report. Although the crises created a high degree of consensus among federal, state, and local agencies as to the nature of the problems and some potential solutions, and many changes will be integrated into conventional procedures and practices, other critical issues are likely to be substantially modified or deferred by Congress. These changes are being debated in this session of Congress and the outcomes will not be known until October of 1996.

The Corps, and in particular the Institute for Water Resources, has undertaken a program of policy studies and research specifically aimed at dealing with the key recommendations of the Galloway's Report directed at Corps programs:

- Examine potential revisions to the planning guidelines to encompass non-structural flood management measures.
- Upgrade the consideration of flood damage reduction strategies at a watershed level rather than a project-specific focus.
- Incorporate non-structural flood damage reduction measures into plan formulation.
- Develop methods and procedures for economic valuation of wetlands and natural ecosystems.

- Develop alternative cost-sharing policies to induce wiser use of the floodplains and complement the NFIP.

5. INFORMATION AND RESEARCH NEEDS

The recommendations in the Galloway Report presume that greater collaboration and coordination will improve evaluation and decision making. In theory, this is true if all the information is available and every participant understands the ever-growing mass of information. In practice, more coordination among a myriad of federal, state, local entities, Indian tribes, and a vast array of interest groups simply leads to many more questions and magnifies the complexity and difficulties for evaluation of a multiplicity of options and ultimate consensus and decision making. In the real world of public decision making, interagency coordination and citizen participation increases the complexity, of decision making geometrically as the number of issues increases arithmetically. This is the accepted "cost of doing business." As a consequence, an entire new generation of analytical evaluation and decision making tools are needed to explicate to the public what was once the domain of trained and experienced technical specialists. Now, everyone is an expert and expects to be heard.

In addition, numerous published papers call for some combination of holistic, integrated, comprehensive, multiobjective systems analysis. The reality is that such analysis is beyond the capability of most federal agencies with fairly narrow mandates, even with unlimited budgets and time and certainly beyond the comprehension and grasp of even experienced analysts, much less the casually informed public. No single agency or political entity can deliver on such a promise. At best, only established river basin councils or commissions, designed specifically to deal with the overlap among agency missions, programs, and objectives, can even begin to achieve the degree of comprehensive analysis required by the large-scale response to the Mississippi River flood. Hence, a key feature of the Galloway recommendations--the establishment of such commissions is key to the success of unified floodplain management. But this is one idea that finds little favor either in the Executive Branch or in Congress.

The conventional wisdom suggests that many changes will be accomplished by each of the respective agencies with specific responsibilities, authorities, and program budgets. The key issues confronting the Corps that requires additional information and research fall in the following categories:

- Hydrologic/stochastic analysis of flood frequency. By itself, flood frequency is not a necessary metric other than the fact that it is used as a benchmark and engineering standard in benefit-cost analysis to estimate "expected annual damages."
- Hydrologic/hydraulic systems modeling of flood flows on large river systems to determine the relative influence, on flood stage of each physical alteration (dams, levees, wetlands, trees, etc.)
- Explicit consideration of risk-cost analysis, and a system for tradeoff analysis that allows the public to understand the degree of residual risk-bearing of each alternative.
- Economic evaluation of natural environmental amenities. Again, needed as part of a benefit-cost decision framework.

- Developing a uniform evaluation framework for watershed planning and evaluation. One of the great difficulties in communicating with other agencies is that each uses an entirely different conceptual basis for analysis. The outcomes of analysis are simply not comparable.
- Developing decision support systems for public participation. Need to translate masses of technical information into understandable choices, trade-offs, and decisions.
- Better defining and valuing the ecosystem functions of floodplains and wetlands. The ecosystem values are taken as a given--but there is no consistent, operational ecosystem theory that can provide clear answers as to the benefits.
- Quantifying the flood retention capacities of upstream and mainstem wetlands. Much credit is given to wetlands as a natural flood damage reduction system, with very little modeling to support such assertions.
- Econometric modeling of the impacts of government subsidies, incentives, and tax structure on floodplain location decisions.
- The effectiveness of flood warning and evacuation plans in reducing loss of life and economic damage, as compared to structural flood control strategies.
- The role that navigation plays in defining the hydraulic features of structural flood control strategies.
- What are the long-term foregone opportunity costs of relocating agriculture, commerce, and communities from the nation's floodplains?

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TABLE 1

**National Water Commission (1973) Recommendations for
Reducing Flood Losses**

- Floodplain lands should be treated as an important resource and should be managed so as to make the maximum net contribution to national welfare, keeping in mind (a) that the material wealth of a nation is not enhanced by development of any tract of land subject to flood overflow unless the net value of the resulting production exceeds the costs of development plus the flood losses (or the cost of preventing such losses) and (b) that any nonmaterial values sacrificed through development must also be counted as a cost.
- In formulating plans for flood loss reduction full and equitable consideration should be given to all practicable alternative measures for achieving that goal, with a view to finding the best combination of such measures, using the evaluation principles recommended in Chapter 10 of this report.
- The present trend toward greater use of floodplain regulation as a means of reducing future flood damages, or of reducing future costs for protective measures, should be strengthened by the following Federal actions to encourage wise use of floodplains:
 - a) Enactment of legislation to authorize the Water Resources Council to make Federal grants to the states to be used for mapping floodplains, determining flood hazards, making floodplain management plans, establishing state standards for floodplain regulation activities, and assisting local governmental entities in carrying out floodplain management programs; these grants not to exceed 50 percent of the amount expended by the states for such purposes.
 - b) Amendment to Section 206 of the Flood Control Act of 1960 to require that reports prepared thereunder provide, in addition to flood hazard information, (1) a comparison of the cost of creating values by further development of the floodplain lands with the cost of creating these same values by available alternative measures (such as development of nearby uplands) and (2) a delineation of those floodplain areas that could be of greater value to the Nation if used for open spaces (such as city parks).
 - c) Removal of present legislative limitations upon the amounts that can be appropriated for floodplain management studies in any one year.
 - d) Increasing the funds available for carrying out the cooperative floodplain mapping program of the U.S. Geological Survey, the National Oceanic and Atmospheric Administration, and the Corps of Engineers.
- Existing programs, such as the Land and Water Conservation Fund and urban park grants through which Federal assistance may be extended to state and local entities to encourage the establishment of parks and other open spaces, should be utilized to the fullest practicable extent to encourage public acquisition of those floodplain lands for which the best use is found to be for recreational or open space purposes.
- The requirements of Executive Order No. 11296 should be strictly observed by the Federal agencies to which the order applies, and in particular those agencies should refrain from making any grants or loans, or from insuring any loans, that would be used for construction in floodplains or for the reconstruction of structures that have been seriously damaged by floods, unless adequate provisions have been made to prevent the repetition of such damages by flood-proofing or other means.

TABLE 1 (Continuation)

- Executive Order No. 11296 should be amended to require that all Federal programs within areas covered by a floodplain management plan shall comply with such plan provided it has been approved by the entity representing the community affected, by the responsible state organization, and by the Corps of Engineers or other appropriate Federal agency.
- The Water Resources Council should promulgate guidelines at the earliest practical date to govern the formulation of flood loss reduction and floodplain management plans to be used in future water resources planning.
- The flood forecasting program of the Federal Government should be substantially strengthened by organizational changes along the lines recommended in Chapter 11 of this report and more adequate financing should be provided.
- Communities located in areas subject to flash floods should develop a community action plan to permit prompt response to a flood threat whenever it develops. Communities should develop methods of flood forecasting based on rainfall information from upstream watersheds and should use automatic warning devices where they are found to be feasible.
- The Water Resources Council should develop a plan for a unified national program for the collection of basic data on floods and flood damages as recommended by the Task Force on Federal Flood Control Policy as set forth in House Document No. 465, 89th Congress, to be implemented, to the extent possible, by executive order, and if necessary, by legislation to be proposed by the President.
- The General Accounting Office, or other appropriate independent agency, should make an appraisal of the flood insurance program being carried out by the Department of Housing and Urban Development under the authority of the National Flood Insurance Act of 1968.
- Future Federal or federally assisted projects, including structural measures for the control of floods should comply with the following provisions:
 - a) The share of the cost of the project to be borne by non-Federal interests should be in accord with the cost-sharing principles recommended in Chapter 15 of this report.
 - b) The Federal agency proposing the work or proposing a Federal contribution thereto, should demonstrate by an evaluation in consonance with the principles recommended in Chapter 10 of this report that the sum of all beneficial effects would exceed the sum of all costs, with due consideration being given both material and nonmaterial benefits and costs.
 - c) The state or a responsible local governmental entity should agree to regulate the use of floodplain lands to the extent necessary to prevent further developments that would (1) make necessary, the installation of additional protective works or (2) be subject to substantial damage in the event to a flood exceeding the magnitude of the design flood.
- Any Federal legislation to authorize a program of land-use planning should include special provisions for the coordination of any plans made under the program with floodplain management plans made by the states and the Federal water resources planning agencies.

TABLE 2

**Summary of Recommendations of the
Interagency Floodplain Management Review Committee (1994)**

Organizing Federal Floodplain Management

- Enact National Floodplain Management Act.
- Issue executive order requiring federal agencies to exercise responsibility.
- Activate Water Resources Council to coordinate federal and state activities.

Focus attention on Comprehensive Evaluation Procedures for Federal Water Agencies

- Establish EQ and NED as co-equal accounts in the "P&G".
- Revise "Principles and Guidelines" to accommodate nonstructural alternatives.

Enhance Coordination of Project Development

- Address multiple objective planning.
- Support collaborative efforts among federal agencies and across, state, local, and tribal governments.

Provide for Cost-Sharing

- In pre-disaster, recovery, response, and mitigation activities.
- Require cost-sharing of federal, state, tribal, and local sponsors.

Coordinate Multiple Federal Programs Dealing with Watershed Management

- Establish interagency task force to develop coordination strategy.

Enhance the Floodplain Environment and Natural Storage in Bottomlands

- Take full advantage of existing federal programs.
- Seek legislation authority to increase post-disaster flexibility in land acquisition programs.
- Increase environmental attention in federal disaster recovery activities.
- Better coordinate federal land interest acquisition activities.
- Fund, through existing authorities, programmatic acquisition of lands from willing sellers.

Enhance Efficiency and Effectiveness of NFIP

- Improve marketing of flood insurance; seek state support.
- Enforce lender compliance rules.
- Reduce amount of post-disaster support to eligible homeowners who did not participate in insurance programs.
- Provide safety net for low-income flood victims who could not afford flood insurance.
- Require residences behind levees with less than SPF protection to purchase actuarially based insurance.
- Increase waiting period for activation of policies from 5 to 15 days to avoid purchases when flooding is imminent.
- Leverage technology to improve timeliness, coverage, and accuracy of flood insurance surveys.
- Provide for purchase of mitigation insurance to cover cost of elevation, demolishing, or relocating damaged buildings.

TABLE 2 (Continuation)

Reduce Vulnerability of Those in the Floodplains

- Give full consideration to all possible alternatives for vulnerability reduction including permanent evacuation, flood warning, flood-proofing, levees, and storage.
- Give full weight to social, economic, and environmental values when evaluating vulnerability reduction measures.
- Reduce vulnerability of urban centers and critical infrastructure using floodplain management activities and programs.

Require Periodic Review of all Federal Water Resources Projects

- Ensure projects meet their intended purposes.
- Ensure projects reflect current national social and environmental goals.

Provide for Efficiency in Operations and Consistency in Standards

- Assign principal responsibility for the repair, rehabilitation, and construction of levees under federal programs to the Corps.

Ensure Integrity of Levees and Hydraulic Efficiency of Floodplain

- States and tribes should ensure proper siting, construction, and maintenance of non-federal levees.

Capitalize on Successes of Responses to 1993 Flood and Streamline Future Efforts

- Through NFIP Community Rating System encourage states to develop and implement floodplain management hazard mitigation plans.
- Provide funding for programmatic buyouts of structures at risk.
- Provide state options of receiving Section 409 hazard mitigation grants as block grant.
- Assign the director of FEMA responsibility for mitigating federal disaster response and recovery operations.
- Encourage agencies to use non-disaster funding to support hazard mitigation activities on a routine basis.

Provide Integrated Hydrologic, Hydraulic, and Ecosystems Management of the Upper Mississippi River Basin

- Establish river basin commission for Upper Mississippi and Missouri rivers.
- Assign responsibility to the Mississippi River Commission (MRC) for integrated management of flood damage reduction, ecosystem management, and navigation.
- Assign MRC responsibility for development of a plan to provide long-term control and maintenance of levees.
- Seek authorization from Congress to establish an Upper Mississippi River and tributaries project for management of federal flood damage reduction and navigation activities.
- Establish Upper Mississippi River Basin as a national, cross-agency ecosystem management demonstration project.
- Charge the Department of Interior with conducting an ecosystem needs analysis of the Upper Mississippi River Basin.

Timely Gathering and Dissemination of Information Needed for Floodplain Management and Disaster Operations

- Establish information clearinghouse at the USGS to provide federal, state, and local agencies information gathered on 1993 flood.