

National Flood Programs and Policies in Review



PREFACE

For more than 30 years the Association of State Floodplain Managers (ASFPM) has participated in the development of nationwide flood policies and programs that aim to reduce the traumatic impacts and costs of floods in the United States. The ASFPM also has worked to increase public and official understanding of the critical environmental and cultural importance of the nation's floodplains, their functions, and their resources.

Some of the ASFPM's contributions have included the development and promotion of the No Adverse Impact approach to local floodplain management; pioneering flood hazard mitigation strategies and non-structural and floodproofing alternatives; support of a community rating system for flood insurance; promotion and support of multi-objective planning for floodplains; and advocating the modification of federal policies that inhibit floodplain management or encourage unwise decisions by individuals and government.

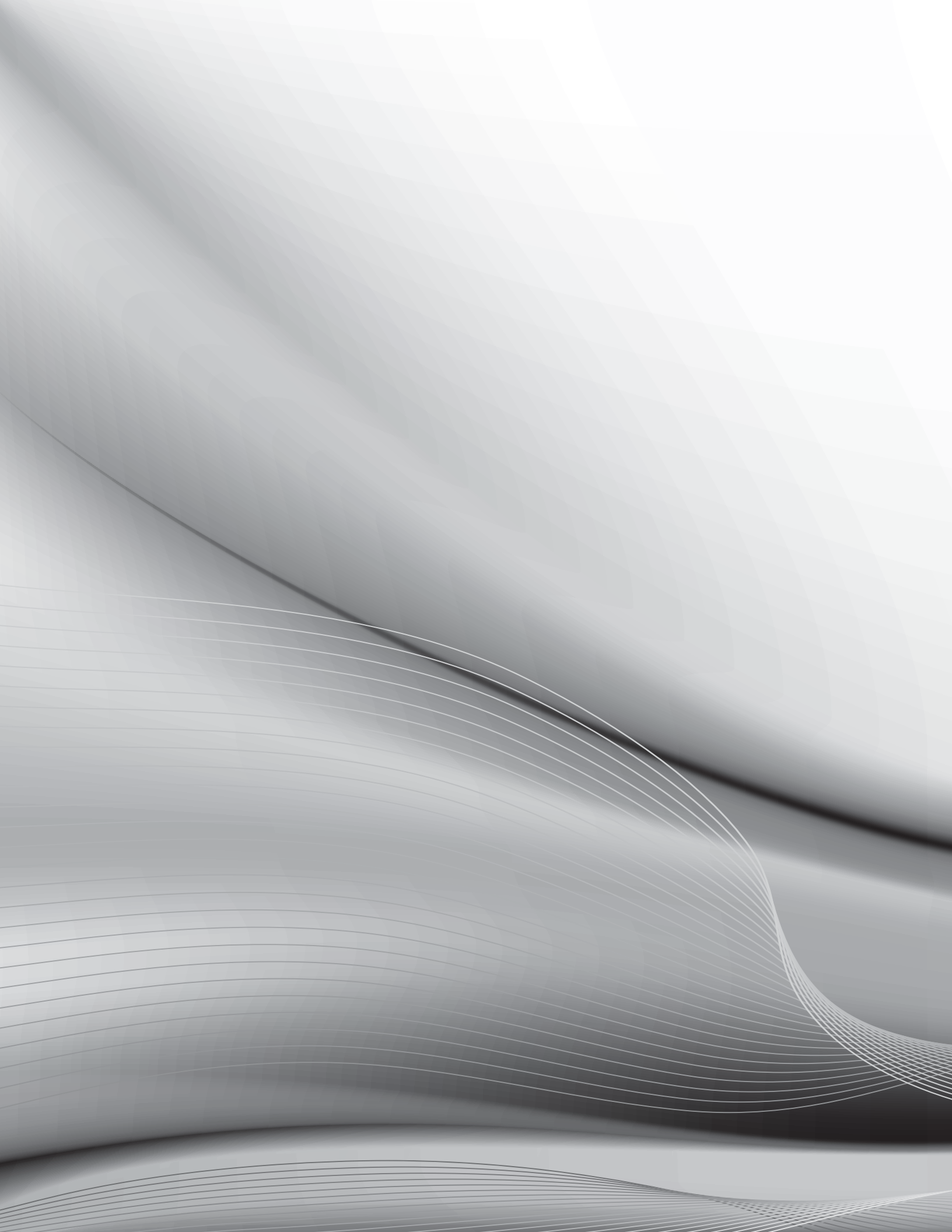
Although it is important to review our accomplishments and those of the nation as a whole, we do so only with the recognition that flood losses have continued to escalate, that progress is difficult to measure and not always permanent, and that the nation and world are changing rapidly in ways that can both help and hinder effective floodplain management.

This document, *National Flood Policies and Programs in Review—2007*, was prepared by the floodplain management practitioners represented by the ASFPM. Its purpose is to identify those ways in which national policies and programs for reducing flood damage and for protecting the natural resources and functions of our floodplains can be improved, and the nation thereby better served. It contains hundreds of ideas and recommendations for making such improvements and enhancing activities at all levels of government, by individuals, and in the private sector.

DEDICATION

*To Gilbert F. White, our mentor,
whose wise counsel guided this
fledgling organization*





CONTENTS

PREFACE	i
DEDICATION	i
CONTENTS	iii
INTRODUCTION	1
Where does floodplain management stand in 2007?.....	1
How did we get here?	2
What's different about today's world?	3
Where do we go from here?	5
NO ADVERSE IMPACTS AND COMMUNITY RESILIENCE	10
PARTNERSHIPS AND INCENTIVES	11
Federal Role	11
Risk Awareness and Individual Accountability	14
State and Local Capability	14
Coordination, Oversight, and Evaluation of Programs.....	20
Funding Mechanisms	23
ECONOMICS	25
National Interest	27
MANAGEMENT OF NATURAL FLOODPLAIN FUNCTIONS AND RESOURCES	29
DATA AND TECHNOLOGY	33
Gathering and Storing Data.....	33
Data for Local Mitigation Plans.....	33
Number of At-risk Structures.....	34
Hydrology	34
River Discharge	35
Sharing Information	35
FLOOD MAPPING	37
Revisions and Amendments to Flood Maps	38
Future Conditions	39
Areas Subject to Special Hazards	39
Maps and Structural Projects	39
Engineering.....	40
Adoption of New Technologies	42
MITIGATION OF FLOOD LOSSES	43
Nonstructural Measures.....	44
Structural Measures.....	51
Mitigation Support Systems	58
AGRICULTURE POLICIES	60

ARID REGIONS HAZARDS, RESOURCES, AND ISSUES	62
Arid Regions Science.....	62
Arid Regions Risk Identification.....	63
Arid Regions Risk Management.....	63
COASTAL HAZARDS, RESOURCES, AND ISSUES	64
Cost of Coastal Hazards.....	64
Protecting Coastal Populations	65
Coastal Resources	66
Coastal Development and Construction	66
Flood Maps for Coastal Areas	71
Public Policy Disconnects.....	71
SPECIAL FLOOD-RELATED HAZARDS	74
Mapping of Special Hazards	74
Management of Special Hazards.....	74
INFRASTRUCTURE AND PUBLIC BUILDINGS	75
Construction of New Buildings and Infrastructure.....	75
Evaluation of Existing Infrastructure and Public Buildings.....	76
Roads, Bridges, and Railroads	76
Post-Disaster Recovery	77
Federal Investment in Infrastructure: Executive Order 11988	77
DISASTER MANAGEMENT AND ASSISTANCE	79
Public Assistance after Disaster	79
Improving Efficiency and Effectiveness	80
Flood Forecasting and Warning.....	82
Flood Response.....	83
The Response Recovery Continuum	83
Emergency Management Assistance Compact.....	84
FLOOD INSURANCE	85
Land Management / Flood Insurance Interaction	85
Flood Insurance Premium Discounts	87
Repetitive Losses	88
Increased Cost of Compliance Insurance	90
Residual Risk of Dams and Levees	90
Increasing the Number of Flood Insurance Policies.....	91
CONCLUSION	94
BIBLIOGRAPHY	95
GLOSSARY	97

INTRODUCTION

This document, *National Flood Programs and Policies in Review 2007*, is the most recent in the ASFPM's periodic reviews of national floodplain management policy. The last such review was published seven years ago, in 2000. Through these reports the ASFPM, the nation's leading organized voice in this field, provides a comprehensive (and perhaps the only current) record of the important adjustments that are needed to ensure that the nation can manage its floodplains effectively both for risk reduction and for the protection of their natural and beneficial functions, now and in the future. These appraisals and recommendations represent the cumulative experiences of professional floodplain managers nationwide.

Where does floodplain management stand in 2007?

Floodplain management programs and policies in the United States today are the products of a decades-long progression of federal (and some state) initiatives whose emphasis, funding levels, and administrative vehicles have changed over time [see box on Historical Perspectives]. The current model is a federal-level approach through which minimum standards are set that are implemented by states and localities through programs for land use, building codes, and mitigation, in exchange for federally backed flood insurance. Federal disaster assistance is then provided when significant flood losses occur. Some localities and some states have the wherewithal to establish and implement standards and programs that are more aggressive than the federal minimums, but most have not developed the capacity or motivation to do so. Flood losses continue to increase. About half of the floodprone buildings in the nation have flood insurance coverage. This does not include the types of buildings that usually do not carry flood insurance or those that are protected by structures like levees or dams and would be subject to catastrophic losses if the structure were to be overtopped or otherwise fail. Experts are now telling us that the federal minimum standards are not sufficient to keep losses from rising, nor is the federal floodplain management framework adequately equipped with mechanisms to gradually reduce the federal taxpayer burden for such losses.

Under this framework, floodplain management consists of a large and complex set of policies and programs that include but are not limited to the National Flood Insurance Program, the Natural Resources Conservation Service's Small Watershed Program, Coastal Zone Management under the National Oceanic and Atmospheric Administration, flood protection and environmental restoration projects of the U.S. Army Corps of Engineers, the wetland and watershed programs of the Environmental Protection Agency, development and redevelopment programs of the Department of Housing and Urban Development, and a variety of other initiatives. All of these are federal efforts but usually are mirrored and implemented by separate initiatives within state and local governments. In 2007 there is no central coordinating mechanism at the federal level to ensure that this array of different efforts, or the actions of Congress and the Administration, work toward common goals.

Thinking Outside the Box

It is evident that the top-down model used by the United States for managing flood risk and floodplain resources over the past 75 years has achieved only marginal success. This, combined with anticipated impacts of population growth and climate change, and the prevailing upward trend in flood losses, have convinced the ASFPM that now is the time to debate a drastic overhaul of national policy and programs.

Some ideas for an alternative model have already been offered [see Thinking Outside the Box, below]. Is flood insurance still the best approach? Should floodplains be preserved for biomass production and carbon sequestration? Can the federal government's role be redefined?

Scattered throughout this report, therefore, are recommendations that would certainly entail re-thinking and quite possibly re-shaping today's federal model of floodplain management, or parts of it, in order to better meet the challenges that the nation will face in the future.

How did we get here?

In 2007 many good things are happening. Under the surface there has been some retreat from the gains of the past, while on the other hand advances are being made in other areas. Existing techniques for reducing flood damage are being improved, while new programs with great promise have been developed. At the same time, Hurricane Katrina exposed numerous weaknesses in our current approach to and policies for protecting people and property from flood damage and suffering and for preserving our natural floodplain functions and resources. We now know that the existing system still allows property and people to be at risk—sometimes substantial risk; that catastrophic events must be managed differently; that we must build and maintain capability at all levels of government and the private sector to be able to recover in a sustainable way from damaging events; that people had not understood much about their flood risk, especially behind levees, but appear to be ready to learn; that agencies cannot afford to stovepipe their programs and program objectives; and that as a nation we cannot continue to ignore the varied risks (and resulting costs to the federal taxpayer) that we face or the accumulated impacts of past activities that have degraded natural protective features, such as wetlands and marshes.

Over the last several years Congress has broadened to some extent its perspective on flood risk and losses, but too often it continues to view flood damage reduction and many water resources issues from a “projects” perspective—individual projects are developed and implemented with federal dollars but without regard to the larger flooding issues facing the community or the rest of the watershed and with even less consideration of the natural floodplain resources. This narrow and near-sighted approach, coupled with a seeming inability to integrate various programs, often results in more—not less—at-risk floodplain development, rising disaster costs, and deterioration of river and stream ecosystems that then, in turn, require increased expenditures for treatment and restoration. This perspective also serves to prevent Congress and the Administration from giving serious consideration to broader initiatives when they are proposed. The same practices are being played out today in the restoration of the New Orleans hurricane protection system, with potentially dramatic consequences. As re-directed by Congress, this system is being rebuilt to a 100-year standard, with insufficient integration of non-structural and insurance mechanisms. If the nation and New Orleans stay this course, the groundwork is being laid for another massive disaster.

Reductions in federal domestic spending have minimized the effectiveness of large, single-purpose agency programs. This has made it essential to integrate numerous smaller programs in order to resolve flood problems—an exceedingly difficult task and one that is made almost impossible by the lack of federal leadership. Some federal programs are being modified in a manner that ignores the state role, or are being set up to provide direct services to local governments with little thought of establishing incentives to build state capability or encourage state, local, or individual responsibility.

In addition, some events (or perhaps non-events) since 2000 are significantly influencing flood policy today.

- The federal government did not publish an update to the *Unified National Program for Floodplain Management* during this period, with the last update having been published in 1994. This, the demise of any practical federal agency coordination, is symptomatic of the challenges the federal government faces in developing and implementing broad, well-coordinated programs.

- The ASFPM launched its no adverse impact floodplain management strategy, which is being pursued by numerous states and communities. This is a forward-looking and comprehensive management principle that has the potential to re-shape floodplain management and related efforts.
- The Flood Map Modernization initiative was supported by a broad ASFPM-led coalition, and resulted in the Administration and Congress providing funding with which the Federal Emergency Management Agency is supporting new flood insurance studies and nationwide digitization of flood maps.
- Significant advances have been made in hazard mitigation—the institution of hazard mitigation planning on a nationwide scale, and the aggressive funding of disaster mitigation programs. Although mitigation planning holds great promise, the shifting of federal resources from post-disaster mitigation to the pre-disaster phase and making the awards competitive have resulted in funding some high-quality projects, but perhaps not the most effective ones.
- The Clean Water Act continued to evolve. Stormwater management initiatives through which both water quantity and quality can be managed are on the rise nationwide, but are far from universal. Troubling U.S. Supreme Court rulings continued to raise questions about the applicability of Section 404 of the Clean Water Act, which protects many of the natural and beneficial functions and resources of floodplains.
- The Corps of Engineers has worked to drop the use of the term “flood control” from its lexicon. Corps leadership has demonstrated interest and commitment to flood loss reduction approaches that integrate non-structural and structural measures and in environmental restoration, but Congress’s tendency to view water resources management on a project-by-project basis, lack of funding, and Congressionally mandated benefit/cost procedures have hindered the Corps’ success in moving in this direction.
- The absence of national policy and programs for levee safety finally culminated in a critical nationwide situation that has received more attention since the levee failures in New Orleans after Hurricane Katrina. Over time, federal policies and budget restrictions have gradually diminished the effectiveness of the nation’s levees, increasing the residual risk to property owners and federal taxpayers.

What’s different about today’s world?

Changing social, environmental, and political realities dictate constant adjustments in the policies, programs for, and practice of floodplain management. Some trends, such as public perception of risk or the relative priority placed on certain domestic programs, shift back and forth over time or in accord with the political climate. The four changes described below have recently become dramatic enough that they are exerting a definite influence on floodplain management and therefore on the nation’s ability to reduce losses and protect its natural floodplain functions and resources.

Population Growth and Migration

A critical factor in crafting management strategies for the floodplains of the United States is the growth and movement of the U.S. population. The U.S. Census projects an additional 82 million

new residents by the year 2030, an increase of 29%. Increased demand for land for housing and other development will continue to push new development into hazardous areas and further strain those natural ecosystems and their resources, as well as increase runoff and flood levels on existing properties.

The location of the U.S. population is as important to floodplain management as its size. People are tending to migrate to the coastal areas and to locate their primary, recreational, and retirement homes in aesthetically pleasing areas, such as along rural streams and lakes and the ocean coast. The risk of flooding, erosion, and resource degradation in these areas poses challenges for floodplain managers, in addition to the more obvious threat of storm surge and high winds of hurricanes. The nation's population has also migrated westward and towards the south. In the West, new development is built on or near alluvial fans, moveable stream beds, and other arid-region flood hazards that are not directly addressed by the regulatory criteria of the National Flood Insurance Program (NFIP) or by most states and communities. At the same time, the natural defenses to hazards in all of these locations are being degraded by human incursion and its accompanying infrastructure, as are the local natural and beneficial floodplain functions, important habitats, and recreational assets.

A Changing Climate

The earth's climate is constantly changing, but scientific evidence shows that in recent decades one change—global warming—has been accelerating in ways that are outpacing current strategies for coping with natural hazards, including flooding. Whatever its cause, climate change is—and will continue to be—resulting in altered precipitation patterns, shifts in the frequency and intensity of storms, increased rates of runoff and soil erosion and the accompanying environmental impacts, and a rise in sea level. These current and expected changes have widespread implications for the flood protection of human populations; their accompanying housing, commerce, and infrastructure; agricultural lands and production; and sensitive ecosystems throughout the planet. Further, climate change is altering the historic record of floods and storms that has formed the basis for the design of various protective measures, creating uncertainty about the adequacy of those measures to protect us from the storms that are expected in the future.

The Aftermath of September 11th

The terrorist attack of September 11, 2001, led to a restructuring of government, reprioritization of resources and efforts, and a forced integration of homeland security concerns with emergency management. Mitigation activities are perhaps the least understood in a homeland security environment, and outside of the natural hazards/emergency management arena, this restructuring is leading to mitigation's becoming simply a sub-set of preparedness. This trend is one that could dramatically (and negatively) influence floodplain management for years to come. Legislation was passed in 2006 that directed the Department of Homeland Security to bring the elements that formerly constituted the Federal Emergency Management Agency (FEMA) back together. It is not yet clear whether implementation of this law will remedy the situation.

Electronic Communication

The rapid evolution of the internet and its connection to personal computerized devices, including cell phones, has shaped a society in which the expectation is that most information can be obtained through these media (rather than through newspapers or books) and also that it should be available instantaneously. This is posing both challenges and opportunities for flood

risk communication. Graphical techniques for conveying risk-related information (such as weather forecasts or flood frequency data) have become more effective and simpler to use and understand. Geographic information system (GIS)-based data are making it far easier to disseminate flood risk data and perform increasingly complex analyses of flooding problems. Along with the web-based availability of flood maps and improved models for predicting damage, all of these advances are changing the face of floodplain management.

Where do we go from here?

The techniques for minimizing and avoiding flood damage are well known, have been proven effective, and are constantly being improved. The means by which these techniques are delivered and implemented, however, leave much to be desired. The ASFPM is concerned that, if we do not find a way to integrate seamlessly our many flood-related programs, institutionalize coordination among all levels of government, and build and solidify local and state capability, then the hard-won advances in floodplain management will be lost. In that case, the cost to the nation and all federal taxpayers will be extreme, as demonstrated by the aftermath of Hurricane Katrina.

If the existing top-down model is ever to reduce flood losses and effectively protect natural floodplain resources, it must be molded to provide for a solid federal/state partnership, with significant appropriate authority delegated to the states. The federal government must enhance the leadership and guidance it provides by truly integrating its many programs under a common and clearly articulated floodplain management policy with pertinent goals; funding the needed nationwide programs such as flood mapping and streamgaging; eliminating program duplication; resolving contradictions; closing loopholes; and discontinuing its practice of undermining the rest of the effort by picking up all or most of the costs of preventable flood disasters.

Thinking Outside the Box

Much of the discussion and most of the recommendations contained in this report are aimed at making specific improvements within the current framework for managing flood risk and floodplains in the United States. However, in light of anticipated changes in population and climate, the prevailing upward trend in flood losses, and the lack of encouraging feedback about the success of many existing efforts, the ASFPM believes that serious consideration also should be given to making more dramatic changes in national policy and programs.

One concept that is receiving more and more support is the need to change the top-down model so that states become the focal point for managing flood risk and floodplains [see discussion on State and Local Capability, below]. The logic is that the management techniques that work best to reduce flood losses rely on authorities that are reserved to the states under the U.S. Constitution, namely land use management, adoption of building codes, and conducting community planning for development, mitigation, and resource protection. Unfortunately, under the current system there are few if any incentives for states to assume this central role. In addition, the federal government's long-standing visibility in building flood control structures and supplying financial disaster assistance has fostered a belief not only that flood risk management is being implemented by the federal government on behalf of the whole nation but also that the federal level is the proper place for such action.

Other searching questions about the prospects of success through the adoption of a different paradigm have been asked in multiple venues over the past few years. Numerous national policy dialogues have involved the ASFPM, the Corps of Engineers, the Federal Emergency Management Agency, the American Water Resources Association, the leadership of numerous agencies, environmental and professional groups, other non-governmental organizations, the White House staff, and researchers. In addition, an analysis of the nationwide impacts of 35 years of implementation of the National Flood Insurance Program was undertaken during the sweeping Evaluation of the NFIP completed in 2006. And several groups have called repeatedly for high-level examination of the full scope of the nation's water resources policy.

Several possible fundamental shifts also were discussed at the inaugural Gilbert F. White National Flood Policy Forum in September 2004. Seventy-five of the nation's top floodplain management experts considered several alternative approaches, including (1) keeping a standard-based framework but using a higher standard than at present (perhaps the 500-year flood rather than the 100-year flood); (2) devising a program under which flood insurance is mandatory for every structure in the nation, but rates are based on the height of the building above the expected flood level; this would be combined with some land use regulation; (3) applying a benefit/cost analysis to every proposed activity in a floodprone area, to balance the flood risks, uncertainties, and consequences; and (4) adopting a market-based strategy, which would abandon standards and insurance and rely instead on market incentives to shape floodplain uses more compatible with floodprone lands, such as agriculture, carbon sequestration, biomass production, and habitat (ASFPM Foundation, 2005).

In summary, consideration should be given to wholly different ways of addressing the nation's flooding problems.

- Federal agencies should continue to support and participate in explorations of alternative paradigms for management of flood risk and floodplain resources.
- Congress and FEMA should consider shifting to a model under which authority for flood risk management programs is delegated to the states, and incentives are provided to encourage state assumption of responsibility.
- A Presidential or Congressional commission should be appointed to take a serious and penetrating look at the federal model for addressing flood hazards with an eye toward making major changes as needed.

A Call to Action

Experienced professionals in floodplain management within the ASFPM and among its colleague organizations analyzed existing national programs and policies to identify weaknesses and strengths and to find ways to remedy the former and capitalize on the latter. Through that analysis and its accumulated expertise, the ASFPM has developed over 200 detailed suggestions for improving and/or altering national policies and programs for the management of flood risk and the protection of natural floodplain resources. Each suggestion is tailored to the particular circumstance under scrutiny, and is aimed at one of more of these outcomes: (1) remedying current specific problems in consistency, implementation, funding, coordination, or similar deficiencies; (2) adopting new approaches as alternatives to existing programs or policies; (3) using incentives and

other techniques to nudge responsibility and authority down the hierarchy (away from the federal level and toward the states, localities, and individuals); and (4) providing stronger federal leadership and overall integration of programs at all levels.

All of these ideas will be the focus of ASFPM effort over the next five years or so, in our work with state and local governments, federal agencies, the insurance industry, individual professionals in floodplain management, Congress, and our many other colleagues and partners in both the public and private sectors.

How to use this Document

This report is organized by topics that are of concern to floodplain managers [see Table of Contents]. Under each topic, the issues that are the most problematic today are discussed, and recommendations for resolving them are made, highlighted by bullets. The individual sections can stand alone, so the report need not be read in any particular order. An attempt was made to keep technical language and abbreviations at a minimum, but a glossary of terms and acronyms appears at the end of the report to help those readers less familiar with floodplain management.

Some Historical Perspective on Floodplain Management

The flood loss reduction policies of the United States were crafted a century ago in recognition of a federal role in flood protection, and were modified after devastating floods in the 1920s and 1930s. The policy at that time was founded on a popular belief in human ability to control nature through technology and through the might of the federal government. In the late 1950s and 1960s it was recognized that federal programs could not possibly control all floods, and that management both of floodprone lands and of human occupancy of them was necessary.

The conceptual framework for these policy changes emanated from Gilbert F. White's dissertation, *Human Adjustment to Floods*, published in 1945. Although it was not broadly embraced at the time, this groundbreaking work was the first to suggest a multi-pronged strategy for the management of flood losses. Several states already were implementing floodplain management initiatives, but the first federal application was made by the Tennessee Valley Authority through the work of James Goddard in the 1950s. Between the academic foundation laid by White and the applications pursued by Goddard and a handful of other floodplain management practitioners, lessons were learned that allowed for the crafting of a new way to address flood losses.

Despite this knowledge, during the 1950s and early 1960s mainstream federal policy continued to promote a strong federal lead in the control of floods—particularly in providing federal funds for structural control projects—along with increased post-disaster benefits, so that there was very little incentive for local or state governments to worry about managing flood hazards.

With the establishment of the National Flood Insurance Program (NFIP) in 1968, the relationship between the federal government and state and local governments was altered. From that point forward the premise was that escalating disaster costs must be controlled and that flood protection was not simply the responsibility of the federal government. Through flood insurance, those at risk began to bear a larger share of the costs associated with flooding. The NFIP also served as a mechanism to bring the responsibility for floodplain management to the states and communities of the nation.

The passage of the National Environmental Policy Act in 1969, the Clean Water Act in 1972, and the Coastal Zone Management Act in 1972, set the stage for widespread attention to water resources and their attendant

hazards. In 1977, President Carter signed Executive Order 11988, Floodplain Management, directing all federal agencies to take flood hazards into consideration when planning, funding, and implementing their activities.

In addition to these visible policy changes was the development of the *Unified National Program for Floodplain Management*, initiated by the Water Resources Council and later transferred to the Federal Interagency Task Force on Floodplain Management (chaired by FEMA). The work of the Water Resources Council and Task Force led to the broadening of floodplain management tools and concepts to include such techniques as floodproofing, the idea that the purpose of floodplain management is both loss reduction and resource protection, and the promotion of multi-objective planning strategies.

The 1993 Midwest floods brought a renewed sense of urgency to floodplain management and a shift in focus on the part of the federal government. The magnitude of those floods prompted the White House to take intense interest in coordinating the recovery. The Administration became receptive to the advancement of a comprehensive and balanced floodplain management policy. Agencies, FEMA in particular, were provided with greater flexibility to orchestrate a recovery premised on relocating people and towns out of the floodplains. Legislative changes moved quickly through Congress and the Administration to lay the foundation for more aggressive disaster mitigation programs.

The Midwest flood recovery, although far from perfect, was revolutionary in terms of federal effort, and because of this it proceeded with a sense of vision, urgency, and purpose. For the first time in history acquisition and relocation was conducted on a massive scale. Over 25,000 buildings were removed from floodplain areas after the 1993 floods and most of the remaining vacant areas were required to be set aside as permanent open space. On the negative side, hundreds of levees failed during the 1993 floods, but no change in national levee policy resulted.

After the 1993 floods, the White House established an Interagency Floodplain Management Review Committee and charged it with conducting a comprehensive review of floodplain management. Its 1994 report, *Sharing the Challenge—Floodplain Management into the 21st Century* (sometimes referred to as the “Galloway Report” because the committee was led by Gerald E. Galloway, Jr.) [<http://edc.usgs.gov/sast/2P-00526.pdf>], emphasized that the responsibility and accountability for floodplain management must be shared. It specifically called upon state and local jurisdictions to refrain from putting people and property at risk by avoiding floodplain development; relocating at-risk people and buildings when appropriate; and treating the floodplain as part of a watershed and ecosystem.

The politics surrounding floodplain management, however, quickly became complicated. Interested press and others awaited the results of the Galloway committee with high anticipation. The environmental community was particularly expectant, because for the first time in such a high-level document, the prospects for and benefits of leaving floodplains in an undisturbed state were being seriously discussed. Unfortunately, when it was officially released, *Sharing the Challenge's* sensible, balanced approach to floodplain management, which had appeared to be receiving bi-partisan support in Congress, was portrayed in the press as an environmental initiative—a “greening of the floodplains.” These perceptions, coupled with the fact that both its premises and recommendations ran counter to the short-sighted economics-based decisionmaking tools in wide use then and today, resulted in diminished support and endorsement for the report, and follow-up since then has been relatively sporadic.

Meanwhile, up until the 1993 floods, a remnant of the Water Resources Council had been nurtured by the federal Interagency Task Force on Floodplain Management. The Task Force was staffed by senior career personnel from various agencies, had produced over the years the several updates to the *Unified National Program for Floodplain Management*, published *Floodplain Management in the United States: An*

Assessment Report, and advanced many key floodplain management tools. Equally important, the Task Force understood that the way to improve floodplain management was through the development of state and local capability and the shifting of responsibility for it from the federal level to local and state governments. For several years, the Task Force was the focal point for agency staff to meet, resolve conflicts, pool resources, and be the “Akeepers of the flame” for the advancement of a coordinated (federal/state/local/private) floodplain management policy.

A misfortune of timing was that the well-intentioned moves of the Administration early in the Midwest recovery in essence usurped the toehold on advancing floodplain management that the Task Force had maintained up to the 1993 floods. To compound this problem, there was a dramatic turnover both in agency personnel serving on the Task Force and in appointed and career staff within the Office of Management and Budget and the Council on Environmental Quality. This resulted in a sudden and serious diminution of institutional knowledge and experience in floodplain policy at the federal level, and resulted in a vacuum in federal oversight, coordination, and leadership. The Task Force has not met since the late 1990s.

During the rest of the decade, modest advancements in a balanced floodplain management strategy were made. The first significant update of the NFIP was realized with the passage of the National Flood Insurance Reform Act of 1994 (P.L. 103-325), which strengthened provisions for the mandatory purchase of flood insurance and established the Hazard Mitigation Grant Program within FEMA. The latter was the federal government’s first program that aimed to prevent and mitigate flood damage instead of simply providing funds to rebuild to pre-disaster conditions. This recognized the wisdom of reducing future flood costs for property owners as well as local, state, and federal taxpayers. An initiative to modernize and digitize all the nation’s flood maps was funded by Congress and begun by FEMA. An incentive-based sub-program of the NFIP, the Community Rating System, was developed, through which flood insurance policyholders are rewarded with reduced premiums when their communities undertake flood risk reduction or resource protection activities that exceed minimum NFIP standards.

In 2002 Congress created the Department of Homeland Security and moved FEMA from an independent agency to a subdivision of the new department. This diminution in status, along with repeated reorganization of functions and programs, budget woes, and shifts in legislative and executive priorities, resulted in lost ground for floodplain management at the federal level. The absence of a federal coordinating body made it impossible for other agencies to exercise leadership in floodplain management while FEMA was engaged in re-orienting its operations within DHS.

The disastrous hurricane seasons of 2004 and 2005, culminating in the catastrophic Hurricanes Katrina and Rita, galvanized public and official awareness of many of the risks of coastal development, the ramifications of the loss of natural protective features, the error of relying solely on structural features like levees, and the enormous public and private costs involved in fully recovering from such an event and simultaneously correcting past errors so that the devastation will not be repeated. Only a few of the impacts of the disaster on public policy can be identified at this writing. Again the approaches to flood loss reduction represented by the National Flood Insurance Program are being subjected to Congressional scrutiny; the NFIP is in debt to the U.S. Treasury for about \$20 billion; ways to ensure the safety of levees nationwide are being debated; and questions are being raised about how costs for repair, recovery, and mitigation of flood and hurricane disasters should be shared among the local governments, states, and federal taxpayers. The resolution of these and many other issues will help shape national programs and policies for the next several years.

NO ADVERSE IMPACTS and COMMUNITY RESILIENCE

Floodplain managers, planners, environmentalists, and local officials share an awareness of the benefits of protecting the natural functions of floodplains as a means of both protecting property from flood losses and preserving natural ecosystems. This attitude is translated into action through various strategies for ensuring that human activity proceeds with minimal negative impacts across space or into the future. Some of these approaches are known as “low-impact development (LID),” “Smart Growth,” “sustainability,” and the use of “green infrastructure.” These approaches combine recognition of the interconnectedness of environmental, economic, and social actions; a balance of present needs with future needs; recognition of natural and geographic boundaries rather than artificial or political ones within which to make decisions; and a locally based, participatory planning and decisionmaking process.

The “no adverse impact” approach developed by the Association of State Floodplain Managers provides the philosophy and legal underpinnings for a holistic approach that puts floodplain management in the vanguard of this trend. The concept and its implementation are explained in *No Adverse Impact: A Toolkit for Common Sense Floodplain Management* (ASFPM, 2003) and in other publications of the ASFPM. No adverse impact floodplain management is essentially a “do no harm” policy, based on the concept that the actions of any community or property owner should not adversely affect others, now or in the future. It calls for the anticipation of the potential negative effects of any development action within the watershed on other people and property and on the environment itself—now and in the future. Those impacts can be one-time-only or cumulative and they encompass the combined effects on legal, social, ecological, and physical systems. Any potential negative impacts must be either avoided (by preventing the development from taking place) or mitigated, through measures specified by the community.

Not only does an no adverse impact approach foster long-term sustainability, but it also contributes to local and national disaster resilience—the ability to withstand natural extremes such as floods without experiencing them as catastrophic or disastrous events. A community that has followed the no adverse impact approach to managing its floodplains gains multiple benefits. Not only is the community safer and more resistant to disaster, it is also more economically and environmentally durable and more efficient. In addition, the residents of such a community enjoy a stronger economy and a better quality of life on a day-to-day basis because the disruption and costs of floods have been avoided.

The ASFPM encourages the adoption of no adverse impact floodplain management as a basis for fostering disaster resilience and sustainability at the local and state levels and over the long term. It is holistic, broad-based, sensitive to the natural functions of floodplains, and demands local control and responsibility. Although implementation of this approach takes place at the community level, as with other techniques federal leadership and incentives will be needed to make it more widespread and thus yield the greatest possible long-term benefits.

- No federal program should allow the transfer of flooding impacts from one entity to another or from present generations to those of the future.

PARTNERSHIPS AND INCENTIVES

Flood damage is a direct consequence of floodplain investment activities, both public and private. Those who occupy and use the floodplain should be responsible for the consequences of their actions. The federal government is clearly responsible for federal activities that invade the floodplain. But the authority and responsibility for guiding and controlling how land is used by the private sector and others lies exclusively with non-federal entities. All land use authority flows from the states, so is accomplished by either the state or local government. To the degree that state and local governments sanction unfettered floodplain development (including new construction of public facilities), they share responsibility for excessive flood damage, and should therefore share a concomitant portion of the consequences and costs.

- Congress should amend the Disaster Relief Act to apportion the costs, roles, and responsibilities of states and localities, the federal government, and the public in a manner that is commensurate with the risk faced by each entity. Citizens, businesses, and local and state legislators need to better understand that the federal government will not always bail them out after a flood. Federal programs and federal disaster relief policies must use incentives to induce people and state and local governments to bear their fair share of the risk.
- The federal agencies, in collaboration with states, localities, and the private sector, must find clearer ways to communicate flood risk so that it is meaningful to citizens and communities, thus enabling them to take appropriate steps to reduce risk and damage.

Federal Role

In its concern for the general welfare, the federal government has a proper interest in measures to hold flood damage to an economic minimum. It has a responsibility to discourage floodplain development that would impose a later burden upon federal taxpayers, that would benefit a few at the expense of others, or that would victimize unsuspecting citizens. It does not follow, however, that the federal government should be solely responsible for the success of a program to reduce flood losses and human suffering over the long term through a plethora of measures both in and outside the floodplain.

Yet, due to the policies of the last 70 years, the federal government has been cast in that role. For example, the Katrina disaster in New Orleans has been characterized as a failure at the federal level, even though the state and local governments allowed and encouraged development of the city, and failed to perform their roles in operating and maintaining the levee system and being prepared to evacuate the population. What is lacking is the state and local responsibility and capacity for anticipating and mitigating the adverse impacts and losses from flood hazards in their jurisdictions. That is why the ASFPM believes that incentives should be provided by the federal government to reward those states, localities, and individuals who are taking initiative to break the cycle of development, damage, and redevelopment at federal expense and instead build their own capability to manage flood hazards and floodplain resources in a sustainable manner.

The optimal federal role would be (1) leadership, including appropriate laws and executive orders to create an effective framework for flood loss reduction throughout the nation; (2) information provision, including developing and/or setting criteria for collection, maintenance, and archiving of solid data, including maps, stream gages, forecasts, flood damage data, and watershed studies;

(3) providing for flood insurance and associated mechanisms; and (4) facilitation, by wielding appropriate incentives and consequences to encourage individuals, communities, states, and the private sector to take appropriate actions and decisions to reduce flood losses and to conserve and enhance the natural functions and resources of floodplains and coastal areas. The federal agencies must see their role not as “doing” the planning and implementation of projects, but as fostering the development of state and local capability and programs to reduce flood risk and costs. There are several ways in which this can be done, as described below.

- Public Assistance and mitigation funding should be withheld from the damaged floodplain areas of communities not enrolled in (or not in compliance with) the National Flood Insurance Program (NFIP). Today there are few, if any, economic sanctions for local governments that fail to participate in the NFIP, even though their failure to do so makes their citizens ineligible for Individual Assistance, federal home loans, some grants, and other services. In effect, the citizens are being penalized while the municipality continues to get bailed out by federal taxpayers.
- Similarly, the non-federal share of disaster assistance costs should be reduced in communities where state and local efforts are mitigating the flood hazard. Proposals before Congress have suggested penalizing communities that do not achieve a minimum standard, but an incentive program makes more sense both politically and from a public policy standpoint. An even more effective approach to generating positive state and local actions would be to amend existing law to so that the pro-active entities would be allowed to bank some portion of the funds they spend as the non-federal share of their next disaster. This could be an especially effective approach for encouraging investments in capability at the state level, where state legislatures could see it as a “pay now or pay later” scenario.
- National standards should be developed for the design, placement, construction, and reconstruction of infrastructure after disasters, including roads, bridges, railroads, and other facilities. These standards must be high enough to ensure that damage from future floods and other hazards is avoided. Communities that adopt these minimum standards (or higher ones) should receive proportionally increased federal Public Assistance after disasters and increased funding for mitigation projects.
- Federal financial assistance for flood losses should be based upon the individual’s demonstrated willingness to mitigate the risk. The ASFPM believes that flood insurance is the best means of accomplishing this. For example, those living in identified flood hazard areas should not receive disaster assistance if a flood insurance policy was not in place at the time of the flood.
- The premiums on structures with repetitive losses and on any structures that are not primary residences should continue to be adjusted to reflect the actual risk.
- Federal incentives and programs for farmers like the Conservation Reserve Program, the Wetlands Reserve Program, and permanent easements, are vital financial assistance in the development of sustainable uses for floodprone lands. These sorts of incentives should be continued and generously supported.

- Highly subsidized crop insurance and flood disaster payments on floodprone agricultural lands should be discontinued, as they are neither sustainable nor sensible public policy. Crops that can withstand flooding, add carbon sequestration, demand little or no chemicals, and provide a good return for the farmer now exist, and can be encouraged with incentives.
- Agricultural properties subject to repetitive flooding should be denied subsidized crop insurance and flood disaster payments if their owners turn down offers to purchase permanent easements or refuse to convert to sustainable crops.
- Federal assistance to states and localities for flood control structures, nonstructural flood measures, mitigation, and flood disaster assistance should all be based on the same, sliding cost-sharing formula, to provide an incentive. A minimum cost share would be available to all localities but the federal share would be increased for communities and states that engage in disaster-resistant activities exceeding minimum criteria, are implementing aggressive mitigation programs, or that elect nonstructural projects to mitigate flood risk.
- Federal financial assistance should not be provided to states or localities to build or rebuild public infrastructure that would encourage development in high-risk flood hazard areas.
- Federal disaster assistance and NFIP participation should be made contingent upon states' ensuring that their regulations, funding, and programs are compliant with the NFIP.
- Nonstructural measures that permanently remove property from high risk zones should receive a higher federal cost share because in the long run these measure save federal dollars that would otherwise be necessary for operation and maintenance of structural works and/or for the repair of damaged property after a flood. Congress should raise the non-federal share of the standard formula used by the Corps of Engineers so that all nonstructural water resources projects it undertakes use a 75/25 federal/non-federal ratio.
- All taxpayer-funded flood disaster relief should be contingent upon taking flood mitigation action where feasible—whether public or private.
- The federal government should set an example by enforcing appropriate restrictions on floodplain lands it leases, and terminating those leases on schedule. In some areas of the nation, buildings exist on floodplain lands leased from the Corps. These leases were intended only to “live out” the original landowners and then expire, and they included clauses specifying that neither flood insurance nor flood disaster relief would be available to the owners. A further condition was that the buildings were not to be converted into permanent homes, although most of them have been. However, because of political pressure, hundreds of these properties receive flood insurance claims payments and disaster relief, and leases are being renewed because Congress will not allow the Corps to terminate them. In Illinois, these properties make up a significant proportion of the state's repetitive loss properties.
- The federal government should encourage market-driven private-sector incentives for flood mitigation.

Risk Awareness and Individual Accountability

Federal attempts to resolve the problem of rising flood losses should focus on promoting sound investment decisions by individuals. The most significant national impact will be realized through millions of individual decisions and actions rather than through a handful of government decisions and actions, even though each of the latter may be larger in scope. The federal government can take the following steps to make it easier for people to make the “right” decisions.

- Federal monetary assistance for individuals should be based upon whether they had a flood insurance policy before the disaster, even if their property lies outside of the 100-year floodplain. The total amount of assistance received by an individual should be reduced (or a portion of it converted to loans) to reflect the amount of damage that could have been covered by a flood insurance policy.
- FEMA should develop and implement procedures by which the Director can mandate implementation of mitigation measures for structures for which it would be cost-effective. Those who use their flood insurance claim payment for mitigation should be further rewarded by receiving an additional increment of support in the form of a grant.
- Flood insurance rates for any structure that is not a primary residence should be based on the actual risk to the structure. This includes second homes, vacation homes, rental properties, and businesses.
- Subsidized insurance for pre-FIRM primary residences should be gradually raised to actuarial rates in order to encourage mitigation.
- FEMA should encourage the insurance industry to rate flood insurance as a component of all homeowner’s policies. Property owners would have the ability to opt out of the flood coverage and use the NFIP policy, but once it is in place many would likely retain it.
- FEMA should evaluate ways to eliminate the use of Letters of Map Revision (issued after the use of fill or the modification of a channel to alter the floodplain) to avoid the purchase of flood insurance. The most direct approach would be to discontinue the practice of waiving flood insurance after issuance of a Letter of Map Revision based on Fill. Properties for which a Letter of Map Revision based on Fill is issued would still enjoy the reduced flood insurance premium rates that are assigned to an elevated structure.

State and Local Capability

Traditional flood protection programs have resulted in heavy reliance on federal programs, planning, and implementation with little or no consideration given to building local and state capability. (A partial exception is the NFIP.) This arrangement was fairly effective when federal funds were abundant, the construction of flood control works was widespread, fewer communities were involved, and our view of damage prevention was short term and narrower. But, based on current trends, future federal budgets will no longer support this approach on a wide scale. The federal budget cannot continue to fund large disaster costs, and current approaches have not resulted in reducing flood damage.

Further, local involvement and impetus is essential for a truly sustainable approach. Experience indicates that the best local floodplain management takes place where there are strong state floodplain management programs. As discussed below, the experience of other federal programs has been that using federal leadership to build state and local capability and resources is an efficient way to achieve national goals, but that state direction and initiative need to be fostered. Flood protection in the future will be a state and local effort, and federal policy must shift and recognize the need to support and build that capability.

The role of the state government is to provide, as necessary, authority and policy development, technical assistance, training and tools to communities, coordination, and prioritization and integration of floodplain management issues within that state. The federal-state-local relationship must be modified in the following ways to reflect current and future policy needs and budget realities.

- In order to provide adequate assistance in building strong local programs, and to meet these other goals, states should develop, fund, and implement adequate technical and financial assistance initiatives to train, oversee, assist, and monitor local programs. These should include but not be limited to ongoing collaboration among all state agencies that have an impact on flood losses and hazards, issuance and implementation of a state-level executive order on floodplain management, and coordination of NFIP activities within each state. States thus should come to view the NFIP's Community Assistance Program only as an auxiliary funding source; and the Community Assistance Program itself should be designed to leverage building state and local capability and encourage less oversight and more long-range planning and mitigation initiatives. If necessary, federal incentives should be provided to induce such actions.
- States should help their communities incorporate progressive floodplain management approaches into other community processes, as outlined in detail in ASFPM's *No Adverse Impact Toolkit* (ASFPM, 2003). Incentives to and support for this effort should be provided by all federal programs.
- States should combine resources for disaster response and short- and long-term recovery by joining existing or proposing new regional mutual aid compacts.
- Qualified states should be delegated the authority and funding to perform and administer floodplain mapping programs for FEMA, administer the Hazard Mitigation Grant Program and the Flood Mitigation Assistance Program, and conduct environmental reviews for mitigation projects. This will help build state capability and streamline and hasten the implementation of programs, which will reduce flood losses over the long term.
- States and communities should be encouraged to develop the capability to do their own engineering studies and reviews, such as reviewing Letter of Map Change submissions. Incentives are needed for states to develop strong levee and dam safety initiatives and integrate them with their flood hazard programs. Delegation of such authorities should be made to a locality only through a state or with concurrence of the state.
- Encouragement and support should be given by federal agencies and states to professional certification programs for floodplain managers, adjusters, agents, and others.

- The federal government should encourage the integration of the certification programs for administrators of the International Codes and for floodplain managers.

Local governments must become the focus of hazard mitigation efforts. Using comprehensive local plans that consider the entire watershed and address multiple community issues and concerns is the best way to manage development so that a viable climate is created for economic growth, hazard resiliency, resource protection, and social and environmental equity. Many communities are using the approaches outlined in the *No Adverse Impact Toolkit* for community activities in mapping, education and outreach, planning, regulations and development standards, mitigation, infrastructure, and emergency services.

- Local governments need to be encouraged, via federal incentives and other means, to better integrate floodplain management regulations into their overall land use and conservation plans.
- Mitigation funds should not be available to a locality unless it has a comprehensive mitigation plan in place. Communities must be provided with the tools, responsibility, rewards, and a workable process through which they can move toward sustainable development approaches that engage their citizens, the private sector, and non-governmental organizations.
- The successful activities of communities that participate in the Community Rating System of the NFIP should be publicized and shared.

State Delegation and Partnering

A true partnership among the federal, state, and local levels of government is essential to effective management of flood risk and floodplain resources. Federal leadership, guidance, and incentives are needed to entice states to take responsibility, and then state and local capability and resources must be developed, again with federal participation. A top-down planning and implementation process does not foster this partnership. In fact, it tends to result in continuing reliance on the federal government.

Further, FEMA recognizes that it is not realistic to expect to add adequate federal staff to facilitate all community floodplain management and mitigation programs. The move to a FEMA/state collaborative effort is essential, and building state capability in order to assist communities is an integral part of an effective solution. A “managing state” arrangement had been tried under FEMA’s Hazard Mitigation Grant Program to enable capable and willing states to assume a stronger management role in the program, but met with limited success.

- An evaluation of the managing state concept should be conducted to determine how effective it has been in building state capability and improving program outcomes.
- FEMA should explore the option of true delegation to states of authority and responsibility for various programs in mitigation, including many aspects of the NFIP (mapping, map changes, community training, technical assistance, monitoring, etc.). Many federal programs already use the delegation model.
- Any program to delegate portions of the FEMA programs to the states must be designed

around the goals of building state capability for long-term reduction in hazard losses and suffering. Such an approach should be developed by FEMA in collaboration with its state partners. Effective options needing legislative authority can be presented to Congress with mutual support of FEMA and the states.

- Any delegation approach should function as an incentive to gain broader and increased state involvement and commitment in mitigation. Incentives can range from funding cost shares to more independence, and should be an integral part of the delegation framework.
- The delegation concept should be expanded to other FEMA programs (like the Community Assistance Program, discussed below) as an incentive to build state capability and reduce disaster costs.

Community Assistance Program

The Community Assistance Program-State Support Services Element (known as CAP) is a cooperative agreement between FEMA and the states, supported by NFIP funds. Through CAP, FEMA provides funding to the appropriately designated state agencies charged with NFIP oversight. These agencies (designated by individual governors) receive a 75% federal-25% state cost-shared fund to help communities within that state achieve and maintain compliance with the NFIP.

CAP funds are also used to conduct flood mitigation and technical assistance activities that support the goals of both the state floodplain management program and the NFIP. These activities work to mitigate the NFIP's allowable encroachment into the nation's floodplains and the increasing risk to the National Flood Insurance Fund. In fact, CAP has been a significant spur for many states to develop and implement broader floodplain management capability—beyond that needed to meet the narrower objectives of the NFIP and ensuring community compliance. Many states' floodplain management capabilities rely strictly on CAP funding, due to a lack of emphasis by state governments to provide dedicated state funds to the program¹. Unfortunately, the CAP often has tended to replace state capability rather than encourage states to develop it. Ideally, the CAP should leverage state capability, not replace it.

The trend for CAP to exist primarily as a “measurable” contract between FEMA and the NFIP State Coordinators has curtailed its original partnership concept. There is a need to overhaul the CAP so that it meets both FEMA requirements for ensuring compliance with the NFIP and the floodplain management objectives of the states. It is important to recognize that the vast majority of state activities integrating various state programs that influence flood losses ultimately reduce disaster costs and flood insurance claims, and thus should also be appropriate activities under the CAP. In turn, states should be discouraged from replacing state-paid positions for FEMA-funded positions.

- FEMA needs to view the Community Assistance Program primarily as a state-capability building program, not as a way to obtain services from state assets.
- CAP funding should be based upon clearly understood nationwide criteria that establish a reasonable “minimum floor” of funding for a viable state floodplain management program and also specify what is required to exceed that level of funding. For example, the establishment and maintenance of one fully funded state-paid professional staff

¹For 2002, 28 states reported that 75% or more of their funding for floodplain management salaries came from the CAP (ASFPM, 2004a).

member should be a prerequisite to receiving CAP funding. The ASFPM's *Effective State Floodplain Management Programs 2003* (ASFPM, 2004b) identifies 10 elements of effective state programs and could be used to develop such funding criteria.

- To further build state capability, the delegation concept should be extended to FEMA's Community Assistance Program, and funding for that program should reflect a calculated need for effective activities under the NFIP, with annual inflation-linked increases.
- Governor-level commitment to floodplain management and NFIP coordination should be made with every change of state administration. This coordination should be between the FEMA Regional Director and the state governor, and the governor's commitment should trigger FEMA funding levels.
- States should view the CAP as an auxiliary funding source for ongoing National Flood Insurance Program coordination within their broader floodplain management programs, not as the sole source. FEMA should provide incentives and disincentives that encourage states both to adopt this view and to provide appropriate state resources.
- States participating in the CAP should be allowed to dedicate some proportion—perhaps up to 50%—of their CAP funds to state-selected flood loss reduction projects or activities.

State and Local Mitigation and Planning

Local planning for floodplain management and mitigation needs to be better emphasized and supported. Localities that have taken the initiative to analyze alternatives and implement their best options should be recognized and rewarded. Floodplain management planning credited by the NFIP's Community Rating System is used by many communities as a model for developing mitigation plans.

Experience indicates that the best floodplain mitigation occurs in the states that have strong programs. Floodplain management is not unique in this regard. Environmental programs like those established pursuant to the Clean Water Act, the Coastal Zone Management Act, and others, demonstrate that using federal leadership to build state and local capability and resources is an efficient way to achieve national public policy goals. These experiences show that state direction and initiative needs to be fostered. In contrast, the top-down planning and implementation process of existing federal agencies with flood-related missions does not build standing capability within a state, and will result in continuing reliance on the federal government to provide technical plans and funds. To build and support state capability the following ideas should be considered.

- The Pre-disaster Mitigation Program should be managed through allocations to each state based on criteria FEMA develops in cooperation with the states, not run as a national competitive program by FEMA. A step towards this end was put in place for Fiscal Year 2007 and should be evaluated. The PDM program should place a special emphasis on mitigation planning for at least five years.
- The Community Assistance Program needs to be redesigned to encourage more delegation and less oversight and more long-range planning and community assistance.

- Technical and financial support and other incentives need to be developed at the state and federal levels to encourage communities to undertake their own mitigation activities.
- Technical assistance programs like the Corps' Flood Plain Management Services and Planning Assistance to States programs, which provide precise technical input into overall state mitigation strategies, should be expanded and receive continued support. Such programs encourage bottom-up planning and local action, as opposed to top-down programs inherent in the Corps' other water resources programs.
- Federal agencies need to provide training for state and local officials in the application procedures for mitigation funding.
- State and local hazard mitigation plans should be required to include emergency action plans and no adverse impact approaches.
- Federal agencies should encourage states and communities to develop holistic mitigation plans that address multiple federal programs with a comprehensive review process.

Community Rating System

The Community Rating System of the NFIP was established by FEMA as an incentive mechanism aimed at recognizing and encouraging exemplary community floodplain management that exceeds minimum NFIP standards. Flood insurance premiums for residents of communities participating in the Community Rating System are lowered to reflect the reduced flood risk that is a result of community activities that meet the three goals of the Community Rating System: reducing flood losses; facilitating accurate insurance rating; and promoting the awareness of flood insurance. The 1049 communities that participate in the Community Rating System today represent 66% of all NFIP policyholders nationwide. Policyholders in Community Rating System communities receive premium discounts ranging from 5 to 45%. (One community has achieved a rating entitling its policyholders to a 45% discount.) In 2006, the Community Rating System premium discounts amounted to \$191 million.

Although it is not perfect, the Community Rating System is a good example of a federally based program that offers incentives to localities for undertaking floodplain management activities. It has been shown to be effective in encouraging new local initiatives and maintaining existing ones. Every nonstructural measure discussed in this paper is rewarded to some extent by the Community Rating System.

- States should encourage and assist their communities in joining, maintaining, and improving their standing in the Community Rating System, to increase local capability.
- The successes of the local programs of Community Rating System-participating communities should be publicized and transferred to more communities by FEMA.
- FEMA should consider identifying certain Community Rating System activities and phasing them in as additional standards and requirements for community participation in the NFIP.

- The Community Rating System should be subjected to an independent evaluation to ensure that it is appropriately rewarding practices that truly have long-term flood loss reduction benefits.
- Community Rating System credit should be awarded for protecting and maintaining natural storage areas within watersheds.
- After each major flood disaster, Community Rating System community compliance should be evaluated to determine what gains have been made due to Community Rating System participation and to see if the program is really mitigating community losses, or just lowering community premiums. There should be clearly established audit mechanisms for Community Rating System communities, especially after disasters.
- Other types of incentives should be considered for use within the Community Rating System, besides insurance premium reductions for individual residents. For example, communities might participate more fully if another “reward” were available, such as a grant for a local project or program.

Community-based Public-Private Partnerships

A federal program is needed that fosters the sort of far-reaching mitigation approaches that the ASFPM has called for in the past. It should combine establishing partnerships between the public and private sectors, leveraging resources and energy, and making mitigation a standard part of community planning. Through it, FEMA and other agencies could challenge communities to protect families, businesses, and communities by reducing their susceptibility to all types of natural disasters. It should be based on three premises. First, mitigation is a local issue, best addressed by a local partnership of government, business, and private citizens. Second, private sector participation is essential to comprehensive and long term solutions, because floods and other disasters threaten the economic and commercial growth and sustainability of localities (it is estimated that 85% of the businesses in New Orleans will not re-open). Finally, mitigation is a long-term effort that requires long-term investment.

- A community based public-private partnership should be developed by FEMA and/or other federal agencies to promote more pre-disaster mitigation and disaster rebuilding sustainability in communities throughout the nation. The initiative’s underlying concepts should be adopted in other federal and state programs.

Coordination, Oversight, and Evaluation of Programs

Water resource issues are inextricably linked, and efficient accomplishment of agency mandates requires coordination and collaboration among agencies. When Congress passed the National Flood Insurance Act of 1968, it anticipated the gradual development of a broader, nationwide effort to reduce both flood damage and the loss of natural floodplain functions. The periodic progress reports from the Administration to Congress required under the Act (the most recent was in 1994) all have been titled *A Unified National Program for Floodplain Management*, and discuss the “program” as though it were a distinct, viable initiative.

In reality, however, the Unified National Program has suffered from lack of high-level attention from past and current administrations. The United States has no unified national program for

floodplain management in practice. This stems in part from ambiguity in national goals, and from Congressional direction that yields diffusion of responsibility among levels of government and agencies. This results in uncoordinated, fragmented, inconsistent, and duplicative efforts, gaps in program delivery, and missed opportunities. An attempt was made in the 1990s to reshape the Unified National Program by professionals with the ability to direct a limited number of meagerly funded programs, but without sufficient authority to bring about widespread policy change. If its goals are to be met, the Unified National Program must be elevated within the Administration.

- A water resources coordinating mechanism needs to be established at a high level within the federal government. It could include responsibility for the *Unified National Program for Floodplain Management*, and have oversight to ensure that all federal policies and programs are supportive of (or exceed) the NFIP and the hazard mitigation programs of FEMA and other agencies. Upgraded Executive Orders or other measures are needed; they should tie flood disaster relief and other federal funds to a state's and community's participation in and compliance with the NFIP, as well as to the purchase and maintenance of flood insurance.
- One option would be to assign responsibility for the Unified National Program to the Office of Domestic Policy or to the Council on Environmental Quality in the White House, where there could be executive management by senior administration officials, with federal agency participation at the Deputy Director level, using existing agency staff to develop policy regarding the work products.
- Congress should pass an act to establish and implement a National Floodplain Management Policy. It should include a national riparian zone policy of protecting, maintaining, and restoring riverine and coastal areas in order to preserve their natural and beneficial resources as sustainable ecosystems for future generations.
- A coordinated, watershed-based, multi-objective approach for all water resource activities must be adopted. It should include coordination with efforts to improve water quality, quantity, and supply; the creation and maintenance of upland storage; and coordinated planning among upstream, downstream, rural, and urbanized localities within the same watershed.

It is easy to point to specific outcomes of limited policies or programs in floodplain management, but a careful appraisal of the array of policies and activities that have evolved under the NFIP has been missing for a long time. After seven years of effort, the first comprehensive evaluation of the NFIP since its inception now has been completed. Although the various studies carried out under the Evaluation examined the relationship of the NFIP to some components of federal disaster relief, in general the evaluation was weak in its analysis of the linkages to other federal water and watershed programs or to other programs that affect flood losses, such as those of the Corps of Engineers, the Department of Transportation, the Environmental Protection Agency, the Natural Resources Conservation Service, and others.

The NFIP Evaluation does, however, contain a plethora of data that will allow FEMA and its partners to diagnose and prescribe modifications for Congressional and administrative changes that will benefit the nation's taxpayers, those who are at risk from flooding, and those who will purchase

land and structures that may be at risk. This analysis and diagnosis will require varied types of expertise and partners from the many disciplines related to the NFIP.

- FEMA should establish a team to review and analyze all the reports from the Evaluation of the National Flood Insurance Program with an eye toward identifying the most effective modifications to the existing program, and to propose big-picture changes that may require further analysis or trial efforts. The team should have representatives of FEMA, other federal agencies, experts representing state and local partners, private sector stakeholders, and academia.
- The Pre-Disaster Mitigation Program should be evaluated, to determine the kinds of mitigation measures that are being funded and implemented, and whether they really are reducing losses and protecting floodplain resources. This should include an evaluation of the most effective means of administering the program, such as through state allocations and delegation of responsibility.
- Likewise, a compilation of activities funded by the Flood Mitigation Assistance Program, especially those related to reducing repetitive losses, needs to be done, followed by an analysis of their long-term impacts, to establish future program priorities.
- Periodic independent reviews should be done of state and local floodplain management policies and programs, to identify what successes have been achieved in certain states and locales, what contributed to that success, and how they could be duplicated elsewhere.
- During 2002 and 2003, FEMA funded a project to develop and describe the components of an effective state floodplain management program, which resulted in a report called *Effective State Floodplain Management Programs* (Association of State Floodplain Managers, 2004b). A review and analysis of that product should be done to identify ways in which FEMA can foster states' moving toward more effective models.

Federal leadership is critical as well to develop the strong, action-oriented programs and policies that are needed at all levels of government and within the private sector both to gain a fuller understanding of the dynamics of changing climate and to minimize its impacts. Such floodplain management measures as mandatory setbacks, higher freeboard allowances, restoration of natural floodplains and wetlands, and modified construction standards need to be explored, along with many other options. Listed below are some steps that the federal government should consider.

- The U.S. Geological Survey and the National Oceanic and Atmospheric Administration should support and participate in domestic and international programs for the collection and analysis of data on climate change.
- Joint evaluation of populations centers should be conducted by the National Oceanic Atmospheric Administration's Sectoral Applications Research Program (SARR), the Department of Housing and Urban Development, and the Federal Emergency Management Agency (FEMA). This should include scenario-based analysis of the fragility of these areas in the face of a changing climate, the expected types and quantity of damage, its impact on the national economy, and responsible modifications to current

management strategies. This effort should be scoped by a committee of the National Academy of Science.

- When states and communities update their all-hazard plans, FEMA should require that they include an evaluation of the impact of future climate change on their locales, including the potential impacts of sea level rise, extremes in precipitation and runoff, and more severe hurricanes—and include recommendations for adaptation as appropriate.
- The Office of the President should issue an Executive Order directing federal agencies to consider climate change, including adaptations to it, in all their planning, permitting, design, and construction.

Enforcement of Federal Executive Order 11988

Executive Order 11988 directs federal agencies to comply with wise floodplain management practices. Although on its face it is a powerful mandate, Executive Order 11988 seems to be receiving only marginal compliance as federal agencies fail to adhere to its spirit and letter, and continue to locate or fund non-floodplain-dependent activities in floodplains, thereby putting these investments at considerable risk as well as increasing flood damage to other properties.

- Compliance with Executive Order 11988 should be overseen and enforced by a specific entity within the Administration.
- In addition, a new Executive Order should be issued, with an expanded scope and mechanisms for enforcement and accountability. This would reaffirm the federal government's commitment to leadership in floodplain management.

Funding Mechanisms

Reliable and ongoing funding must be made available for programs, entities, and activities that foster partnerships, state and local capability, and sustainable approaches to floodplain management. For example, funds for implementing mitigation must extend beyond the post-disaster period, and beyond the federal planning process (which can last 20 years). Federal funding should be used as an incentive to foster state and local programs and projects that go beyond minimum standards; that include mitigation planning; factor hazards into the design and construction of new public infrastructure; require hazard disclosure in property transfers; create economic incentives for retrofitting vulnerable buildings; adopt building codes; and identify and insure at-risk public buildings. Under the current arrangement, federal assistance appears to flow more freely toward localities that have made little or no effort, because they end up with more at risk development and thus sustain more damage.

- Adequate funding should be provided for initiatives that support all aspects of floodplain management, including data collection, forecasting, geographic information systems, FEMA flood mapping, the U.S. Geological Survey streamgaging program, the National Oceanic and Atmospheric Administration's Integrated Ocean Observing System, scientific research, and analysis.
- Generous and reliable funding is needed for programs that have the most promise for long-term impact. These include technical assistance programs like the Corps' Flood

Plain Management Services and its Planning Assistance to States programs; mitigation initiatives like the Flood Mitigation Assistance Program and Pre-Disaster Mitigation program, which are not restricted to the post-disaster setting; and programs to purchase permanent easements like the Natural Resource Conservation Service's Wetland Reserve and Watershed Protection programs. In addition, the Administration should ask Congress to declare Flood Mitigation Assistance funds to be non-federal, because they are generated by flood insurance policyholders and are not taxpayer funds. If they were considered non-federal, these funds could be leveraged for more flood mitigation activities.

- For nonstructural projects, land and easements should be considered part of the total project cost, not a local sponsor requirement. Economics sometimes dictate that non-federal sponsors choose the alternative with the lowest non-federal cost. Due to the high cost of land in many areas, the large amount of land needed for some nonstructural projects, such as evacuation of high risk areas, and the variations in how the cost of a project is shared, often result in a perverse situation in which the alternative with the lowest non-federal cost is often a structural one, even though it may have a higher cost overall to the taxpayers.
- All federal assistance for structural, nonstructural, and disaster assistance programs should be based on the same, sliding cost-sharing formula to provide an incentive to state and local action. Under this concept, a minimum cost-share would be available to all, including communities without financial resources to undertake expensive projects. But the federal share would be increased for communities and states that engage in disaster-resistant activities beyond minimum criteria. Further, nonstructural mitigation projects would always receive a higher share of federal funding than structural projects.

ECONOMICS

The use of economic analysis for evaluating programs of floodplain management and mitigation is necessary but can often result in unintended impacts. In an idealized situation, an economist would be able to quantify all the variables that come into play in analyzing a project (economic growth, environmental consequences, social impacts, and others) and come to a rational, economic-based decision about whether proceeding with a proposed project is in the nation's best interest. The reality, however, is that the current practice in economics falls far short of what theory envisions, and in most cases our projects are justified solely on those benefits and costs that are readily quantifiable in financial terms, rather than on adequately measured less-tangible elements, such as environmental quality or non-monetary human preferences. In the National Research Council's 2004 report, *Analytical Methods and Approaches for Water Resources Project Planning*, the committee commented on benefit/cost analysis and stated, "Benefit/cost analysis should not be used as the lone decision criterion in judging whether a proposed planning or management alternative in a Corps planning study should be approved" (NRC, 2004, p. 5).

Although this recommendation was directed at the Corps of Engineers, the shortcomings of the benefit/cost approach apply equally to programs of the Corps, the Federal Emergency Management Agency (FEMA), the Natural Resources Conservation Service, and any other federal programs that attempt to justify projects purely on benefit/cost analysis. These federal decisions, in turn, drive outcomes at the state and local levels that likewise are biased toward economic measures.

The Economic and Environmental Principles and Guidelines for Water and Related Land Resources for Implementation Studies (known as the Principles and Guidelines), set out by the Water Resources Council in 1983, go one step further by optimizing water resource development projects that maximize the a single federal objective of "national economic development" (NED). Critics of the Principles and Guidelines (and related manuals) see a bias in them toward structural solutions to flooding problems, and a failure to properly evaluate nonstructural alternatives. Although the Corps recently has begun requiring that environmental quality be maximized to some extent, this is a matter of agency policy only and its positive impact on nonstructural flood mitigation has yet to be seen.

In far too many cases we have allowed economics—as measured by NED or determined according to a benefit/cost ratio—to become the bottom-line indicator of the feasibility and the appropriate selection of alternatives in any project. Although economics clearly must play a role in the decisionmaking process, the policy evolution that has made benefit/cost economics the acid test is ill founded. Stepping back from the perceived logic of benefit/cost to view the situation in perspective, we have a national policy that does the following three things.

First, flood control spending has become premised on an economic return. This begs the question whether we are directly or indirectly encouraging investments in high-risk areas. Disallowing the calculation of indirect benefits in a benefit/cost analysis devalues the true economic benefits of a project and creates a situation in which projects that may provide an immense quantity of indirect benefits may not even be approved.

Second, the systems may not be set up to recognize "least cost" alternatives because of the way in which they are constrained by policy or overarching objectives. For example, when federal spending is guided by an objective of maximizing national economic development, the fundamental premise is that the federal spending is an investment and that, within reason, project

cost is not necessarily a constraint because the objective is to maximize the net benefits of the project as compared to its cost. This approach, however, may not adequately consider a more narrowly focused mission of merely mitigating the flood damage for the least potential cost. Thus, projects that tend to lead to evacuation of the floodplain may not compete as well as with projects that can demonstrate a return even if the evacuation option is a lower-cost alternative.

It must be recognized that there are limits to how much the federal government will spend annually on flood loss reduction projects and a policy of maximizing national economic development in fact limits the number of projects the federal government can afford at any given time and thereby limits the total amount of flood mitigation that can occur. The ASFPM is unaware of any comprehensive study that has evaluated the actual investment return of these expenditures under the national economic development model and the total flood mitigation that has been purchased under that model as compared to a model that would attempt to maximize the amount of flood hazard mitigation that would occur if the objective were to expend funds on a least-cost mitigation solution to a given threshold or standard.

Third, our investment-based approach does not fully consider that the real policy problem facing the U.S. Treasury is cash flow. During the 1990s Congressional debate over disaster funding shifted from funding disaster costs by increasing the national debt, to funding them by making offsetting cuts in other domestic programs. This is a sound fiscal approach, but its policy ramifications are large. Now in 2007, we have returned to a policy of debt financing because our disaster costs greatly exceed our ability to pay, especially for catastrophic events such as Hurricanes Katrina and Rita. This means we are using our grandchildren's futures to subsidize current development.

In summary, our current policy does little to match project activities with the goal of minimizing the creation of tomorrow's losses. Instead, it is heavily focused on repairing yesterday's mistakes with old technology. A new vision is needed that focuses on adequate consideration and representation in decision making of economic, environmental, and social benefits in light of contemporary water resource planning needs for the 21st century, the severe environmental degradation facing our waters and estuaries, and the realization that federal funding for investments or for disaster recovery will be further constrained in future federal budgets when discretionary funding shrinks. In essence, a policy of leveraging (and often exploiting) our water resources for economic return and expansion was an important strategy for the 20th century, but now we need to decide whether this is the right choice for the 21st century, considering the previously mentioned factors and the need to preserve and often to restore the environment we have degraded. This examination should also consider whether we have properly accounted for the long term operation and maintenance costs we are and will continue to encounter for the structural projects built over the last decades.

These steps are recommended for establishing a more far-seeing federal water policy.

- The White House and Congress should evaluate the recommendations of the 2004 National Research Council report and convene an interagency work group to evaluate implementation of the most pertinent study recommendations. The aim would be to develop a viable and sustainable water resource development approach for use of federal taxpayer dollars.
- The estimated costs of proposed alternatives to flood problems should include both

implementation costs (direct financial outlays for design, real estate acquisition, construction, operation and maintenance, and project monitoring) and economic opportunity costs—any current benefits that would be foregone if the solution is implemented. This would also include any “negative benefits” in the form of project-induced damage that can be expected in the future. It is important that the opportunity costs of foregone benefits be accounted for and brought to the table to inform the decision.

- FEMA should approach the Office of Management and Budget to seek a reassessment of the regulations governing benefit/cost analyses. The time has come for all benefits to be included in a benefit/cost analysis. These should include recreation benefits, avoided damage to land use (erosion, crop losses, etc.), increase in real estate values due to proximity to open space, ecosystem improvements, and revenue generation from tourism. Consideration should also be given to allowing FEMA some flexibility in the use of discount rates.
- FEMA should re-establish its National Benefit/Cost Analysis Team—a group of experts that can offer advice and guidance in program policy and implementation—to evaluate FEMA’s benefit/cost procedures. The team should include representatives of a broad range of stakeholders, including state and local personnel.
- Better methods for quantifying the economic benefits of natural and cultural resources must be developed, adopted, and applied.
- A federal water policy coordinating body should be re-instituted and an early task should be an evaluation of the *Principles and Guidelines*, with an eye toward broadening the basis of project selection beyond national economic development, incorporating environmental and economic sustainability and the benefits of public safety (lives saved), and refining the methods of accounting for benefits.
- The principles of sustainability should be incorporated into any revision to the *Principles and Guidelines*.
- A study should be done of the feasibility of a unified floods-only benefit/cost method that would be used by both FEMA and the Corps.
- A joint committee should be formed and charged with finding a mutual standard for estimating damage. The discontinuity between Corps and FEMA estimates of damage and their models is serious enough to warrant this action.
- The old and outdated damage curve values being used in FEMA’s benefit/cost analysis software modules should be reassessed.

National Interest

For nearly a century the nation’s interest in economic growth and expansion drove the programs of the Corps and other related federal initiatives. This policy focus emanates from a time when there was a need to expand populated settlements into remote areas of the nation, for both growth and

security reasons. Water was a key resource that the federal government could leverage to promote this growth.

That was then. The United States has just exceeded 300 million in population with explosive growth in areas of the country that would not have grown as rapidly—if at all—in the absence of a water resources policy that provided federal taxpayer subsidies. It is time to recognize that for all practical purposes we have leveraged our water resources to the point that supplies are being exhausted and ecosystems have been seriously strained, especially in estuaries, coastlines, unstable arid lands, and riparian zones.

Environmental degradation and loss represents an ever growing threat to our national welfare and economy. One only needs to look at the environmental degradation of Eastern Europe to understand this relationship. For the most part our current environmental programs marginally protect and rarely restore resources because of a heavy emphasis on regulation. If the nation is going to sustain its economic position, investments in restoring and conserving water-based natural resources are absolutely vital, and debate should ensue as to whether a vision of environmental restoration should in fact be our principal national water resource interest for the next century.

- Congress should task the National Research Council to determine whether the nation's water resources policy should be shifted from a development focus to a focus on management and sustainability, and whether the National Economic Development (NED) policy standard for water resource investments should be replaced by a policy of National Economic and Environmental Sustainability (NEES).

MANAGEMENT OF NATURAL FLOODPLAIN FUNCTIONS AND RESOURCES

In the 1970s and 1980s, floodplain management was defined by the *Unified National Program for Floodplain Management* as having two equal objectives: flood loss reduction and the conservation and management of natural and beneficial floodplain functions. Today it appears that from a policy basis, the nation has made only minor progress in achieving the latter goal even though there is apparent desire by the public to conduct multi-use projects that incorporate management, conservation, and restoration of the natural environment. Unfortunately, federal programs are constrained by policies such as the *Principles and Guidelines* that decidedly favor developed uses of the floodplain, and by the engineering-based policies of the National Flood Insurance Program (NFIP) that have little relationship to natural systems.

By the year 2007 the United States has already dramatically (and in many cases, permanently) altered much of its floodplain riparian resources. However, because of the nation's abundance of streams and watercourses the potential remains for conserving and/or restoring a good portion of these critical resources. Dams can be a vital part of our water resources infrastructure, yet far too many of them, of questionable value, continue to block rivers and streams—in some cases permanently altering aquatic habitat and species. In addition to causing higher floodwaters in downstream communities, levees endanger public safety in two ways today. First, the presence of a levee tends to encourage development behind it, bringing people directly into harm's way when the levee fails or is overtopped. Second, years of poor levee maintenance have prematurely weakened hundreds of levees around the nation, as the Corps reported in early 2007.

In 2007 the nation very well may be at a pivotal point in the conservation of the its riparian zones. Late in 2006, the population of the United States eclipsed 300 million people, with projections that by the year 2030 another 80-90 million people will be added. Just as decisions were made in the early 1900s to drain "swamps" in order to "reclaim" those land areas, population growth will lead to increased pressures to develop lands such as floodplains. A lack of attention to these valuable resources could ultimately lead to the irreversible loss of habitat, species, and natural linear corridors that are essential for all species.

Many of our current actions in floodplains cause both adverse impacts to our flood protection as well as to the natural environment. Practices that encourage floodplain encroachments typically transfer the flood risk to others as well as resulting in degradation of habitat and species.

Perhaps the most disturbing trend is the declining productivity of the nation's coastal waters and estuaries. This decline, although episodic in some cases (that is, due to natural phenomena), may be more directly related to environmental impacts such as point and non-point source pollutants, loss of habitat, and over harvesting. Considering that the nation's economy is fundamentally a function of its natural resources, this decline in productivity may well be indicative of a serious potential threat to the nation, and at the same time suggests that we have not fully considered the opportunity costs associated with activities that lead to the demise of these resources.

Since the early 1900s the nation's water resources policy has been focused on investments to bring about growth of the nation's economy. One only needs to look to the western expansion over the past century to appreciate the degree to which these investments have in fact expanded the economy, but often at the expense of the environment. Now, in 2007, it is time to consider whether leveraging water resources development at the expense of the environment is good future economic policy. Just as farmers learned that to optimize agricultural returns it was necessary

to rotate crops and employ conservation practices, the nation's water resources may similarly be leveraged to the point that lack of conservation and restoration will ultimately undermine the ability of the nation to benefit from its water resources.

Current environmental programs in the floodplain are primarily in place to regulate activity that affects the environment, with very little consideration given to managing or enhancing the resource. Although these programs are important, they attempt primarily to reduce the extent of the impact, and do little to restore degraded areas. At best, programs such as Section 404 of the Clean Water Act cause developments to avoid environmentally sensitive waters not necessarily to protect the environment, but rather to avoid the permitting process. The Corps' 2007 revision to the rules for Nationwide Permits under Section 404 increased the number of categories of proposed actions that are no longer required to be individually reviewed, diminishing the careful scrutiny of potential adverse impacts on wetlands and related resources. Further, a series of recent Supreme Court rulings reflects a growing intention within the Court to narrowing Section 404 jurisdiction rather than broadening it. Although there is much debate on the actual impact of these rulings on current programs, what is clear is that the Court has become fairly evenly split between those who would choose to sustain current authorities and those who prefer to narrow them. Should program narrowing be accomplished, either by ruling or by perception, the potential for severe degradation of riparian zones and some types of wetlands most certainly will result. Most at risk will be those states that have no wetland or riparian zone management laws or programs.

An investigation of the natural and beneficial functions of floodplains in relation to flood loss reduction was mandated by Section 562 of the National Flood Insurance Reform Act of 1994 and subsequently FEMA established a task force and published the report, *Flood Loss Reduction: The Natural and Beneficial Functions of Floodplains*. Little else has been undertaken by Federal Emergency Management Agency (FEMA) in this policy area.

During the 1990s both the Natural Resources Conservation Service and the Corps of Engineers undertook promising programs for the management of natural resources and functions. The Natural Resources Conservation Service began to emphasize the purchase of long-term conservation easements for floodplains and wetlands. This has been an important tool that has led to protection of critical resources. Currently, however, the long term viability of this program is in question. Population growth is encroaching on key agricultural production areas and recent price increases for corn (driven by ethanol production) are leading to increased pressures to bring more land under production. The long-term concern is whether conservation easements will be sufficiently funded to compete with what appears to be a significant upward trend in crop prices. Likewise, it may be time to consider alternative practices for floodprone lands that both provide environmental benefits and can be harvested for biomass production—such as prairie grasses or willows.

In the 1990s the Corps gained authorities for restoration projects, began to look at nonstructural alternatives including setback levees as part of the P.L.84-99 program, and undertook significant restoration work in several locations as directed by Congress—the most notable of which was the Everglades restoration project. Currently the Corps faces two apparent problems in these program areas.

First, economic methods as bounded by the *Principles and Guidelines* continue to dictate that environmental benefits be monetized. But it is unclear whether adequate sophistication in quantitative approaches exists to provide input on the direct impact to the economy of natural resource conservation or to adequately reflect human preferences and choices. Further, it is unclear whether the lower-impact but more sustainable benefits of natural resource conservation can in fact compete with higher-impact economic development strategies within the *Principles and Guidelines* framework as currently implemented unless such “competition” is bounded by policy statements. There is a fine line between resource stewardship that provides for the economy and resource exploitation that ultimately undermines an economy; unfortunately for the nation, there is no apparent means of taking this into consideration during project-specific evaluations.

Second, the Corps has gained authority for restoration projects, but no priority for these efforts in appropriations. In spite of the long-term need to engage in more environmental restoration, unless there are dedicated funds established for restoration projects, traditional projects will continue to gain the most support during appropriations because of the short-term financial gains that they produce.

Numerous steps must be taken to begin to ensure the protection and restoration of floodplain and coastal functions and resources.

- The Council on Environmental Quality and the White House should convene a national study on the impacts of water resources development on the environment, and the extent to which environmental degradation is threatening the nation’s economy.
- Based on the results of the study, the Council on Environmental Quality and the White House should engage in a national policy dialog on the environment and the economy and, if appropriate, reformulate a statement of federal interest for water resources investment more heavily weighted towards environmental management, sustainability, and restoration than towards economic development.
- Congress should establish a national riparian zone policy. This is needed to clarify the importance of, and the steps needed to protect, maintain, and restore the areas along our rivers and streams so that they can not only provide their natural benefits to today’s population but also survive as sustainable ecosystems into future generations. A first step would be recognizing the multiple benefits of riparian zones for habitat, water quality, flood protection, recreation, cultural resource protection, and others. This would help to shape program interaction and clarify the need for holistic management.
- Congress, along with the Environmental Protection Agency and key stakeholders, should consider whether clarifications to Section 404 of the Clean Water Act are needed to ensure protection of vital wetlands and riparian zones.
- Congress should establish and fund a dedicated appropriation within the Corps’ budget specifically for environmental restoration projects, which would not compete against traditional water resource development projects. Separate prioritization of projects would be developed that consider both economics and national goals of resource restoration and conservation. This should be funded from general funds but should

also examine the concept of user fees for environmental restoration where feasible for existing water resource projects such as ongoing waterway and port operations, federally operated water and power projects, and new federal water resources projects including programs of emergency repair.

- The Natural Resources Conservation Service should be directed by Congress to evaluate conservation easements and determine the viability of these programs in the face of potential escalations of crop prices, coupled with the concept of considering restoration strategies that might meet both conservation and biomass production needs for the nation.
- FEMA should be directed by Congress to undertake a study of the Letter of Map Change process to determine whether it adequately protects the natural floodplain system or is silently encouraging the demise of these resources.
- As part of its floodplain mapping program, FEMA should collaborate with the Environmental Protection Agency, the National Oceanic and Atmospheric Administration, and the U.S. Fish and Wildlife Service to produce resource mapping of the nation's floodplains. As part of future federal investments in the floodplain, a resource management strategy should be developed as part of the preferred plan.
- The Corps, in cooperation with other agencies and economic and resource experts, should evaluate the best means to properly assess environmental resource benefits, including methods to monetize these benefits and perhaps other qualitative factors that reflect current inability to monetize all benefits.
- National emphasis should be placed on protecting and maintaining the natural storage capacity of suitable areas within all watersheds. If runoff from uplands is not addressed, downstream floodplains simply continue to expand, and increased flood damage is inevitable. This goal can be approached through development regulations, wise agricultural policies and practices, easements for temporary flood water storage, and preservation of natural areas.
- Continuous buffer zones along rivers, streams, coasts, and smaller waterways need to be encouraged. The Continuous Conservation Reserve Program could be converted to a permanent nationwide easement program for riparian buffers. In addition, new initiatives to create permanent floodplain easements should be explored, perhaps through the Wetland Reserve Program.

DATA AND TECHNOLOGY

The passing of each flood illustrates more clearly that the nation's floodplain management field is technology rich, but data poor. Adequate data is vital for the decisionmaking processes that determine the most sustainable development approaches for an area, or the most prudent flood mitigation project.

Gathering and Storing Data

The 1992 study *Floodplain Management in the United States: An Assessment Report* (Federal Interagency Task Force on Floodplain Management, 1992) emphasized that there was no system for accurately and systematically estimating flood damage nationwide. That lack is even more painfully obvious today. No agency at the federal level has the task of defining "floods," defining "damage," or accumulating flood damage data. It is not possible to evaluate a program's effectiveness without measuring its results in dealing with the problem. The nation does not yet have a good handle on addressing this, and we cannot hope to get one, without better data on flood damage, costs, and risks.

At present no single entity has the responsibility for collecting and storing data about flood- and disaster-related matters. The ASFPM believes that the federal government should take responsibility for collecting the kinds of data that benefit the entire nation and for which significant economies of scale can be realized, such as streamgaging and flood mapping. Although states and localities will use the data, and supplement it, national standards and support for collection and archiving are essential.

- A comprehensive, nationwide database should be established with information on the costs of disasters, costs and benefits of mitigation measures, and other pertinent information.
- The database should accumulate information based on stream reach or shoreline, rather than on geopolitical boundaries, as the Corps of Engineers did in its National Shoreline Study.

Data for Local Mitigation Plans

Communities do not have sufficient data to develop adequate mitigation plans. Neither National Flood Insurance Program (NFIP) claims data nor data on damaged properties are circulated regularly or provided to appropriate state and local personnel immediately after a flood disaster. This makes it all too easy to overlook mitigation opportunities for the damaged structures just at the time when property owners are most open to such possibilities. This information is equally valuable for pre-disaster mitigation planning and community comprehensive development plans.

- Information on damaged structures gathered by federal agencies, their contractors, and others should be provided as it is generated, and made easily accessible to state and local personnel after a disaster.
- Information on disaster assistance, damage to community infrastructure, flood-related repair costs, and mitigation expenditures should also be provided to state and local personnel in "real-time" (as the expenditures are authorized and the data is collected).
- NFIP claims information should be made more available to states and communities. It is

recognized that the privacy of the people with flood insurance needs to be protected. A process should be established whereby certain entities (non-profits, research institutions, etc) would be provided the information with the provision that “private” portions of the data be treated as confidential. In addition, the data should be aggregated by census block and zip code (so that privacy would be protected) and made available on FEMA’s website. If necessary, Congress should amend the Privacy Act to make such limited uses permissible.

- FEMA should establish an online database of state and local hazard mitigation plans. This would facilitate state and federal review of the plans, streamline the process of updating them, and make the plans and supporting information more widely available.
- Open source tools for estimating flood damage should be developed. FEMA, working with the National Institute of Building Sciences, has developed a tool (HAZUS) for estimating damage. However, the fact that the source code is not available severely limits the ability of communities and states to use and enhance it.
- Flood zones developed for digital Flood Insurance Rate Maps should include flood depths and water velocities. Flood insurance rates should be established based on this information so that the cost would more accurately reflect the risk.

Number of At-risk Structures

The number of structures in the flood hazard areas of the nation is not accurately known. Information on the number and location of at-risk structures is a necessary part of developing a national strategy for reducing or insuring flood losses through the NFIP and through taxpayer-funded programs, such as the Disaster Relief Act and Hazard Mitigation Grant Program. Such an undertaking could be implemented through the Community Assistance Program, by using consultants, or other measures.

- Accurate data on the number of floodprone structures, the number and location of dams and levees, and population at risk throughout the nation must be collected and made readily available.
- An accurate count of the number and locations of structures in and near (e.g., within 100 feet of) the floodplain and all structures protected by levees should be required for participation in the NFIP and as part of state and local mitigation plans done under the Flood Mitigation Assistance program, the Hazard Mitigation Grant Program, and Community Rating System applications.

Hydrology

Flood modeling and resultant maps are only as accurate as the hydrological data that underlies them. Vigilance is needed in maintaining and upgrading existing systems for such data collection.

- The U.S. Geological Survey (USGS) should automate data inputs and update its regression equations. In addition, the USGS and the Corps should work with the National Weather Service to more effectively utilize Doppler radar rainfall data.

- Future-conditions and cumulative impacts should be incorporated into the identification, mapping, and regulation of flood risk areas under the NFIP. The future conditions should account for changes in the watershed, its floodplain, and its hydrology; climate change and variability, including sea level rise; subsidence; and other similar phenomena that alter future flood risk.
- Congress should fund updates of the National Weather Service's Regional Rainfall Frequency Curves.

River Discharge

A key piece of data needed at all levels of government for accurate flood mapping, prediction of flood flows, flood warning, and other activities is river discharge from an adequate network of stream gages throughout the nation. Historically, the most comprehensive and reliable data has been the stream gage network of the USGS. Unfortunately, this network has slowly been shrinking as federal funding to the USGS itself decreases, and the budgets of other federal agencies, states, and localities (who collectively maintain about half of the gages) are reduced. Thus we are losing—where not already lacking—the basic data from which to develop flood level and risk calculations as well as flood warnings to prevent loss of life and protect communities. This is particularly troublesome because continuous, long-term records are essential for accurate forecasting—interruptions in the record can never be filled.

- An expanded national network of stream gages should be federally funded through the USGS's budget. This network is critical for providing U.S. citizens with flood warnings and identifying and communicating flood risks. These gages provide baseline information that should be collected and maintained by the federal government. States and other organizations that use the information should help secure this funding.
- The USGS, working with the states, should keep the list of the critical network of index gages updated and show the loss of gages.
- The USGS should develop mechanisms so that local government flood warning systems information could supplement their stream gage data.

Sharing Information

According to FEMA, the most important lesson learned from Hurricane Katrina in 2005 was the need to improve “communications—the sharing of information.” The devastation caused by Katrina was so extensive that first responders had no street signs or local landmarks to get to people needing rescue. Local government offices with mapping information and data sets were destroyed. The maps, aerial photography, and data generated by the private sector were copyrighted and could neither be shared nor easily integrated with other maps and data.

An industry standards consortium (the Open Geospatial Consortium) has established technical communications standards for improving data exchange. Delivery of geographic information in an “OGC-compliant” manner will ensure that data and maps being served up by a web-based mapping application can be seamlessly integrated with other geospatial data and maps.

Information is further enhanced when communities make their mapping data available free through these OGC services. In the aftermath of a disaster, manual fee and license-based requirements can slow disaster response, putting people and property at risk. This situation can be improved by establishing open user agreements and using interoperable data access protocols before a disaster. However, they often depend upon key people being reachable after a disaster. Hurricane Katrina demonstrated that reaching the individuals identified in the user agreements may not always be possible, thus rendering them unusable.

- All federal agencies should ensure that all data they and their contractors collect are in the public domain.
- If a license agreement is the only option, FEMA should ensure that State NFIP Coordinating Offices, NFIP participating communities, and all potential stakeholders (e.g. the Mapping Coalition and the proposed Technical Mapping Advisory Council) be included in the license agreement.

FLOOD MAPPING

Flood Insurance Rate Maps, produced and distributed by the Federal Emergency Management Agency (FEMA) in conjunction with the National Flood Insurance Program (NFIP), are critical to the management and planning of floodplains. They serve as a key planning tool for communities and states by demarcating areas subject to flooding, providing the basis for determining the depth and velocity of the flood hazard for floodplain regulations, and identifying flood insurance rates to be charged.

Although the majority of floodprone areas of the nation are mapped, studying and re-studying those and unmapped areas, revising, and producing maps is an ongoing process. In addition, on-the-ground conditions change continually, often at a rate that outpaces federal capacity for mapping the flood hazard areas. In 2003, Congress funded a multi-year effort—the Flood Map Modernization initiative—through which FEMA is updating Flood Insurance Rate Maps, digitizing existing paper maps, and developing procedures for producing all future maps in digital form. Even when the current Map Modernization initiative is completed, however, thousands of stream miles across the country will require restudy, and others will never have been mapped. In addition, communities that are growing and/or facing development pressure in floodplain areas will need their maps updated frequently. To improve the utility and effectiveness of flood maps, several changes should be considered.

- FEMA should work with the Administration and Congress to obtain funding beyond the current sunset of the Map Modernization initiative for ongoing mapping and maintenance.
- The Technical Mapping Advisory Council should be re-instituted to resume its role of providing guidance to FEMA on implementation of Map Modernization. Consideration should be given to using future development conditions for hydrologic and hydraulic calculations to determine flood elevations; setting up a process to map developing areas quickly; requiring developers to perform the necessary engineering studies before construction of large developments; and identifying other hazard areas on the flood maps, such as levees, dams, subsidence zones, and erosion-prone areas.
- Continued funding for map programs is crucial. The NFIP cannot and should not be expected to pay for flood hazard maps whose use far exceeds the provision of flood insurance rate information.
- Congress should authorize and fund a multi-agency effort to produce topographic maps for the entire country using LiDAR and other modern techniques, with the U.S. Geological Survey as the lead agency. Accurate topography depictions with at least a 2-foot contour interval (1-foot in some areas) are essential to produce effective floodplain maps. The cost of such mapping would likely be in the \$5 billion range, and will be an investment in the future that will provide many benefits beyond floodplain management, including support for federal, state, and local infrastructure; military needs; development; and environmental protection.
- States that are qualified to perform and administer floodplain mapping programs should be delegated the authority and funding to administer and manage flood mapping for FEMA under its Cooperating Technical Partners Program. This will develop skills and

program presence in the states, serve as a magnet to develop other sources of revenue for floodplain mapping, and ensure that future maps will be updated and maintained.

- The federal agencies, in collaboration with states, localities, and the private sector must find clearer ways to communicate flood risk on maps and otherwise, so that it is meaningful to citizens and communities, thus enabling them to take appropriate steps to reduce risk and damage.
- No matter what their location with respect to identified Special Flood Hazard Areas, structures for which a certain number of flood damage claims (perhaps two) have been paid should be mapped and insured as floodplain properties. This includes flooding from stormwater.
- A better way should be found to determine flood risk for flood insurance purposes, so that information useful for community planning and floodplain management can be left on flood maps.
- All floodplains should be mapped all the way to the upstream source of flow.

Revisions and Amendments to Flood Maps

A number of short- and long-term options need to be explored to simplify and clarify the flood hazard map amendment process. Currently, there is an assortment of amendments available with confusing applicabilities and procedures. Changing and/or making more specific the name of the exception being granted would help avoid sending an unintended message, i.e., that the property is no longer subject to regulation or to flood risk.

Developers sometimes add fill to the surface of a piece of land before constructing buildings upon it. Because they have raised the elevation of the surface of the property, they can obtain approval for removing the property from the official “floodplain” and hence from regulations and flood insurance. Once such approval is obtained from FEMA through a Letter of Map Change (of which there are several types), buildings may legally be constructed on that land with their lowest floors below the base flood elevation.

- FEMA should evaluate ways to eliminate the use of Letters of Map Revision (issued after the use of fill or the modification of a channel to alter the floodplain) to avoid the purchase of flood insurance. The most direct approach would be to discontinue the practice of waiving flood insurance after issuance of a Letter of Map Revision based on Fill. Properties for which a Letter of Map Revision based on Fill is issued would have flood insurance premium rates based on the risk.
- States or communities with approved capability should be delegated the authority to review Letter of Map Revision submissions and certify their reviews. Communities could be delegated such authority provided that implementation occurs through the state or the state concurs that the community can act directly.

Future Conditions

Flood discharges for a watershed typically are calculated based on current runoff conditions and past floods. But urbanization tends to increase both the quantity of runoff and the speed at which it reaches downstream properties and communities, thus worsening flooding over time. Because of this, floodplains need to be managed not to the conditions of the past, but according to the conditions that will exist when the area is fully “built up.” This will reduce the cost of remapping, minimize future damage, and improve sustainability.

- Future-conditions and cumulative impacts should be incorporated into the flood identification, mapping, and regulation of flood hazard areas under the NFIP. The future conditions should account for changes in the watershed, its floodplain, and its hydrology; climate change and variability, including sea level rise; subsidence; and other similar phenomena that alter future flood risk.

Areas Subject to Special Hazards

Several types of flood hazards are not adequately addressed on FEMA’s flood maps. The mapping techniques used seldom reflect the true flood hazards in areas subject to ice jams or those that experience uncertain flow path flooding (alluvial fans, overland sheet flow areas, pothole lakes, sediment flow streams, aggrading and degrading channels, and migrating channels). In these types of areas the boundaries of the floodplain itself fluctuate as the channel moves or the lake level rises or falls. This poses special challenges for useful mapping because constant updating of the maps would be necessary to ensure that the flood hazard is always accurately depicted.

- There needs to be full integration of geologic hazards into the floodplain mapping process, because land subsidence, landslides, mudflows and other geologic phenomena can exacerbate flood hazards as demonstrated in New Orleans, Galveston, and Houston.

Maps and Structural Projects

Flood Insurance Rate Maps are used to plan future development and help advise individuals about flood risks. The current practice of modifying a Flood Insurance Rate Map to reflect the presence of a levee, dam, channel, or other structural measure fosters a false sense of security to those living in the area protected by these structures. Dam- and levee-failure zones—areas that will be inundated when the flood control structure is breached or overtopped—are rarely mapped. Thus, local officials and citizens often forget that floodplains protected by dams are still at risk from flooding. This omission also promotes constricting the channel, the loss of riparian zones, destroying floodplain characteristics, and ultimately leading to higher flood stages (and potentially increased damage) downstream. Options need to be evaluated that reflect how Flood Insurance Rate Maps and resulting management tools could be modified.

- Flood hazard maps should be developed that depict all related hazards, for example, the failure zones of all dams, levees, diversions, and reservoirs. Not only is this identification important for notification and warning purposes, but also development in these zones should have added flood protection, and flood insurance should be mandatory, with rates based on the residual risk.
- All development proposals should provide added flood protection for facilities that are built in dam and levee failure zones.

- The Corps and FEMA should continue the effort already begun on a trial basis to inventory all levees in the nation and develop a GIS database that includes the general condition of levee, the number of people and structures “protected” by the levee, and the provisions for its operation and maintenance.

Engineering

Engineers rely on principles, physical “laws,” theories, empiricisms, and practices to help them quantify a natural system for purposes of analysis or design. However, in spite of all the analytical sophistication applied, there is always a degree of uncertainty associated with the engineer’s ability to accurately quantify the system under consideration. Some of these uncertainties and ways to address them are discussed below.

Hydrologic and Hydraulic Models

One area in which uncertainty is always present is in the accuracy of the modeling used to generate predictions of flood levels and the geographic extent of flooding. Progress in this area has been dramatic over the past few decades. The existence of the Corps’ Hydrologic Engineering Center as a national leader and single point of contact has been beneficial to the advancement of this technology. However, constantly changing conditions require continued vigilance and improvement of techniques.

- More accurate and flexible engineering models must continue to be developed that reflect unsteady state flow conditions, levee breaches, split flows, and hazards of unstable land forms and debris flows. Efforts should be made to make engineering models available publicly and more easily understood by non-engineers.

Review of Risk-based Analysis

Engineers have dealt with uncertainty in a variety of ways, but most frequently by adding a safety factor that accounts for design uncertainty. In floodplain management this safety factor historically has been called “freeboard,” and is actually based on hundreds of years (or more) of experience with flood risk reduction measures, such as levees and dams.

Beginning in the early 1990s the Corps of Engineers decided that by using sophisticated statistical methods it might be possible to quantify uncertainties and risk. Thus it would no longer be necessary to incorporate a standard approach of adding freeboard to all designs or considering freeboard when evaluating the performance of existing facilities.

Accordingly, the Corps developed and implemented a technique known as “risk-based analysis” (RBA). Simply stated, RBA uses sophisticated modeling techniques that generate hundreds of scenarios that consider and accumulate the uncertainties associated with various design parameters. From the outset, the ASFPM had significant concerns about the use of this technique. These concerns did not necessarily imply that continued use of freeboard was a better long-term approach, but rather that the departure to RBA was abrupt, had significant policy ramifications, and had not been sufficiently vetted outside of the Corps. Some specific concerns about RBA included:

- RBA employs the Monte Carlo simulation—an advanced simulation technique of which the Corps’ application apparently had not been independently reviewed.

- RBA requires that the engineer understand and quantify preferably all, but at a minimum the most significant, individual uncertainties that surround all aspects of the structure's design (the hydrology and hydraulics as well as geotechnical, structural, and other physical parameters) along with any operational and maintenance exigencies. The ASFPM had and continues to have reservations about the extent to which anyone, especially those who must use the techniques, can adequately understand these uncertainties and the extent to which uncertainty distributions can be adequately "fit" to a given field application.
- RBA results are complex, are a departure from a standards-based world in which a structure either meets a given design standard or does not, and could promote bad decisionmaking by uninformed users if not properly bounded by policy.

A specific concern raised by the ASFPM was how RBA was to be applied to the certification of levees for purposes of the NFIP. FEMA and the Corps negotiated an approach that bounded the lower end of what constituted an acceptable level as a 90% non-exceedance probability for the 100-year flood. (The Corps later affirmed this approach in the National Research Council evaluation described below.)

The end users of RBA are communities that receive flood control structures to protect the lives, health, and property of their citizens. Few, if any, decision makers at the local level understand RBA, yet they are the ones who decide what level of protection the community will fund. In almost all cases they rely on the technical staff of the Corps to tell them if the structure is "safe," with no independent understanding of what that level of safety represents.

Because of these concerns, the ASFPM urged Congress to instruct the Corps to seek an independent evaluation of RBA by the National Research Council (NRC). This resulted in a study by the Water Science and Technology Board of the NRC, completed in 2001. The study reached 25 conclusions with multiple recommendations. In general, the NRC was favorably impressed by the direction in which the Corps was heading with RBA, but at the same time it shared the ASFPM's concerns about the method and the manner in which individual uncertainties were being evaluated. In an October 26, 2001 letter to Stephen Parker of the NRC, the Corps responded to the NRC observations and described future actions that the Corps would undertake to improve RBA.

RBA has profound implications for how flood protection facilities are designed and evaluated. On the positive side it can lead to "right sizing" structures for the anticipated risk. On the negative side, internal biases in the method or lapses in approach (if they occur) could lead to faulty decision making, some of which could result in costly and catastrophic structural failures during a design event for which the structure should have provided protection.

The ASFPM remains cautious about RBA, viewing it as a promising method that is still under development. Ongoing and frequent evaluation of RBA during the next 20 or more years of its development and implementation is essential to ensure that the approach leads to a high degree of confidence in the resulting characterizations of risk and uncertainty. Further, the Corps has accumulated more than five additional years of experience in the development and deployment of RBA since the first NRC review. An extended period of evaluation also will allow time for field results to be gathered that will test and validate the application of the method, and allow for an ordered

and cautious movement, where appropriate, from the use of freeboard to the use of risk-based approaches.

- Congress should direct and fund the convening of another NRC panel to evaluate results from the application of RBA in the field to date, the degree to which the Corps has incorporated the recommendations of the previous NRC panel, and the implications of any recent advances in the field of risk analysis. Due to the complexities of RBA, the NRC is one of the few entities qualified to conduct independent reviews and provide solid recommendations on the use of the technique.
- Based on the findings of the NRC evaluation recommended above, the Corps should determine whether (or in which situations) its RBA approach is the best way to quantify uncertainties.
- The Corps and FEMA, in cooperation with other agencies as part of the Interagency Task Force on Floodplain Management, should evaluate the appropriateness of using some combination of design standard, freeboard, and RBA constrained by a high non-exceedance probability for those situations in which the failure of flood protection structures such as dams and levees will have catastrophic consequences (primarily high-density urban areas, such as New Orleans). The NRC committee also may wish to comment on this issue in the new evaluation recommended above.

Adoption of New Technologies

In the current age of computerized mapping techniques and geographic information system (GIS) based maps, FEMA should place emphasis on utilizing these technologies when producing FIRMs. Significant resources are currently designated for printing paper maps at the completion of a digital floodplain mapping project. Efforts should be made to amend this process to allow for “print on demand” of FIRMs. This could significantly (25–30%) lower the cost of producing and/or storing FIRMs. This amended procedure will better serve local communities because as FEMA’s Letter of Final Determination is issued to a local community, the map panels may also be issued (without waiting for printing). This gives a local community the best opportunity to adopt its maps. When delivering preliminary maps to local communities, digital versions of the maps should be delivered as well.

- All flood maps should be digital. The automatic provision of paper flood maps to communities by FEMA should be eliminated in favor of issuing digital maps, and localities given the option to have maps printed if desired.

MITIGATION OF FLOOD LOSSES

Mitigation is defined as taking steps to eliminate or reduce the long-term impacts of hazards. There are two broad mitigation approaches, which can be used alone or combined. “Nonstructural” measures are used to make existing and future development more resilient to flooding or to preserve (or restore) natural floodplain functions so that developed property is not affected. Some nonstructural techniques include regulations, zoning, buyouts of floodplain properties, construction standards, and protecting or restoring streams, floodplains, and wetlands. The second mitigation approach is the “structural” one. In general it seeks to prevent the advance of flood waters, usually through an engineered measure such as a dam, levee, or floodwall. Mitigation can be applied to the built environment such as neighborhoods, public and private buildings, and infrastructure; and to the un-built environment, such as agricultural areas and other open spaces. In fact, mitigation techniques and approaches for built and un-built areas differ significantly—and the most effective mitigation is that which prevents flood losses in the first place. Finally, mitigation has been referred to as the “cornerstone” of contemporary emergency management in the United States because it underpins and influences decisions made in preparing for, responding to, and recovering from disasters.

The ASFPM is a leading advocate in the nation for the promotion of nonstructural flood loss reduction measures, while recognizing the need for structural mitigation measures, in more limited circumstances and only with careful planning. Although the United States has been experimenting with structural flood control measures for well over 150 years, nonstructural measures are a more recent phenomenon. It was not until the philosophy that humans must adjust to floods promoted by such thinkers as Gilbert F. White and Jim Goddard that the nonstructural era of floodplain management began. White advocated, where feasible, the adaptation to or accommodation of flood hazards rather than the structural solutions. By pointing out the drawbacks of structural approaches to flooding, White ushered in a new era of flood mitigation, where nonstructural works are integrated with structural works to reduce the impact of flooding.

Although progress has been made in the use of nonstructural mitigation measures, the balance between such measures and structural measures is not yet optimal and still far from integrated. After the 1993 floods on the Mississippi River, the use of nonstructural measures such as acquisition and demolition of floodprone buildings, strengthening building codes and floodplain management ordinances, and relocation of floodprone communities and infrastructure was unprecedented in scope. However, the results were mixed because at the same time, in areas around St. Louis for example, levees were strengthened and increased in size—thereby inducing at-risk development. Hurricane Katrina was a potent reminder of the false sense of protection structural flood control measures provide and the limitations of sole reliance on them. In the aftermath of Hurricane Katrina, we are faced with decisions not unlike those faced a decade earlier in terms of mitigation.

Integration of structural and nonstructural mitigation approaches can be effective. For example, channels and levees often are built to contain river flows, but these structures cut off human access to the river and also can result in unexpected and potentially catastrophic damage when the structures are breached or overtopped. A more balanced approach could be to build the levee, but site it farther away from the river, allowing more space for natural conveyance and storage of flood waters. Then, this protection would be supplemented with nonstructural techniques such as purchasing and removing buildings that are too close to the water, requiring other buildings (those

in the flood fringe) to be elevated, keeping the vacated land in public ownership, and requiring the purchase of flood insurance by those who occupy the area behind the structure. This combination of structural and nonstructural measures will reduce flood losses, preserve and maintain natural riparian functions, and provide recreation opportunities and public open space.

The nation's citizens and policymakers have not yet fully recognized the inherent limits of existing statutes and prevailing policy to curtail excessive flood damage. Under current laws and procedures, new structural projects can be authorized for largely agricultural areas. Mandatory flood insurance zones are removed from risk areas behind "certified" levees. There is an over-reliance on benefit/cost analysis and its inherent biases, which preclude broader use of nonstructural measures. In consequence, the nation faces a continuation of the dismal cycle of losses, partial protection, further induced (though marginal) development, and more unnecessary losses. Action can and should be taken to change this situation by emphasizing the wide array of nonstructural approaches that are available to mitigate flood losses, and by finding ways in which they can be combined with existing structural projects to yield a more balanced approach. Successfully applied, mitigation contributes to both flood resiliency and long-term sustainability.

Nonstructural Measures

Nonstructural mitigation measures are efforts to manage the use of floodprone land so as to curb damage from the flooding that can normally be expected to occur. These approaches are based on a longer-term and more holistic view of flooding and the watershed. Nonstructural techniques can be a highly effective, low-cost method of damage prevention. The mitigation needs vary from community to community and nonstructural mitigation techniques vary accordingly. For example, a rapidly developing community may need to invest heavily in techniques such as planning and code enhancement, while an older or built-out community may focus on making existing at-risk development and infrastructure more resilient to flooding or on restoring floodplain lands or wetlands. In many communities development in floodprone areas can be completely prevented. Development investments elsewhere in the community will return similar or increased benefits to the nation and community, without the costs and consequences of catastrophic flooding.

One of the concerns that have dogged nonstructural mitigation in the past—especially in Congress—has been the belief that we cannot really know if mitigation is cost-effective. A report by the National Institute of Building Sciences has now demonstrated conclusively that nonstructural hazard mitigation is cost-effective (Multihazard Mitigation Council, 2005). In fact, the report found that the average flood mitigation project returns five times as many future benefits as it costs. With this respected report, it is hoped that the concern of mitigation project cost-effectiveness has finally been settled.

Nonstructural mitigation measures have increased in popularity and status. Perhaps the most important federal policy was the passage of the Disaster Mitigation Act of 2000. That legislation, which amended the Stafford Act, established requirements for states and community to adopt hazard mitigation plans and tied FEMA mitigation funding to the development and adoption of such plans. Thus, in the past six year a significant planning effort has been underway across the nation. All 50 states and U.S. territories have developed state plans and over thirteen thousand communities have adopted local mitigation plans.

Federal Mitigation “Project” Programs

Many federal agencies have programs or provide funds to implement nonstructural mitigation projects. The majority of these programs address existing, at-risk development. These types of projects generally encompass acquisition/demolition of flood prone buildings, elevating them, retrofitting them to provide either partial or full protection, floodproofing, relocation of buildings and infrastructure, or stormwater management projects. Although the Federal Emergency Management Agency (FEMA) is the most widely known and has the most programs available to fund such projects, other agencies, such as the Corps of Engineers, also have such funding available. The Department of Housing and Urban Development often provides supplemental funds after disasters that can be used for nonstructural mitigation. Other federal agencies such as the Economic Development Administration, and the Natural Resources Conservation Service provide resources for certain types of mitigation projects. The availability of a range of programs is encouraging; improvements could be made through the following two steps.

- Institutional arrangements for delivering nonstructural programs after a disaster (modeled after those used after the Midwest floods) should be made permanent. This has been done to a great extent, but it should not be allowed to backslide.
- A sliding cost share should be considered, so that a community or state that is undertaking mitigation activities would receive a more favorable cost share for mitigation projects than those that are not.

The Corps has the authority under its flood control programs to consider and implement nonstructural mitigation projects to reduce flood damage; however the path to accomplish these projects is circuitous and difficult. Although the Water Resource Development Act of 1999 authorized the Corps to undertake a nonstructural initiative known as Challenge 21—Riverine Ecosystem Restoration and Flood Hazard Mitigation, Congress never appropriated funds for it. The following measures are recommended to enhance the Corps’ ability to implement nonstructural mitigation programs.

- Permanent authority by which the Corps can carry out nonstructural projects should be established and funded. Although nonstructural alternatives are theoretically feasible under current authorities, the nonstructural projects brought to fruition to date have been pushed by knowledgeable individuals fully committed to their implementation.
- Internal, systemic biases need to be removed from the Corps’ program guidelines and benefit/cost analyses so that nonstructural alternatives can move forward on their own merits.
- Congress should modify the cost-sharing ratio that is applied to Corps’ projects so that all nonstructural projects receive a larger federal share—a 75/25 federal/non-federal ratio—while the existing 65/35 ratio would still apply to structural projects.
- Although the Corps has been given some flexibility to study nonstructural mitigation projects and mitigation planning through its Flood Plain Management Services and Planning Assistance to States programs, Congress has consistently reduced the federal appropriations for these programs. Authorizations and funding for these programs should be increased.

FEMA has the most extensive portfolio of nonstructural mitigation programs. The Hazard Mitigation Grant Program (HMGP) is the only post-disaster program in FEMA's stable of mitigation programs. Under this program, after a federally declared disaster, mitigation funding, up to a specific percentage of the total damage amount from that disaster, is made available for mitigation. Over the last 10 years, this percentage has varied from 20% to 7.5% (20% is available only to a state or territory that has an enhanced mitigation plan).

FEMA also has several funding programs not contingent on a federal disaster declaration. The National Pre-Disaster (PDM) provides funding for projects similar to those allowed under HMGP; however, funding is made available annually, based on Congressional appropriation. The Flood Mitigation Assistance (FMA) program was born through the National Flood Insurance Reform Act of 1994. The FMA program raises \$50 million every year for flood mitigation planning, project, and technical assistance grants to states. Two programs created after the 2004 Flood Insurance Reform Act are the Repetitive Flood Claims program and the Severe Repetitive Loss program, but they end in 2009. These programs target buildings that have had a history of repetitive flood claims for mitigation. Increased Cost of Compliance is an additional coverage available under a flood insurance policy that can be used to pay for the "increased costs" that property owners would have for coming into compliance with their community's floodplain management ordinance. Finally, mitigation available under FEMA's Public Assistance Program (406 mitigation) can assist with mitigating affected infrastructure, such as roads or critical community facilities directly damaged by a flood.

The ASFPM offers the following recommendations to enhance these mitigation programs.

- Post-disaster funding through the Hazard Mitigation Grant Program should be retained at 15%. When reduced to a 7.5% formula program from 2003 to 2006, many mitigation opportunities were missed during the time that prospective participants are most willing to mitigate—after a disaster. The incentive-based approach, through which states willing to undertake "enhanced" state mitigation plans receive a more favorable 20% level, has been successful and should be maintained.
- Rules must be written to implement provisions of the Disaster Mitigation Act of 2000 and the Flood Insurance Reform Act of 2004. Outstanding rules to be written include the delegation of administration of the Hazard Mitigation Grant Program to states, Severe Repetitive Loss program rules, and rules related to making Increased Cost of Compliance more widely accessible.
- A realistic grant application process and timeline must be developed that is consistent among all of FEMA's mitigation grant programs. For the past several years, unrealistic grant application timelines have hampered many communities from developing project applications. In addition, impediments from within the programs precluded extensive planning for future projects.
- Several changes are needed in the benefit/cost analysis methods FEMA is required to use. First, the data and methods need updating, including the depth damage functions. Second, there must be an exploration of utilizing additional classes of benefits that are obviously not counted, such as injuries avoided, environmental protection, and recreational opportunities.

In addition to the need for rules implementing legislated changes to Increased Cost of Compliance (noted above), other options to use Increased Cost of Compliance, such as at the Director's discretion and for uses in the best interest of the Flood Insurance Fund should be explored.

- The expanded usage of Increased Cost of Compliance funds to include properties that have not been substantially damaged, and those that have been substantially damaged by a non-flood event should be studied.
- FEMA should release an annual report on Increased Cost of Compliance detailing the funds expended and what was accomplished with them.

Planning

Planning for flood risk reduction has been propelled into greater prominence as a result of the Disaster Mitigation Act of 2000 and the ASFP's no adverse impact initiative. Before the planning requirements of the Disaster Mitigation Act, local mitigation projects were often implemented in a haphazard way and without coordination with any type of local plans. The mitigation planning now required at least forces entities wishing to implement FEMA mitigation projects to do so in the context of a larger community plan. Still, more can be done. On the scale of good, better, and best, undertaking mitigation planning would rate a "better" approach, while, incorporating the no adverse impact philosophy in planning and achieving holistic, integrated planning would be the "best" approach.

All Hazard Mitigation Planning. As a result of the Disaster Mitigation Act of 2000, states and communities nationwide must develop hazard mitigation plans to be eligible for mitigation funds of any type from FEMA. The planning process and plan elements required by FEMA as part of these mitigation plans are robust and should ensure plan longevity. All communities and states have either developed plans and will be facing the need to revise them, are just beginning to plan, or have not yet done so. This successful program could be made even stronger through these steps.

- Developing plan update guidance should be a high priority for FEMA. Such guidance should generally take the view that planning and updating mitigation plans is an iterative and long term process—while encouraging continuous improvement of the plans, the bar should not be set at an impossibly high level.
- FEMA should establish an online database of state and local hazard mitigation plans. This would facilitate state and federal review of the plans, streamline the process of updating them, and make the plans and supporting information more widely available.
- An independent evaluation of state and local hazard mitigation plans should be conducted, to determine whether they are actually guiding local flood mitigation activity or are merely shelved once the requirement is fulfilled.
- FEMA should train its field staff and contractors that work with Individual Assistance and Public Assistance to promote mitigation and incorporate into all-hazards mitigation plans.

Comprehensive Planning through the No Adverse Impact Approach. Comprehensive planning, zoning, and subdivision control are a local government's primary land use tools. The comprehensive

plan is the result of a process that involves many local departments, business people, landowners, developers, and citizens. Out of the process emerge policies that reflect local values and concerns and can serve as a foundation for the community to address floodplain management. The no adverse impact floodplain management approach should be part of the overall planning and decisionmaking process. No adverse impact standards that are incorporated into a community's zoning ordinances, subdivision regulations, building and health codes, and special purpose ordinances build on that foundation by anticipating the impacts that a proposed development could cause elsewhere in the watershed, now or in the future, on existing development or facilities or on floodplain resources, open space, or other values that the community seeks to protect. If impacts are identified, then the process provides for mitigation measures that reduce or prevent negative impacts.

- FEMA should require that all state and community all-hazard plans, comprehensive plans, and special area plans include goals, strategies, and actions to analyze the potential for future adverse impacts on flooding and floodplains, the degree of impact, and measures to mitigate these future adverse impacts. This requirement also should be incorporated into federal incentive based programs such as the NFIP's Community Rating System, and local/state mitigation plan update requirements.

Building Codes

Progress has been made on the incorporation of standards for flood-resistant construction in the International Building Code and International Residential Code. Events such as Hurricane Katrina have pushed states like Louisiana to require the adoption of these International Codes. The ASFPM believes that incorporation of standards for flood-resistant construction in these codes is a major step forward in implementing floodplain management at the local level. In particular, it will help ensure that building officials become involved in that part of the floodplain management process that deals with how buildings are constructed. Additional professionals thus will be brought into the floodplain management partnership.

- Extensive training and education efforts should be undertaken, targeted toward both code officials and floodplain managers. Both groups need to become aware that building codes and the land use requirements embodied in floodplain management ordinances must be fully integrated in order to produce an effective local flood loss reduction program.
- Steps should be taken to encourage states and/or communities with unique hazards or long term-vision to implement standards beyond those found in the International Codes.

Refining National Flood Insurance Program Development Standards

At the time they were developed, the NFIP and its regulations represented a political compromise. Although FEMA's analyses indicate that the NFIP yields over \$1 billion in damage avoided to the structures built to those standards, those structures are not even likely to be protected to the 100-year flood in the long term. Why? Although it is critical that we have a standard, or multiple standards nationally for protection, the concept of a probabilistic floodplain (such as the 100-year) is based on a relatively short history of flooding and rainfall, hydrologic calculations that have a significant inherent error, and other variables such as future development that are not accounted for in calculations to determine flood heights or velocities. For example, in Mecklenberg County

North Carolina, studies concluded that the current 100-year flood elevation increased by between 4 and 7 feet when future development conditions and the floodway surcharge were considered. To further prevent future flood damage, the following changes to the NFIP regulations should be implemented.

- The NFIP requirements should require that new construction have from 1 to 3 feet of freeboard above today's estimated base flood elevation. This would acknowledge and mitigate uncertainties, account for increased runoff caused by climate change and future development, allow for wave action from the wakes of rescue boats, and provide a margin of safety for wind-induced wave action on wide flooded areas. It also would result in significantly reduced flood insurance rates for owners of such buildings.
- An alternative to a standard freeboard requirement would be to use some sort of confidence limit in the determination of flood peak flows. Under current procedures, all statistical analysis of river flows and regional analyses are done and then a 50% confidence limit is applied to the estimate. That means that it is acknowledged that the estimates of 100-year peak flows are low 50% of the time and high 50% of the time. Using the 90% or 95% confidence limit instead would rationally increase those estimates so that there would be fewer "surprises." Consideration should be given to using a 90% confidence limit with one foot of freeboard or a 95% confidence limit with no freeboard.
- A no-rise floodway with no impact on water surface and velocity should be required, so that *only* those areas of insignificant hydraulic conveyance could be filled. Allowing cumulative filling of the floodplain until a 1-foot increase in base flood height is achieved (the current standard) causes additional flood damage on other owners' properties in the floodplain, increases downstream flood peaks, and promotes the filling of riparian zones that would be valuable natural resources if left undisturbed. In addition, FEMA standards for a Letter of Map Change that allow rises even beyond one foot should be revised to minimize community liability and ensure that no takings are occurring where flood heights have been increased on undeveloped land.
- FEMA should evaluate ways to eliminate the use of Letters of Map Revision (issued after the use of fill or the modification of a channel to alter the floodplain) to avoid the purchase of flood insurance. The most direct approach would be to discontinue the practice of waiving flood insurance after issuance of a Letter of Map Revision based on Fill. Properties for which a Letter of Map Revision based on Fill is issued would have flood insurance premium rates based on the risk.
- New construction of critical facilities should not be allowed in the 100-year floodplain.
- FEMA should develop more detailed floodplain management standards for the siting and construction of critical facilities. This should begin with a definition of which facilities are considered "critical," and require that they be protected from and accessible during the 500-year flood. When new critical facilities are constructed, at least the primary access route should also be at an elevation at least equal to the level of the 500-year flood to avoid the facility's being isolated during a flood. (It is recognized that additional work must be done to improve estimates of the 500-year flood.)

- Future conditions and cumulative impacts should be incorporated into the identification, mapping, and regulation of flood hazard areas under the NFIP. This includes watershed, hydrologic, floodplain, climate variability, subsidence on other similar phenomena that alters future flood risk.
- Consistent and effective guidance (or a rewrite of the regulation) needs to be developed for implementing 44 CFR 60.3(c)(10), which requires consideration of the cumulative effects of proposed development on water surface elevations. It is either being ignored by most communities or inconsistently applied.
- A floodway analysis should be required for all subdivisions and large scale developments proposed for floodprone areas, in addition to developing 100-year flood data as required by NFIP standards. Additional consideration should be given to lowering the thresholds of the number of lots and acreage that trigger this requirement.
- Conversion of unfinished areas below the base flood elevation to finished floor space continues to be a problem. Processes to ensure continued compliance with “enclosures below the lowest floor” standard should be instituted nationwide. A pilot program is being conducted in Monroe County, Florida, to address this issue. The pilot program should be evaluated and standards developed for a program that could be the basis for a national standard.

Integrating Stormwater Management and Flood Loss Reduction

Local stormwater management programs range from small programs that oversee a community’s stormwater management infrastructure to large integrated programs that manage stormwater for both water quality and quantity. Stormwater management programs can play a significant role in reducing localized flood damage, especially in areas subject to future development, and have the potential to make an even greater positive impact in the future. Unfortunately, current federal and state programs for stormwater management and for flood loss reduction are delivered through two completely distinct mechanisms, and there is little to no coordination between them. At the local level where integrated programs are implemented, staffs are often split between the two areas or have to juggle the different programs.

Municipal Separate Storm Sewer System.

In 1990, the Environmental Protection Agency promulgated rules establishing Phase I of the National Pollutant Discharge Elimination System stormwater program. The Phase I program applied to medium and large Municipal Separate Storm Sewer Systems (MS4s). In 1999, rules were established for Phase II of the program, which applied to small MS4s. The Phase II rules require local stormwater programs be developed that incorporate six program elements: public education and outreach, public participation, illicit discharge detection and elimination, construction site runoff control, post-construction runoff control, and pollution prevention.

Although a tremendous opportunity exists under MS4 programs to manage both water quality and quantity (which is the aspect that results in flooding), unfortunately these programs tend to focus on water quality to the exclusion of most other considerations. This is not productive policy. Effective stormwater management techniques help to limit increases in impervious surface, thereby decreasing the quantity and velocity of stormwater runoff and minimizing flooding. For localities

to be able to integrate stormwater management and floodplain management effectively, state and federal programs need to be coordinated. For example, the State of Washington is using its authority delegated by the Environmental Protection Agency to manage runoff from the 100-year chance flood, which will have a major positive effect on future flooding.

- There should be more emphasis at the federal and state levels on integrating the flood loss reduction and water quality components of stormwater management.
- FEMA and the Environmental Protection Agency should co-sponsor a forum to look for ways to integrate their respective programs and thereby facilitate a more holistic approach at the state and local levels.
- All demonstration projects funded through FEMA's Hazard Mitigation Grant Program and through the Environmental Protection Agency's Watershed and Section 319 Nonpoint Program should take into consideration both flooding and water quality.
- Critical facilities should be required to consider both the mapped flood risk as well as quantify the watershed-based runoff that affects their site.
- All federal and state programs should encourage infiltration to reduce storm runoff.
- All federal and state stormwater programs should incorporate the no adverse impact concept into their planning and management strategies, so flood loss reduction is considered in all development in the watershed.

Structural Measures

Structural mitigation measures can include dams, levees (including floodwalls), diversions, groins, seawalls, channel modifications, and others. Structural mitigation projects are generally large-scale public works or engineering efforts to manage and control water to reduce damage from high water discharges. Although they reduce damage from frequent nuisance flooding, these control structures in many cases have encouraged development in "protected" areas and can raise questions about legal liability for resulting damage (see Thomas, 2006). This scenario creates a unique potential for catastrophic losses in the event of failure, design exceedance, or eventual removal or decommissioning of the structure. As a consequence, once a flood control structure is built, society must forever bear escalating operation and maintenance costs. In addition, since economic considerations dictate that structures be built only to a certain level of protection (rather than to provide complete protection for every foreseeable scenario), events exceeding that level can occur and damage will be greater than it would have been even without the structure, because in the meantime no complementary nonstructural measures (regulations, setbacks, insurance) were applied. In most of these cases, the federal taxpayer picks up the costs of the damage caused by that failure and usually the costs of repairing the structure. Externalizing the costs of structural measures in this way contributes to a bias at the local level towards using structures instead of more sustainable approaches.

To achieve the most comprehensive solution to flood losses, structural and nonstructural measures need to be used in ways that complement each other and avoid over-reliance on engineered solutions. However, there are disconnects and even conflicts between the programs for structural

projects (primarily within the Corps) and those for nonstructural and mitigation approaches (primarily within FEMA). This situation has prompted FEMA and the Corps, with the support of the ASFPM and the National Association of Flood and Stormwater Management Agencies, to work toward improved coordination between the two agencies, both at national and regional levels. A number of issues need attention on this front, including how both sets of programs address flood insurance coverage, rates, and requirements; levee design, construction, certification, and safety; the effect of the availability of post-disaster relief; and residual risk behind dams and levees.

- Structural projects should be used as a measure of last resort and only after other measures, especially nonstructural ones, have been considered. Structures should not be used as a means to facilitate the development of floodprone lands.
- Congress and the Administration should adopt a policy that the 500-year level of protection is the minimal design standard for all structural measures for purposes of flood insurance and other federal investment. It is recognized that additional work needs to be done to improve 500-year estimates.
- Benefit/cost analysis is an appropriate tool with which to evaluate and contrast federal projects, but it should be bounded by a strong public safety design standard, which for federally supported structural projects should be the 500-year level of protection.
- Federal investments in levees should not be made for a structure that provides less than 500-year protection, and the Corps of Engineers planning process of maximizing the NED should explicitly incorporate this public safety standard as a lower boundary for federal investment.
- Structures providing less than 500-year protection, but meeting all the requirements to be recognized by federal programs as providing 100-year protection, and that are currently recognized as fully meeting that safety standard, could be provided grandfathered status. This would allow flood insurance in the “protected area” to be eligible for preferred risk rates. Criteria should be developed to determine when and if protection provided by a specific levee would need to be upgraded and how that would be achieved. For example, the grandfathered status could continue until a claim for federal funds (repair or rehabilitation from the Corps, disaster payments, or flood insurance claims for failure or overtopping) at which time the structure must be upgraded to 500-year standards and meet all associated requirements.
- Any adverse economic, social, or environmental consequences resulting from the construction, rehabilitation, or reconstruction of any structural measure must be mitigated.
- Non-federal owners of structural measures must be required to demonstrate long-term financial and technical ability to carry out operation and maintenance tasks for the life of the structure—before the project is approved, constructed, re-constructed, or recognized as providing a certain level of flood protection. Further, both federal and state oversight and enforcement of the adequacy of ongoing operation and maintenance must be in place and enforced.

- FEMA should require that all communities with a NFIP-recognized structure (such as a dam or levee) have a multi-hazard mitigation plan and an emergency action plan that consider how other hazards affect the structural measure (e.g., earthquake, subsidence, river sedimentation, erosion, etc.) with action steps to account for any of these factors that affect the safety of the structure. FEMA should require that this plan be updated at least every five years, including any changes in flood flows based on increased watershed development. The potential for catastrophic consequences of failure or overtopping of the structure should be included in the planning, design, regulatory, and insurance considerations.
- All federal agencies should agree on definitions of levees and other structures that reduce flood risk. The definitions should take into account the structure's function, level of risk, and associated vulnerabilities.
- Flood hazard maps should depict the failure zones of all dams, levees, diversions, and reservoirs. Not only is this identification important for notification and warnings, but also development in these zones should have added flood protection in the form of appropriate development standards, and flood insurance should be mandatory. This accounts for the potential for the catastrophic consequences of failure of the structure.
- Communication of the residual risk associated with structures, including dams, levees, diversions, and reservoirs, should be an explicit component of all aspects of proposed and current structural projects. It should include notification to all property owners of the risk (e.g., a notice in an annual water bill or tax bill) and other steps such as posting signs in all land areas "protected" by structures stating clearly that the area is protected by structures that may fail or be overtopped, that the area is a floodplain, and with indications of the depth of flooding when the structure fails or is overtopped. Communication to the property owners should provide clear information on their role if an evacuation is ordered.
- FEMA and the Corps should evaluate and eliminate practices that cause increased flood damage or that lead to induced flooding (the transfer of flooding to other property that is primarily open space) unless property owners specifically agree to this intrusion of flooding on their property.
- When the construction, repair, or reconstruction of a structural measure is contemplated, consideration should be given to incorporating nonstructural measures into the protection system and to preserving existing natural functions to avoid adverse impacts to the natural system. During repair or reconstruction impaired natural functions should be restored to the maximum extent that is practical to account for past adverse impacts.
- Plans for structural projects must be developed from a watershed- or basin-wide perspective to determine appropriate, complementary structural and nonstructural approaches; the true long-term costs of maintenance; design elements that would account for cumulative impacts of the presence of the structure; the ecological and recreational benefits of nonstructural options; and ways to protect natural functions and resources.

- A concerted effort must be made to estimate the useful life of existing flood control structures nationwide, and to make plans for a comprehensive program of maintenance, inspection, replacement, and removal as warranted.
- The Corps, FEMA, and their stakeholders should continue efforts to coordinate policies and programs to provide more comprehensive and cost-effective flood risk management.
- Congress should include in the next Water Resources Development Act provisions that require expensive or controversial proposed Corps projects to be independently reviewed and also subject the Corps to the same wetlands mitigation standards as other federal agencies.
- The liability of owners of structural flood control projects, such as levees and dams should be communicated to the owners of those structures on a periodic basis.
- FEMA, the Corps, and their non-federal partners should establish a joint work group to assess ways to enhance the performance of levees, set appropriate levels of protection, and develop consistent guidance on planning structural measures.

Levees

It is apparent from the catastrophic flood damage caused by levee failures in New Orleans after Hurricane Katrina and from other instances that, over time, the nation has gradually and imprudently modified its various policies that affect levees and levee failure. Further, no national program for ensuring the safety of levees exists. The outcome is an unacceptably high risk of catastrophic levee failure and the resultant damage and costs at numerous sites across the United States. A position paper prepared by the ASFPM contains a useful discussion of national levee safety (ASFPM, 2007).

The ASFPM believes that levees (1) must be designed to a high standard; (2) must be maintained and inspected; (3) should be used only as a method of last resort for providing a LIMITED means of flood risk reduction for existing development; and (4) should not be used to facilitate the development of currently undeveloped floodprone lands.

- FEMA and the Corps, along with other federal water resources agencies, should revisit and revise the definition of levee so that it includes elements of function, risk, and vulnerability. The Federal Interagency Task Force on Floodplain Management is one potential vehicle to undertake this task.
- The Corps should be tasked as the lead agency to develop and maintain a comprehensive inventory of current and future levees. This would start with federal levees and ultimately include non-federal and private levees. It should include the numbers of people and buildings at risk.
- The area that would be inundated when a levee fails or is overtopped or when internal drainage systems are overwhelmed or incapacitated should be mapped as a residual risk flood hazard area and depicted on Flood Insurance Rate Maps.

- Emergency action plans that address flood warning and evacuation should be required for all residual risk areas behind levees in order to protect lives and minimize property damage. These plans, and the periodic exercise of them, should be a requirement of any federal or state program that recognizes the levee as providing protection.
- Flood insurance and appropriate development standards should be mandatory for all structures in the failure zones associated with all dams, levees, diversions, and reservoirs, with rates based on the residual risk.
- Levees should not be constructed in floodways. To the maximum extent possible, levees should be set back from rivers when they are constructed or reconstructed. This will allow the river to function more naturally, provide more space for flood water storage and conveyance, reduce flood stages elsewhere, reduce the costs of maintenance and risk of failure because the levee is not exposed to as much high-velocity flow, and provide for the protection or restoration of riparian and wetland resources between the river bank and the levee. Clear guidance should be established about the type and amount of vegetation that is consistent with proper levee maintenance.
- The design of levees should include improved methods of providing resiliency, most notably the inclusion of designed fail-resistant spillways built into the levee so that when the levee design is exceeded, excess flow spills through that area, preventing catastrophic overtopping or failure of the structure.
- Written guidance and training is needed on what constitutes a “proper” inspection and what is needed for certification to allow the NFIP to recognize the levee and what the actual consequences are to the levee owner if the levee is not properly maintained to meet these requirements. This guidance should be developed jointly by the Corps and FEMA to be consistent with each agency’s existing guidance.
- A federal policy should be clearly articulated and implemented that the certification and inspection of levees is the responsibility of the levee owner and that transferring this responsibility to the federal government is inappropriate. The requirement that participation in federal programs of repair, insurance, and disaster relief is contingent on levee owner compliance with these elements should be strictly enforced.
- A state-administered national levee safety program is needed to protect federal interest in public health, safety, and fiscal responsibility as well as to protect public safety and costs related to levees not in the federal system. It must be fully integrated with state and local programs of flood risk management, especially floodplain management and dam safety, and should use a state delegation model similar to that used to implement the Clean Water Act, rather than function as an independent program like the existing National Dam Safety program. State capability in this area is critical and must be developed most effectively through federal legislation that provides incentives and disincentives for states to accept delegation for the development and implementation of effective state levee safety programs.
- Congress should fund the National Research Council to engage experts to evaluate and

propose modifications to the standards for levee design, operation, and maintenance. This project should include a review of previous National Academies reports, and the extent to which previous recommendations have been addressed.

Dam Safety

Many of America's dams have exceeded their intended lifespan, are in critical need of repair, and pose a serious safety risk. The American Society of Civil Engineers has noted that "an alarming number of dams across the country are showing signs of age and lack proper maintenance. Downstream development is increasing. Dam safety officials estimate that thousands of dams are at risk of failing or are disasters waiting to happen" (American Society of Civil Engineers, 1998) According to the American Society of Civil Engineers, more than 200 dam failures have occurred in the past 10 years. Approximately 9,200 regulated dams are categorized as high hazard, that is, their failure will likely cause significant loss of life and property. Thirty-five percent of these dams have not been inspected since 1990 or before, and estimates for the cost of rehabilitation reach \$1 billion nationwide.

Ownership of dams and other flood control works historically has been dedicated rather haphazardly to local sponsors that may or may not have had the interest or ability to maintain the facilities. Often, easements were granted for access and inundation that in today's legal climate would be viewed as highly informal and even unenforceable. Under the Dam Safety Program it administers, FEMA has urged the voluntary adoption of minimal inspection and maintenance standards.

- States have the legal basis, but need incentives to develop strong state dam safety programs. The federal agencies could encourage such state action by tying significant cost shares for federal programs like disaster relief or other cost-share programs to credit the adequacy of a state's dam safety program.
- Dam failure zones should be shown on Flood Insurance Rate Maps.
- Zoning below dams should be tied to failure zones to prevent low-hazard dams from becoming high-hazard ones.
- Flood insurance should be mandatory in the zones that would be inundated after the failure of a dam.
- Dams that cannot be appropriately maintained should be removed. Federal agencies should provide incentives to encourage states to remove such dams.
- When an older dam is being evaluated for safety and repair needs, consideration should be given to whether the dam is still needed, whether some or all of its functions could be economically replaced by nonstructural measures, and how the impacts of the dam on the river ecosystem could be lessened. Federal agencies should provide incentives to encourage states to adopt such evaluation procedures.

Aging Structural Projects in Small Watersheds

Beginning in the late 1940s, the U.S. Department of Agriculture's Soil Conservation Service (now called the Natural Resources Conservation Service), states, and local communities began building

small watershed dams for flood control and sediment detention across the United States. Today, some 11,000 dams, located in 46 states and part of 2,000 watershed projects covering 160 million acres, are seriously aging, and many are beginning to reach the end of their designed 50-year service life. Similarly, the Small Watersheds Program promulgated many miles of agricultural levees, although specific data on these levees was not readily available for this report. When these projects were built, the federal government relinquished all responsibility to the non-federal sponsors, usually local flood control or soil and water conservation districts.

Currently, one-half of these dams are over 30 years old, and the Department of Agriculture estimates that over the next 10 years more than 1,300 of them will reach the end of their life expectancy. Due to siltation, many have lost much of their original sediment and flood storage capacity already, thus not only do they not provide flood protection but many pose significant safety hazards. Proposals have been made to provide new federal authorization and funding to rehabilitate these dams at 65% federal expense. Federal legislation passed in 2000 provides NRCS the authorization to assist with rehabilitation projects. In a number of cases, however, rehabilitation may not be the most cost-effective or beneficial approach and also may not be an appropriate federal responsibility. Many of these dams have outlived their original purpose, or the cost of rebuilding them greatly exceeds the benefits that would be derived.

Adding to the problem is that many of these structures were turned over to local sponsors that had little capability or experience in maintaining structures such as dams or levees, that had no ability to regulate or control development, and that had limited resources or capability to raise funds to ensure long-term operations and maintenance of the facility. As a result, many of the dams need expensive spillway modifications due to increases in downstream population, replacement of outlets that have been corroded, modification of the dam embankment due to changing geotechnical conditions such as subsidence, or upgrades to replace components of past design that have proven inadequate. Similarly, some agricultural levees had been accredited by the NFIP as providing 100-year flood protection, and currently there is a renewed focus on ensuring that these structures can be certified.

There is a need in both NRCS and Corps programs to revisit the operation and maintenance programs and capabilities of the local sponsors, ensure that needed maintenance and certifications and licensing is being undertaken, assist the local sponsor when appropriate to broaden the maintenance of the structure to be more inclusive of entities and individuals benefiting from the structure, and if adequate maintenance can not be assured, to initiate actions to decommission or otherwise mitigate for potential catastrophic failure.

- Any program for addressing aging projects in small watersheds should include a watershed-based, multi-objective planning process to assess the full range of structural and nonstructural approaches for water management in the entire affected basin. The process should review the purposes of the project and identify options for rehabilitation, re-operation, replacement, decommissioning, and/or removal of structure to help assure that actions taken will be in the context of contemporary watershed needs.
- The Natural Resources Conservation Service and other federal agencies should provide technical assistance, if requested, to analyze options for addressing the aging dams in small watersheds.

- Congress should carefully consider what the appropriate federal role should be with regard to the future of these aging small watershed dams.

Mitigation Support Systems

Although mentioned in various places elsewhere in this document, there are several support services or systems upon which mitigation decisions and policy depends.

Building State Capability

With the advent of both pre-disaster mitigation programs that develop and implement projects and mitigation planning, mitigation has become a year-round commitment for both states and communities. Yet there is no provision for dedicated, ongoing funds for hazard mitigation at the state level except for state management and administrative costs when a project is awarded by FEMA. Although a portion of Pre-Disaster Mitigation Program funds is now guaranteed to states with eligible applications, there is still a gap where there is a need to build state capability to manage and oversee mitigation efforts.

- A partnership arrangement should be developed, modeled after the NFIP's Community Assistance Program, but strengthened to allow for the development of permanent state capability to implement and manage mitigation programs.
- Federal agencies need to provide training for state and local officials in the application procedures for mitigation funding.

Streamgaging and Flood Hazard Mapping

Flood mitigation projects and plans are reliant on flood data. The hazard identification/risk assessment portion of a mitigation plan depends on flood maps and detailed flood elevation data to assess where hazards exist and to what extent they will affect an area. Flood mitigation projects depend on these data to determine cost-effectiveness and formulate the proper mitigation solution.

- Federal hazard mitigation programs should recognize the importance of streamgaging and flood hazard mapping and allow program funds to be used for data development when necessary.
- Federal, state, and local governments all need to work toward the provision of necessary funding to support the U.S. Geological Survey in its streamgaging program.

Effectiveness of Mitigation Techniques

With hundreds of millions of dollars being spent annually on hazard mitigation activities, there must be a robust system of research into and evaluation of effective mitigation programs and techniques, with the results of that research incorporated into the ever-evolving body of mitigation policy and guidance materials. Results of such research also should be made widely available for dissemination to the practitioner community. At this time, there is too little investment in this area. Finally, it is critical that there be a mechanism by which mitigation successes can be quantified. One of the reasons that the analysis of FEMA's hazard mitigation programs undertaken by the Multi-Hazard Mitigation Council (released in 2005) was so important was that it was the first comprehensive assessment ever of these programs. Ongoing program assessment and monitoring is essential.

- Every 3-5 years, an independent assessment of hazard mitigation programs should be conducted to determine their cost-effectiveness, review innovations, and summarize ongoing research on hazard mitigation techniques.
- FEMA and other federal agencies should collect and disseminate stories of success in hazard mitigation

AGRICULTURE POLICIES

Floodplain management means both managing flood losses while at the same time managing and conserving the natural and beneficial functions of floodplains. The nation's agricultural policies have a direct impact on both of these objectives.

The ASFPM has often reported on the escalation of flood damage within the nation and continues to believe that this is a serious threat. However, it is still not known precisely what proportion of overall flood damage is related to agriculture and what is related to urbanized areas. On a qualitative basis, there are benchmarks such as that provided by the 1993 Midwest floods, during which agricultural losses accounted for about 50% of the damage. At the same time, if flood losses are assessed on a per capita basis, they tend to be many times higher in agricultural states than in urbanized areas.

In past decades there was more of a sense of a comprehensive vision that combined floodplain management and flood loss reduction within the nation's agricultural programs. However, due to loss of funding, transitions in agricultural programs, and—perhaps most important—a loss of federal coordinating mechanisms, the floodplain management component of agricultural programs seems to have lost its direction. This is problematic both in terms of managing flood losses and managing floodplains.

Over the last 15-years, programs for building dams and levees, such as that of the Natural Resources Conservation Service's Small Watershed Program, have given way to conservation easement programs, many of which are applied in floodplains and wetlands. These programs produce a double benefit because they eliminate or reduce economic flood losses while simultaneously promoting the conservation of open space and related natural functions.

However, these programs were successful primarily because crop prices were moderate and our ability to produce crops exceeded demand for them. This situation, which dominated the latter half of the 20th century, has changed and the new reality is likely to endure for the foreseeable future. That is, increased oil prices have resulted in a large demand for the alternative fuel ethanol, which is produced from grains or other biomass. In 2007 alone, this demand for grain for ethanol production has resulted in a three-fold increase in corn prices.

These higher prices will make it increasingly attractive for agricultural producers to put conservation lands, many of which are floodplains, back into crop production. The net result can only be significant increases in flood damage and the loss of natural watershed functions.

Thus there is an immediate need to evaluate agricultural policies and the degree to which they influence both flood damage and the conservation of natural and beneficial functions. This is particularly necessary since today's national agricultural flood policy appears to be a marginally functioning remnant of programs from the past.

- The National Research Council should be funded to undertake an evaluation of agricultural policies and their impact on flood losses and on the management of floodplain resources and functions. This may require a multi-phase approach that would include the identification and inventory of Department of Agriculture programs that have an impact on flood loss reduction; an inventory of conservation practices and projects; and finally an expert-level assessment of the current status of agricultural programs and their impact on floodplain management.

- Continued and enhanced funding should be provided for the popular and effective agricultural conservation programs that promote the protection and enhancement of the natural and beneficial functions of floodprone lands and of watersheds. Ways should be sought to refine and expand these programs so that floodplain protection is improved.
- The payments made under the Conservation Reserve Program and other agricultural programs that protect floodprone lands should be tied to the current market prices of commodities.
- Federal agencies should seek to better integrate the federal agricultural programs that can contribute to the reduction of flood damage with the federal programs of other agencies that seek to mitigate flood damage.

ARID REGIONS HAZARDS, RESOURCES, AND ISSUES

The arid regions of the United States present unique challenges to floodplain management. It is often incorrectly assumed that such areas face insignificant flood problems because they experience low annual rainfall. The reality is that flooding is a significant concern there because of the high-intensity rainfall on relatively unstable land surfaces. The result is that flooding occurs in areas where no well-defined channel exists and that dry watercourses can rapidly fill with water to create flash floods. Channels that for years occupied one location can shift hundreds of feet or more in a single flood event. And the flood's flow can range from water to mud. In addition, wildfires in arid regions tend to denude slopes so that subsequent precipitation runoff is dramatic and unpredictable. All these arid-region conditions combine to produce hazardous situations such as alluvial fans, debris and mud flows, flash floods, laterally migrating streams, among others.

The challenge to national policy presented by arid regions is threefold:

- These unique hazards are poorly reflected in national policies and programs.
- The ability of engineers and geomorphologists to quantify these hazards is complex, emerging, and in many cases falls far short of our knowledge base pertaining to other parts of the country.
- Explosive population growth in arid regions is leading to increased potential for significant flood disasters.

The following statistics illustrate the growth in the arid regions of the United States.

- From 1990 to 2000, all five of the fastest-growing states were in arid areas (Nevada, Arizona, Colorado, Utah, and Idaho). In 2005, Nevada was the fastest growing state for the 19th consecutive year. In all of these states, much of the increase was due to migration of residents from elsewhere in the country.
- According to U.S. Census projections, by the year 2030 there will be 12 million more people in California, 12 million more in Texas, 5 million more in Arizona, and 1 or 2 million additional people in Colorado and Nevada. All of these states have flood hazards that are either entirely or partially of arid-region character.

To exacerbate the challenges presented by population growth, many of the fastest-growing cities in the arid region states are expanding out of relatively stable valleys to steeper, more unstable areas in proximity to the city center. The Las Vegas area typifies this trend where, over the past decade, tens of millions of dollars of investments have been made in debris and flood water detention devices.

To prevent future flood disasters it will be necessary to tailor federal, state, and local programs to adequately reflect the unique hazards of the arid regions. For example, the NFIP regulations have sections devoted to alluvial fans, debris, and erosion, but little effort has been expended to map these hazards, essentially rendering the regulations meaningless.

Arid Regions Science

A prevailing challenge in arid regions is that our ability to quantify flooding, erosion, and debris flow impacts needs significant further development. There is a need for federal-state collaboration

to invest in and develop tools and techniques that allow for better quantification of these processes, occurrences, and impacts. The federal government has a critical interest in this effort, first because of the massive federal land holdings in the West that are subject to such impacts, but also because of the exposure the U.S. Treasury faces for escalating disaster damage.

Such a collaborative effort should include resource agencies such as the Bureau of Land Management and the U.S. Forest Service; scientific agencies such as the U.S. Geological Survey; and flood hazard experts such as the Corps of Engineers and FEMA. Due to the formative nature of this effort, collaboration with the National Research Council in developing a scope and vision may be warranted. In particular there is a need to consider not only how to quantify the hazard, but how to predict the impact of change agents such as wildfire or urbanization on these hazards. A further need is to evaluate the impact on arid region hazards of drought, climate change, and other factors that diminish perennial stream flow.

- Federal agencies should collaborate, with National Research Council direction, to develop tools and techniques to identify the processes, occurrences, impacts, and associated vulnerabilities of arid region hazards such as flooding, erosion, debris flow, and post-wildfire conditions.

Arid Regions Risk Identification

Hazard mapping in arid regions has for the most part been limited to traditional flooding. Some efforts have been made by FEMA to map alluvial fans, but again these techniques are still emerging. There is a need to expand risk mapping in arid regions to include erosion, distributary flow systems, post-wildfire conditions, and debris and mud flows. Unlike humid regions, the flood and flood-related risks experienced in arid regions can shift dramatically because the watersheds tend to be unstable. Federal policy, however, continues to treat all water bodies in the nation as being stable rather than dynamic—an assumption that is usually reasonable in humid regions but rarely so in arid ones.

- In cooperation with the U.S. Geological Survey and the Corps, FEMA should revamp the strategies it uses for flood risk mapping in arid regions.

Arid Regions Risk Management

Specific management strategies are rarely applied to arid region hazards. The management of erosion and debris flows is only considered in a few of the more sophisticated communities in the West. Techniques to manage alluvial fans were introduced some years ago by FEMA, with a one-size fits all philosophy, often ignoring the fact that there are many types of alluvial fans and pediments ranging from highly unstable to extremely stable. Without federal leadership through the NFIP, it is clear that arid region states and communities will continue to struggle with the management of these hazards, which will result in significantly increased exposure to the federal taxpayer.

- Federal agencies, particularly FEMA, should take the lead in developing effective management techniques and standards for the flood and flood-related hazards of arid regions. Management techniques should be tied to the nature and level of risk posed by the hazard.

COASTAL HAZARDS, RESOURCES, AND ISSUES

The coastal regions of the United States include some of the most diverse and dynamic environments on earth. The nearly 88,000 miles of U.S. ocean, estuarine, and Great Lakes shorelines exhibit a stunning array of physical, natural, and human diversity. Many coastal areas are low-lying and fringed by barrier beaches composed of unconsolidated sand, silt, and clay. Geologically, these barriers are young, extremely mobile, and easily modified by natural processes. Along the undeveloped coastlines weather events such as hurricanes, nor'easters, winter storms, El Niño-related storms, floods, tsunamis, and droughts constantly reshape shorelines by cutting new inlets, eroding some areas, and accreting new beaches in others.

Throughout the 1900s, public response to such coastal hazards as flooding, erosion, and hurricanes evolved haphazardly in response to particular disasters. Early dependence upon engineered shoreline protection ("hard structures") has been supplemented by building and land use regulations, flood insurance, and beach nourishment, among other approaches. Yet the situation today, far from being improved, is in fact more perilous.

Over the past few decades, the distribution of the U.S. population has shifted, so that now about 153 million people (53% of the U.S. population) live in the coastal counties. (By 2008, this population is expected to increase by another 7 million.) This has led to the potential for massive loss of life when a major hurricane strikes a heavily populated area. Even with a few days' warning, a coastal region's infrastructure (bridges, road capacity, highway elevations, etc.) may well be inadequate to evacuate the number of people at risk. What is worse, ever-more intensive coastal development puts more and more high-value property at risk, so that future disasters are certain to be unprecedentedly costly. Not only is population density on the coast increasing, but so also is the ever-expanding network of coastal infrastructure and nationally important industries—ports, power plants, petroleum refineries, fishing, and other water-dependent activities. Finally, that very development endangers the coastal resources (dunes, beaches, wetlands, mangroves, etc.) that attracted people in the first place—resources that, had they been left undisturbed, could have provided natural protection from coastal storms and other processes.

To complicate this situation, sea levels are rising because the changing climate both warms the oceans (causing thermal expansion of water) and melts the glaciers and ice caps. Global sea level is expected to rise from 7 to 22 inches by the end of the 21st century (Intergovernmental Panel on Climate Change, 2007, p. 13). The effects of thermal expansion of the ocean will vary with location and sea level will not rise uniformly over the globe.

Cost of Coastal Hazards

Disaster response and recovery costs have been steadily increasing over the past several decades. The series of coastal disasters in 2004 and 2005 demonstrated how ill-prepared our society is for the national consequences of dense, inappropriate, and poorly constructed development in coastal areas. In 2005, three Category 5 hurricanes traversed the Gulf of Mexico. Hurricane Katrina alone caused more than 1,300 deaths and more than \$100 billion in flood damage.

As coastal communities have continue to grow, the nation has experienced higher property losses, relief costs, more business interruptions and failures, social disruption, and natural resource damage associated with coastal hazards. Given the clear trends of human migration to the coast, burgeoning growth in coastal tourism, and dramatically escalating investment in hazardous coastal

locations, the prospects for controlling these costs are not good unless there is a dramatic change in the way the nation deals with coastal development and hazards.

There are numerous explicit and implicit incentives built into government policies at all levels that operate to encourage and subsidize this coastal development. With regard to flooding in particular, there is an implicit contradiction in national policy: building is essentially prohibited in riverine floodways (the most dangerous part of the floodplain), but in coastal velocity zones (those areas subject not only to high water but also to the energy of moving waves and storm surge) even residential buildings are permitted as long as certain construction standards are met. This is resulting in widespread and expensive development in highly hazardous coastal areas, which will in turn exposes federal taxpayers to high costs of disaster relief and recovery when disaster occurs. Significant shifts are needed in this and other of the nation's approaches to coastal hazards and resources.

Protecting Coastal Populations

In recognition of that fact that there appears to be no way to slow down the increase in coastal population, some improvements in emergency evacuation and warning systems have been made, along with roadway improvements. Much of this has been paid for via the Hazard Mitigation Grant Program administered by the Federal Emergency Management Agency (FEMA) and through hurricane programs funded by FEMA and the Corps of Engineers. There are tidal telemetry systems along many coastal access roads and causeways crossing bays to get to islands. This allows for real-time flood height data to be transmitted to emergency management personnel so that evacuations can be directed or redirected.

Since much of the population in many coastal areas is seasonal, in some states efforts have been made to educate non-residents through brochures explaining flood and storm hazards, evacuation routes, dos and don'ts, etc. Coastal real estate agents make these brochures available to renters. In some areas, coastal roads are required to be elevated when they are built or rebuilt after a disaster, making it more likely that they will be passable in a future evacuation. In spite of this progress, the mass evacuations along the East Coast during hurricanes from 1999 through 2005 demonstrated that the transportation network as a whole is not as capable of handling a large evacuation as had been previously believed.

- Federal programs should provide incentives to encourage coastal localities to make approvals of future coastal development contingent on the demonstration of adequate plans for and ability to evacuate the at-risk population, within a certain time frame.
- Flood insurance should be mandatory in areas subject to coastal storm surge.
- Federal, state, and local highway systems need to be planned and constructed with provisions made for mass evacuation from coastal areas.
- Cooperative efforts should be undertaken among the professional groups for floodplain management, emergency management, hurricane prediction, wind engineering, erosion prevention, resource protection, and others, for educating people and localities about the risks inherent to coastal areas, the natural resources and functions that need to be protected, and how to address those concerns.

Coastal Resources

The coastlines of the United States encompass natural and cultural resources that contribute to the coastal ecosystem and are beneficial to humans, such as habitat, wetlands, scenic beauty, historical assets, and open spaces. The natural features that characterize the coastal areas—dunes, beaches, estuaries, barrier islands, lagoons, and others—are vulnerable to human development and must be protected if they are to continue to support the coastal ecosystem. Various federal agencies and programs are targeted in whole or in part to the coastal areas, including the NFIP, the Coastal Zone Management Program of the National Oceanic and Atmospheric Administration, and various programs of the Corps. But degradation of these resources continues, with one result being loss of natural protection from coastal storms and flooding. To begin to remedy this situation, the following steps should be taken.

- A significant portion of the navigation fuel tax should be used for the restoration of coastal and aquatic habitat, and matched to appropriate authorities.
- More emphasis should be placed on enforcing the NFIP regulations that protect dunes and mangrove stands.
- Enhanced funding should be provided to the Environmental Restoration program of the Corps, and adjustments made to its cost-assessment analysis so that proposed restoration projects no longer routinely fail to meet the National Economic Development standard.

Coastal Barriers

The Coastal Barrier Resources Act of 1982 prohibited direct and indirect federal assistance—flood insurance, shoreline protection, water projects, highway and bridge subsidies, and other federal incentives to development—within specified undeveloped coastal barriers. The barriers so designated, along with those added since then, have become the protected Coastal Barrier Resources System. However, development continues on coastal areas outside the System, either without flood insurance or with private insurance. A recent report by the U.S. Government Accountability Office found that several federal agencies are failing to enforce adequately the restrictions on federal investment specified in the Act (U.S. Government Accountability Office, 2007). In addition there are constant political efforts to have certain designated barrier areas removed from the System so that development is not hindered by the lack of federal subsidies.

- Federal agencies must work with the states and localities to ensure that the standards set in the Coastal Barrier Resources Act are diligently enforced.
- Protected areas should not be removed from the Coastal Barrier Resources System.
- Additional federal and state funds should be devoted to purchasing or obtaining easements on coastal barrier lands in order to minimize high-risk development. Existing funding should be leveraged, particularly after a disaster.

Coastal Development and Construction

There is a serious question about whether construction—especially residential construction—should be allowed in very near-shore areas. But existing policies allow and even foster such development.

- Federal programs should support those coastal states and localities who opt to examine seriously the possibility of gradually “retreating” from the shoreline, not only to reduce the potential loss of life and catastrophic levels of damage from future storms, but also to preserve coastal resources, ecosystems, and processes.

Land use requirements and building codes for construction in the coastal zone are intended to minimize damage resulting from flooding, storm surge, wind, and erosion. However, merely meeting these minimum requirements does not guarantee protection from damage, particularly over the long term, and this is especially true with the advent of climate change and sea level rise. Nor do these minimum standards prevent adverse impacts from accruing to other properties or to the coastal resources.

At a minimum, construction and development standards for the coastal zone should be improved. Several issues need consideration, as detailed in the subsections below.

Cumulative Impacts of Coastal Development

Even though a single human activity in the coastal area may not seem to have much effect on the neighbor’s property or on the surrounding landscape, a series of small alterations on the ground has a significant detrimental impact over time. Cumulative impacts encompass the combined effects on legal, social, ecological, and physical systems. From a legal or regulatory perspective, issuance of a permit may establish a precedent, potentially facilitating the approval process for future requests for similarly situated structures. Another type of cumulative impact is the erosion-enhancing effect of some shore “protection” structures. The construction of one groin, or pair of groins, to hold a beach captive deprives the neighbors’ beach of sand transport. Flanking property owners are likely to respond by constructing their own groins, with a domino-like effect up and down the shoreline.

It is difficult to identify the point at which individual projects accumulate to an extent that threatens the valued properties of the shoreline. Some of the most significant cumulative impacts of coastal development are in the widespread losses of coastal habitats along estuaries, bays, and streams as well as on the beaches, dunes, and ridges. Finally, the natural protection afforded by barrier islands, beaches, ridges, and dunes is degraded by the cumulative impacts of coastal development.

- All planning required by federal programs should mandate an analysis of the cumulative impacts of proposed projects before development is permitted. Guidance should be produced and incentives established to make such provisions achievable.

The Threat of Coastal Erosion

The natural process of coastal erosion has been wearing away the beaches and bluffs along the U.S. coastal and Great Lakes shores from the powers of flooding, storm surge, rising sea levels, and high surf. As shorelines retreat inland, waterfront homes, public infrastructure such as roads, bridges, wastewater treatment facilities, and stormwater drainage systems eventually may become severely damaged beyond use, inhabitable, or surrender to the sea. The Heinz Center report, *Evaluation of Erosion Hazards*, predicts that over the next 60 years erosion may claim one out of four houses within 500 feet of the U.S. shoreline. Most of the damage will occur in low-lying areas subject to the highest risk of flooding, but coastal bluffs will also be susceptible.

Some states have begun to do a better job of identifying and mapping erosion zones in the last few years, with funding support from the National Oceanic and Atmospheric Administration, the Natural Resources Conservation Service, and the Corps. There is fairly widespread agreement among all stakeholders on these erosion problems. The real difficulty lies in how public policy should respond to erosion.

- A study of how long-term erosion could be incorporated into coastal floodplain mapping and into the NFIP should be conducted by FEMA, as mandated by Congress in the Flood Insurance Reform Act of 1994.
- The NFIP should be modified to provide an insurance policy benefit for coastal erosion and mudslides only where those hazards are clearly mapped and regulated.
- Coastal hazards, including erosion, should be managed based on conditions expected to exist 100 years into the future.
- An option favored by the ASFPM is the identification and mapping of areas subject to erosion and the application of an erosion hazard surcharge on NFIP insurance policies.

The traditional approach to erosion—using structures such as jetties, groins, and seawalls in an attempt to protect coastal areas from damage—typically leads to unanticipated adverse impacts both to development and to the coastal processes and valued ecosystem. Therefore, the use of other means to mitigate damage, such as setbacks or relocating buildings landward, is more appropriate in almost all situations. Further, any such projects that involve federal funds need to be analyzed to determine if they best meet national needs or are simply designed to foster local economic development.

- The use of hard structures to protect shorelines should be avoided, unless it can be demonstrated that no adverse impacts will result from the long-term presence of the structure and of similarly situated structures.

The recognized impacts of structures have caused a shift in focus from “hard” armoring of the coast (with jetties, seawalls, etc.) to “soft” armoring via beach nourishment. The Corps has been heavily involved in this, unfortunately often in response to intense lobbying from influential legislators and wealthy property owners.

Beach nourishment is almost always done to support a local economy dependent on tourism. It has been criticized as the “expensive solution” to erosion, since these projects are paid for by many but benefit relatively few, even when the benefits to ecosystem restoration and habitat enhancement are considered. In addition, the technique is only a temporary solution because periodic renourishment is required over the long term (Corps projects and agreements set forth a 50-year project life, with period renourishment every 3 to 6 years in most cases). Another concern is the acknowledged secondary impacts of these projects, namely induced development and redevelopment. The long-term impacts to other properties and to the environment should be considered, along with the costs. In no case, however, should the cost be borne by the federal taxpayers.

- For existing nourished beaches, national guidance is needed to determine when (if ever) renourishment is appropriate and/or in the federal interest.
- Beach nourishment should not be incorporated into the design of any federally funded projects.

Elevation of Buildings

The NFIP and many local construction codes require that residential development be constructed so that the first floor of a dwelling is elevated to or above the base flood elevation. However, many Flood Insurance Rate Maps do not show up-to-date base flood elevations. Structures that are built according to the minimum standards, therefore, are still likely to be damaged. A relatively minor increase (1 or 2 feet) in the elevation of the building's floor can translate to significant damage reduction over the long term and also serve to lower flood insurance premiums on that structure.

- The NFIP regulations should be modified to require coastal structures to be elevated above the minimum requirement by adding one to three feet (or more) of "freeboard" or additional structural elevation.

Setbacks

The closer buildings are sited to the water, the more likely they are to be affected by flooding, wave action, erosion, scour, debris impact, overwash, and high winds, which tend to be stronger along the coast. Repeated exposure to these hazards—even if the buildings are designed to reduce those impacts—leads to increased long-term costs for maintenance and damage repair, as well as to higher insurance rates. Simply siting buildings back a set distance from the water's edge allows for the natural protective systems to do their work and absorb or diminish wave impacts and other coastal energies.

- A national policy for setbacks for erosion, sea level rise, and other coastal hazards is needed. One option is that the NFIP require (or at least provide Community Rating System credit for) construction setbacks that account for the coastal conditions that are expected to exist 100 years into the future.

Use of Fill in Coastal Areas

Using structure-supporting fill to elevate buildings to or above the base flood elevation in coastal A Zones has been an accepted flood mitigation practice for both new construction and substantial repair or improvements to existing buildings. However, fill can cause stormwater runoff impacts in the vicinity of the elevated buildings, resulting in ponding and often inundating nearby properties. This problem is particularly troublesome in low-relief coastal communities, where flood elevations have increased over time as flood maps were updated and newer (post-FIRM) structures were constructed on fill placed to the new base flood elevations.

- The NFIP regulations should be revised to limit the use of fill to elevate buildings in coastal A Zones.
- The NFIP regulations should be revised to prohibit the use of fill for septic systems in V Zones.

V Zone Building Standards in Coastal A Zones

The FEMA 2000 *Coastal Construction Manual* defined an additional hazard zone—coastal A zone—not established by the NFIP regulations, defining it as that portion of the Special Flood Hazard Area of a V zone or landward of an open coast without mapped V zones (e.g. the shorelines of the Great Lakes), in which the principal sources of flooding are highly correlated with coastal winds or seismic activity. Coastal A zones may therefore be subject to wave effects, velocity flows, erosion, scour, or combinations of these forces that, while not as severe as those in V zones, are still capable of damaging or destroying buildings on inadequate foundations. The *Manual* recommends that buildings in coastal A zones be designed and constructed to be more resistant to coastal flood forces.

The NFIP requirements for V Zone structures state that a building must, among other requirements, be elevated on piers, piles, or other open foundation type, with the lowest horizontal structural component elevated to or above the base flood elevation. The areas below the base flood elevation are to be kept free of obstructions. This allows floodwaters and waves to pass beneath a building without transferring any additional loads onto its foundation components.

When structures cannot be sited away from these hazards, one of the most effective mitigation options available is to construct (or retrofit) buildings in coastal A Zones to meet V-Zone standards. The cost of doing so could be more than offset by the long-term benefits of lower insurance premiums and damage and disruption averted

- The NFIP regulations should be revised so that the V Zone is defined as the area subject to 1.5-foot storm surge (instead of the current 3 feet).
- The National Flood Insurance Program regulations should be revised so that buildings in coastal A Zones are subject to the same design and construction standards as those in V Zones.

The Threat of Subsidence

Subsidence is a lowering of the land surface that can result from numerous causes, including tectonic forces, consolidation of sediments, or the withdrawal of oil, gas, or groundwater from below the surface. Subsidence can increase the vulnerability of human development to hazards by resulting in greater inundation by floodwaters, increased wave heights, and loss of wetlands.

- FEMA should map subsidence and require or provide incentives for communities to create geographic information system (GIS) maps that overlay areas of subsidence, the rate of change, the land uses affected, and the political subdivisions involved. With this basic information communities can initiate programs to prevent and control activities to minimize damage. For example, the Harris-Galveston Coastal Subsidence District requires permits for the withdrawal of groundwater in an attempt to reduce excessive pumping and subsidence.
- FEMA should require communities to prohibit critical facilities from being located in subsidence regions, implement building codes that reduce the potential for damage as structures subside, locate utilities in a pattern that directs development away from regions of subsidence, and levy taxes and fees on the users that cause subsidence or build on lands that will subside.

- A national policy on subsidence is needed. One option is that FEMA map subsidence areas based on conditions at least 100 years into the future.

Flood Maps for Coastal Areas

Significant updates and remapping are needed of the coastal areas depicted on Flood Insurance Rate Maps, including V Zone and A Zone boundaries, and AO Zones. For those areas that have been remapped, the changes on the ground often have been found to be significant. In addition, there is a discrepancy between the definition of V Zones in the NFIP regulations, and the delineation of V Zone boundaries on the Flood Insurance Rate Maps. The maps need to catch up with the 1988 change in the definition of V Zone, based on primary frontal dunes.

- FEMA should map all coastal hazards on its flood maps, including erosion, subsidence, and storm surge.
- The National Oceanic and Atmospheric Administration, FEMA, and the Corps should cooperate to produce coastal bathymetric maps and integrate them with topographic maps of the coast. Both sets of data are needed to accurately calculate storm surge, wave runup, flood reach in coastal A Zones, and other coastal hazards so that maps and appropriate management techniques can be identified and implemented.
- FEMA should support Cooperating Technical Partners in delineating the areas of all coastal hazards on flood maps.
- FEMA should map subsidence and require communities to create GIS maps that overlay areas of subsidence, the rate of change, the land uses affected, and the political subdivisions involved.

Public Policy Disconnects

There are at least two explicit and implicit incentives built into national policies that operate to encourage and subsidize coastal development.

First, there is a major dichotomy in national policy for floodprone development, namely that nationwide, building is essentially prohibited in riverine floodways, but in analogous coastal areas (coastal velocity zones, which face the risk of both deep water and high, moving waves) even residential buildings are permitted as long as certain construction standards are met. Thus, instead of teaching people that hazardous coastal areas should not be developed because of the risks of flooding, high-velocity waves, winds, and erosion, we are instead giving people and communities advice that it is safe to develop in those areas.

Second, coastal development increases and becomes more costly because it puts high value property at risk so that future disasters are certain to be unprecedentedly costly. That very development endangers the coastal resources (dunes, beaches, wetlands, mangroves, etc) that attracted people to the coast in the first place. These are the very resources that could be providing natural protection from coastal storms and other processes.

According to the Heinz Center (2000) what is missing from coastal public policy is a holistic view of coastal hazards. This view would include a community's risk and vulnerability, together with an inventory of the full range of costs of coastal hazards. Fundamental changes are needed to address the risks of weather-related coastal hazards and the increasing vulnerability of local and regional communities, economies, social systems, and governmental and private organizations.

Coastal Zone Management and Floodplain Management

The Coastal Zone Management Act established a federal-state partnership to promote comprehensive land and water planning and management for coastal areas. The role of the National Oceanic and Atmospheric Administration, which administers the Act, is to look out for the national interest in coastal issues as well as provide incentives, guidance, and technical support to the states. Passage of the Coastal Zone Reauthorization Act in 1990 provided additional impetus for states to address hazards, by requiring them to assess eight coastal issue areas—among them natural hazards and sea level rise—and develop strategies for state program improvement for the most important of these issues.

In many states there is relatively poor coordination between state coastal zone management activities and the state implementation of the NFIP. One reason for this is that local land use planning plays only a minor role in state coastal zone management efforts, which tend to concentrate instead on hazard assessment, large scale planning projects, and state-level regulation. The NFIP's key concern, on the other hand, has been identifying flood hazard areas and helping municipalities manage them appropriately.

A more comprehensive approach to coastal management should lead to improvements in the actual resources—better water quality, protection of the habitats and wetlands, and reduced vulnerability to coastal hazards. In practice, these outcomes depend on a combination of efforts across federal, state, and local governments and the private sector. Better coordination among the various programs and their components would contribute to a more comprehensive approach.

An example of the benefits of collaboration can be seen in the potential for leveraging resources to purchase coastal lands at risk. Land acquisition is a strong tool for protecting coastal property and resources. Although there are multiple sources of federal funds for land acquisition scattered among several agencies (including annual appropriations for the National Oceanic and Atmospheric Administration's National Estuarine Research Reserves, Congressionally earmarked funds for the Coastal and Estuarine Land Conservation Program, and FEMA's pre-disaster mitigation funding and post-disaster Hazard Mitigation Grant Program), seldom do state coastal zone managers and floodplain managers work collaboratively to leverage these resources to purchase coastal land. Land acquisition would benefit from comprehensive planning efforts to guide acquisition choices and identify common priorities.

- The development of state or regional comprehensive coastal acquisition plans should be required. Funds from FEMA's Pre-Disaster Mitigation Competitive Grants and the Flood Mitigation Assistance programs should be made available to develop these plans. They should be developed in collaboration with FEMA-mandated state and local hazard mitigation plans. Regional acquisition plans could then be used to coordinate multiple funding sources.

- The land acquisition provisions of the National Oceanic and Atmospheric Administration's National Estuarine Research Reserve program should be modified so that upland areas outside of the management plan boundaries can be purchased. Alternatively, those program sites may be able to administratively amend their management plans to include upland acquisition as a priority.
- The role of the headquarters and field staff of the National Oceanic and Atmospheric Administration should be more directly targeted at improving coordination: working with other agencies to find complementary programs, and eliminate duplicative ones, and helping states pull together different federal resources.
- Coordination of coastal zone management, floodplain management, and emergency management among all federal agencies and the states should be improved.

SPECIAL FLOOD-RELATED HAZARDS

Many parts of the United States face unusual flood-related hazards that cannot be adequately mapped or managed with a “one size fits all” national program. These include the special conditions inherent in many arid regions (alluvial fan flooding, migrating channels, intermittent streams, debris flow, and flooding after wildfires) as well as situations faced in other parts of the country, such as closed basin lakes, ice jams, and flash flooding from mountainous areas.

Because many of the areas prone to these special hazards are not mapped under the National Flood Insurance Program (NFIP), there is little basis for management of the risk unless communities conduct the studies and perform the mapping themselves voluntarily, which most do not. Further, management techniques that are in place for these areas may not be successful in mitigating the special risks.

Mapping of Special Hazards

States and localities need accurate mapping of these unique areas so that appropriate management techniques can be tailored and applied to reduce the risk. The NFIP also needs this accurate mapping to enable the calculation of appropriate flood insurance premiums.

The Federal Emergency Management Agency (FEMA) has recognized that delineation of a floodplain on an alluvial fan cannot be accurately accomplished by using traditional methods of floodplain analysis. Similar assessments, recommended approaches, and decisions need to be made about the other special hazards as well.

- FEMA should map special flood-related hazards during the conduct of Flood Insurance Studies and depict them on Flood Insurance Rate Maps.

Management of Special Hazards

As noted above, the NFIP criteria and guidance are largely silent on techniques for local management of special flood-related hazards. The Community Rating System offers incentives to localities that identify and manage unique hazards within their jurisdictions, but a more widespread effort is needed.

- FEMA should require that state and local all-hazard mitigation plans address any flood-related special hazards to which the locale is prone.
- Management and mitigation techniques for special flood-related hazards should continue to be explored, shared, and implemented.

INFRASTRUCTURE AND PUBLIC BUILDINGS

A community's infrastructure consists of publicly and privately owned facilities and buildings that support the community's general functions and the health, safety, and welfare of its citizens and its economy. It is generally considered to include water supply and wastewater systems (plants and distribution/collection); roads and streets; stormwater and drainage facilities; gas and electric power systems (plants, substations, distribution); public buildings (office buildings, emergency operations centers, fire and emergency medical system stations, police stations, correctional facilities, schools); institutions of higher learning; health care facilities (hospitals, clinics, long-term care); and dams, levees, diversions, and reservoirs. Building and maintaining infrastructure and public buildings represent a significant investment. America's infrastructure is aging and the costs of maintaining it are rising.

Flood and erosion damage to infrastructure and public buildings can slow a community's recovery from a disaster in both the short and long terms. Damage can take the form of physical/structural damage and/or the loss of services provided by the infrastructure. The economic impacts of loss of service are difficult to count, but ways must be found to do that. Damage that is eligible for reimbursement under FEMA's Public Assistance program accounts for a large share of recovery costs. Many costs (both for ineligible facilities and for the local cost-share, which can be considerable in a major disaster) associated with putting infrastructure back online are not eligible for federal assistance.

Congress incorporated into the Stafford Act some incentives for the mitigation of infrastructure and public buildings.

First, Section 404 Hazard Mitigation Grant Program funds originally were authorized to be computed based on certain categories of Public Assistance. Early implementation considered mitigation of public buildings to be a priority.

Second, Section 406(d) specifies a reduction in the amount of Public Assistance provided to public and nonprofit facilities that are insurable under the NFIP but not insured for flood damage. This reduction is equivalent to a "deduction" of \$500,000 for a structure and \$500,000 for its contents (the maximum coverage available for nonresidential buildings).

Finally, Section 406(b) specifies a reduced federal cost share (to not less than 25%) if a facility damaged more than once in a 10-year period has not been mitigated.

These provisions represent steps in the right direction, but an additional measure would improve the resilience of infrastructure over the long term.

- Public Assistance funds should not be available to communities unless cost-effective mitigation measures are applied to their infrastructure and facilities, including following advisory base flood elevations when they are issued.

Construction of New Buildings and Infrastructure

Under the NFIP, communities are required to regulate all development in Special Flood Hazard Areas, including buildings and infrastructure other than buildings. Although the NFIP regulations and ordinances adopted by communities address non-building development, there are few if any technical standards for the design and placement of these components of the infrastructure. In

addition, some states preempt local regulation of certain utilities and regulate them through a public services commission. This situation has resulted in gaps in the flood mitigation measures applied to new infrastructure, which could begin to be remedied through these steps.

- National standards should be developed for the location, design, and construction of infrastructure exposed to flooding, flood-related erosion, and other impacts, including a requirement to consider alternative locations.
- Utility companies that are eligible for Public Assistance should be required to examine flood and flood-related risks in the planning, design, and construction of utility systems.

Evaluation of Existing Infrastructure and Public Buildings

All states and many communities have prepared plans to meet the requirements of the Disaster Mitigation Act of 2000, and many others are in the planning stage. These plans may identify specific projects, but usually they lay out broader objectives that support the identification of specific projects when funding becomes available. Damaged infrastructure and public buildings can have long-term adverse consequences, sometimes affecting entire communities, but many mitigation plans have yet to address these vulnerabilities in meaningful ways.

- As a condition of participation in the NFIP, FEMA should require that states and communities identify floodprone buildings and facilities that are insurable under the NFIP, evaluate the potential for damage, and identify the need for flood insurance.
- FEMA should require that, as part of their mitigation planning, states and localities evaluate the type, nature, and severity of damage to their infrastructure that would qualify for Public Assistance in order to determine if there are feasible and cost-effective mitigation measures to reduce such losses in the future. The measures to be considered should include relocation outside of the Special Flood Hazard Area, change in use, and retrofit floodproofing. Particular attention should be paid to costs associated with public facilities, roads and bridges, public utilities, and parks and recreational facilities. Some projects may be eligible for FEMA mitigation grants.

Roads, Bridges, and Railroads

The Federal Highway Administration requires state departments of transportation to comply with NFIP requirements when building and replacing roads and bridges as a condition of receipt of federal funds; local bridges in the federal system (longer than 20 feet) meet the same requirements. New and replacement roads and bridges are to meet certain minimal standards (notably the floodway standard that requires no encroachment that would result in an increase in flood heights), but implementation is not uniform. Many local roads and bridges are built in Special Flood Hazard Areas without due consideration of performance during passage of the base flood. Under E.O. 11988, bridges should not cause an increase in flood elevations, but enforcement of that requirement is uneven and uncertain.

Perhaps the biggest failure to prevent future damage related to roads and bridges occurs in the post-disaster situation on county and local roads. Very few standards are applied to the repairs, including any consideration of reducing the impact on flooding caused by the road or bridge—it is simply replaced in kind in most instances. However, most counties would apply different standards if they were available.

Many local and state officials have similar concerns about railroad embankments, most of which, particularly in rural areas, were built many years ago and act to impede drainage and/or redirect flood waters in ways that exacerbate flooding problems and increase losses. Addressing this problem is difficult, since railroads historically were granted exemptions from many state and local laws. However, there is no reason why railroads should continue to be able to pass adverse impacts on to other entities.

- FEMA and the Department of Transportation should work together to produce guidelines and standards for the replacement of roads and bridges with federal disaster funds.
- FEMA should work with the Department of Transportation (EO 11988 provides the authority) and state highway departments to develop standards for local, county, and state transportation departments to use in post-disaster repair.
- National standards should require that roads, bridges, and railroads are built or rebuilt to avoid or minimize adverse impacts on other property and on natural functions and resources.

Post-Disaster Recovery

FEMA's Public Assistance program generally reimburses local governments for their costs to repair damaged facilities to their pre-damage condition. Under many circumstances, additional funding can be provided for feasible and cost-effective mitigation measures that will reduce future damage and resultant public expenditures. A list of pre-approved measures is maintained, and others may be approved on a case-by-case basis. Although the situation is improving, too few federal Public Assistance inspectors (often contractors) and state Public Assistance inspectors fully understand what constitutes effective mitigation and even fewer communities are aware that mitigation can be accomplished as part of Public Assistance-funded recovery.

- FEMA and state Public Assistance programs should ensure that employees and contractors have the necessary guidance and training to identify, assess, formulate, and approve mitigation measures for public facilities and public infrastructure.
- In their hazard mitigation plans, communities and other eligible entities should be required to identify feasible and cost-effective mitigation measures in advance of damaging floods to expedite the incorporation of those measures into Public Assistance projects and mitigation measures and other recovery activities.
- To obtain Public Assistance funding or mitigation grants, floodprone communities should first be participating in and be compliant with the NFIP.

Federal Investment in Infrastructure: Executive Order 11988

Other federal agencies that support construction of new and replacement public facilities and infrastructure should be following the rules they adopted for compliance with EO 11988, but this does not appear to be happening uniformly. This implementation should result in guiding new and

replacement facilities to less hazard-prone areas and to the protection of facilities that are located in flood hazard areas (including protection to the 500-year flood for critical facilities).

- Executive Order 11988, Floodplain Management, needs to be reinvigorated and federal agency compliance should be evaluated. More emphasis needs to be placed on avoiding the Special Flood Hazard Area, especially for critical facilities; on protecting facilities to higher-than-minimum requirements to acknowledge consequences of loss of service after a flood; on establishing 500-year protection for critical use facilities; on the avoidance of transferring negative impacts; on compliance mechanisms; and on incorporating future-conditions hydrology in decisionmaking.

DISASTER MANAGEMENT AND ASSISTANCE

Historically, disaster programs in the United States have been directed at returning people and communities back to “normal” as quickly as possible. Unfortunately, in our rush to do this, we have also restored them to their previous at-risk condition. This was again demonstrated with the catastrophic disasters caused by Hurricanes Katrina and Rita. It will always be necessary for the federal, state, and local governments to have programs to administer assistance after disasters. The ASFPM believes that disaster aid and the post-disaster recovery period should be used as much as possible to encourage, facilitate, and reward actions that are lessening the potential damage from future floods, and building overall local sustainability.

However, under many current policies, post-disaster rewards are still provided for those who did no mitigation before the disaster and (in the case of local governments) have enabled additional at-risk development to take place. In other cases, the complexity of the disaster assistance program or financial reality makes it more attractive to people and to communities to restore damaged buildings or infrastructure to an at-risk condition than to mitigate the danger. A concerted effort must be made to improve the manner in which disasters are managed and disaster assistance provided. Government efforts must be efficient without fostering an added moral hazard.

Public Assistance after Disaster

The bulk of federal disaster assistance is provided for the repair and rehabilitation of public infrastructure (roads, bridges, stormwater systems, utilities, etc.) after a disaster. This assistance comes in the form of funding for repairs and replacement through the Federal Emergency Management Agency (FEMA), levee repairs by the Corps of Engineers and the Natural Resources Conservation Service, and activities like clearing the channel of a waterway. A much smaller portion of all the federal financial assistance goes to individuals and families for emergency needs and for repairs to their residences.

FEMA has adopted a policy and maintains a list of pre-approved mitigation measures that can be funded under the Public Assistance program as part of repair for public buildings and infrastructure projects. However, this policy is not always fully embraced by FEMA Public Assistance staff (and its disaster employees and contractors) when reviewing projects that otherwise are eligible for disaster assistance, such as public buildings, infrastructure, and critical facilities.

The programs of the Robert T. Stafford Relief and Recovery Act are an important element of recovery from and mitigation of the devastation of floods. The assistance programs established in that Act help communities replace infrastructure and mitigate against future damage. Some changes are needed to address catastrophic situations that lead to the inability of local governments to pay their local officials’ salaries. Permit officials are an especially critical part of the recovery process. Unfortunately, the Stafford Act’s provisions allow federal funds to be used only for payment of overtime for such officials and not their base pay. This has forced some communities to lay off their officials in order to hire additional personnel to assist in administering the rebuilding effort, which adversely affects the community’s long-term recovery and mitigation against future disaster. Also detrimental is the inability to use Stafford Act funds to make determinations of substantial damage, which are required under the National Flood Insurance Program (NFIP) before rebuilding and mitigation can proceed.

To make federal programs for disaster assistance to localities more consistent and effective, the following steps are recommended.

- Flood disaster aid for public infrastructure should only be awarded to communities that are participating in and compliant with the NFIP. Such economic sanctions applied to local governments should result in wiser decisions being made at the local level about investment in the floodplain, siting critical facilities, and insuring public structures.
- All federal assistance for structural, nonstructural, and disaster assistance programs should be based on the same sliding cost-sharing formula. Under this concept, a minimum federal share of the cost would be available to all communities, including those without financial resources to undertake expensive projects. But, as an incentive, the federal share would be increased for communities and states that engage in disaster-resistant activities beyond minimum criteria. Further, nonstructural mitigation projects would always receive a higher share of federal funding than structural projects.
- As part of its Public Assistance program, FEMA should ensure that its employees and contractors have the necessary guidance and training to identify, assess, formulate, and approve feasible and cost effective mitigation measures for public facilities and public infrastructure during post-disaster reconstruction.
- FEMA Stafford Act provisions should be revised so that communities can be reimbursed for costs they incur to perform damage inspections, administer codes and ordinances, and process permits for repair and reconstruction when the damage to public and private property exceeds the capacity of the responsible local agency. The costs associated with performing these functions should be reimbursable for 12 to 24 months or longer if needed to guide the community's post-disaster rebuilding and recovery.

Improving Efficiency and Effectiveness

In most disasters, numerous federal agencies direct funding and programs toward the stricken area. There are at least two dozen separate programs in as many federal agencies for nonstructural disaster recovery assistance alone. It is frustrating when a coordinated federal disaster response and recovery strategy does not evolve and, instead, each agency pursues its own priorities, application procedures, and rules. Considerable time and energy is lost in trying to mesh specific procedures and policies among agencies or levels of government in order to take the simplest of steps toward recovery—for example, determining whether the applicable federal rules require a damaged house to be assessed by its pre-disaster market value or its damaged market value.

Between the mid-1990s and 2003, FEMA was a lean organization and responded to both natural and human-made events in an effective matter. FEMA had built excellent relationships with states and communities; was able to respond quickly to disasters and decide on policy matters regarding its programs; had a true multi-hazard focus; and had developed a track record of success in accomplishing its mission. Furthermore, FEMA oversaw a system of comprehensive emergency management in the country—one that linked and incorporated preparedness, response, recovery, and mitigation into an overall approach for how the nation addresses hazards and disasters.

Since 2003, when FEMA was subsumed by the Department of Homeland Security and despite the development of the National Response Plan, there has been an apparent lack of coordination among federal agencies. Events like Hurricane Isabel and Hurricane Katrina have shown FEMA's reduced capability. It has become painfully clear that FEMA lost the nimbleness and direct access to the President that it had as an independent agency.

Legislation has been enacted to provide autonomy for FEMA within the Department of Homeland Security. This new legislation will enable the four phases of disaster management—preparedness, mitigation, response, and recovery—to be directed by FEMA as before. The separation of these functions within the Department of Homeland Security has hobbled FEMA's effectiveness. It is absolutely critical that these functions be reunited and that FEMA be allowed to regain its central, effective, disaster-coordination function.

These recommendations are offered to improve federal disaster management.

- FEMA should be restored to independent-agency status, with direct access to the President.
- Until FEMA becomes an independent agency, Congress should carefully oversee the implementation of the 2006 legislation that strengthens FEMA's position within the Department of Homeland Security.
- FEMA should continue to work with all federal agencies to ensure that all disaster-related policies and programs are supportive of the floodplain management standards embodied in the NFIP.
- Upgraded Executive Orders or other measures should tie disaster relief and other federal funds to NFIP participation, compliance, and the maintenance of flood insurance by individuals and state and local governments.
- A National Response Plan should be developed that not only details standard response but also directs the use of disaster funds that are viewed as discretionary and the goals of long-term recovery and redevelopment. Additional guidance and clarity must be provided under the Emergency Support Function 14: Long Term Recovery, including purpose, roles, and the concept of operations.
- A uniform set of application forms covering many or all programs would facilitate implementation of mitigation measures during reconstruction.
- Data related to damage assessments conducted for purposes of Individual Assistance should be shared with state and local officials.
- The availability of post-disaster Public Assistance and Individual Assistance ought to be reviewed to ensure consistency with the spirit of Executive Order 11988's directive to curtail federal support to any activity that creates, continues, or otherwise supports activities that may result in future flood damage.
- A set of emergency rules should be adopted that covers disaster programs in all agencies

so that issues of funding, cost sharing, priorities, and the like are handled consistently.

- The administration and oversight of the Hazard Mitigation Grant Program, Flood Mitigation Assistance, and the Pre-Disaster Mitigation program should eventually be turned over to qualified states.
- Federal agencies, including FEMA, NOAA's Office of Coastal Resource Management, the Economic Development Administration, the Environmental Protection Agency, the Corps, and the Natural Resources Conservation Service, should collaborate in the design of a state-combined review process of flood compliance, enforcement, and mitigation opportunities, to be implemented particularly after a flood when FEMA is positioned to pull federal agencies together.

Flood Forecasting and Warning

River forecasts and warnings are being made more widely accessible and easier to interpret. Forecasts should explicitly state the variability of estimates so that individuals do not get a false sense of security, but instead pursue appropriate protective actions, just in case. Flood forecasts and warnings also should attempt to incorporate impact-based estimates where possible. For example, recent forecasts from the National Weather Service will sometimes include statements such as "A crest of 979 feet will submerge parts of Main Street and Oak Street." Statements such as these reinforce the consequences of the event in a way that is not possible using only flood crests or depths. The ASFPM urges caution in releasing warnings that are confusing or may have the effect of delaying appropriate action—like evacuation.

- Federal agencies must speak with one voice in the issuance of forecasts and warnings.
- Better ways need to be found to convey to the public the uncertainties associated with weather and flood forecasts, and to help people understand their risk and take appropriate action to prepare for and avoid such hazards.
- Programs such as the National Streamflow Information Program must be fully funded. The program consists of a backbone of federally funded stream gages that are critical to flood forecasting and warning and to calibrating models for flood mapping and data for flood mitigation.

Many local governments are developing flood warning and monitoring systems. Despite vast differences in program components, there is one common frustration: the difficulty of progressing beyond collecting and monitoring data to actually evacuating people and property during a flood threat.

- The National Weather Service, in partnership with state and local governments and other federal agencies, needs to find ways to better integrate and utilize this locally generated data, including disseminating it in a way that causes people to understand their risk, personalize it, and then take appropriate and timely action.

Flood Response

An impending flood results in many activities' occurring—often concurrently. Emergency action plans for dams and levees are exercised, local emergency operations plans are activated, evacuation and flood fighting efforts begin. All of these efforts are heavily influenced not only by policies and programs that involve flood response, but also by programs that involve mitigation, preparedness, response, and recovery. For example, the owner of a levee certified under the NFIP as being able to protect against the 100-year flood should be required to demonstrate, through periodic exercising of an emergency action plan, that the structure will not fail or be overtopped due to unfamiliarity with emergency procedures. Yet current levee certification requirements do not require this kind of demonstrated effort.

Another ramification of poor flood response activities is damage to other communities. Flood fighting either saves or damages property, depending on one's perspective and location. Independent sandbagging efforts on the levees during the 1993 Midwest flood led to flood damage at other sites along the river, and to sabotage. Finally, the issue of evacuation must receive significant attention. Hurricane Katrina showed that mandatory evacuation orders must be issued with enough time for the affected population to evacuate, that evacuation routes must be identified and maintained, and that evacuation shelters must be accessible, functional, and adequate in size.

The following actions would improve the nation's flood response efforts.

- Leveed rivers that affect multiple states—like the Mississippi—should have a flood fighting plan in place, with some mechanism of federal oversight or coordination to ensure that the outcome of the flood fight is understood.
- Emergency action plans and emergency operations plans must be developed in anticipation of a disaster to ensure that emergency activities (such as building temporary levees or placing sandbags) will not adversely affect other properties or communities.
- Nationwide campaigns like “Turn around Don't Drown” should continue to educate citizens of the dangers of driving into flooded areas, the leading cause of flooding deaths.
- Assistance to communities through mechanisms such as Public Assistance or operations and maintenance funding should be conditioned upon the development and periodic exercise of local emergency action/operations plans, and on evacuation plans in areas that are susceptible to large or catastrophic floods.

The Response Recovery Continuum

There is no question that after a disaster, all levels of government must respond as swiftly as necessary for the safety and welfare of those affected. It is during the later, recovery phase that there must be a rational pause to avoid missing the many opportunities presented. All mitigation is meaningful only in the context of the hazard looming somewhere in the future. Science can reasonably assure us of the locations of flood hazard areas that, in the absence of mitigation, will certainly become the settings for future disasters. Therefore, all efforts toward recovery must involve an intelligent assessment of ways to seize mitigation opportunities wherever they present themselves.

- Any taxpayer-funded flood disaster relief must be tied to requirements for mitigation. Some mitigation is required as a condition of receiving relief in some situations under some programs now, but it should be made a universal and more stringent requirement.
- The availability and amount of financial assistance after a flood disaster should be contingent on participation in and compliance with the NFIP.

Emergency Management Assistance Compact

The Emergency Management Assistance Compact (EMAC) was established by Congress in 1996 (P.L. 104-321) as a mutual aid agreement and partnership among the member states. All 50 states, the District of Columbia, Puerto Rico, and the U.S. Virgin Islands have enacted legislation to become members of the compact.

The strength of EMAC and the quality that distinguishes it from other plans and compacts lies in the governance structure; its relationship with federal organizations, states, counties, territories and regions; and the ability to move almost any resource one state has to assist another state, including medical resources. EMAC allows for a quick response to disasters using the unique resources and expertise possessed by member states. In 2005, EMAC was used to deploy almost 66,000 personnel in response to Hurricanes Katrina and Rita. Currently, EMAC is only being used in the response plan of a disaster and not for long term recovery or mitigation.

- The Emergency Management Assistance Compact needs to be expanded to cover the recovery and mitigation phases of catastrophic events.

FLOOD INSURANCE

Flood insurance is an important tool for protecting what is most people's largest asset, their house. It provides financial protection to property owners and renters and reduces the cost of disaster assistance paid by taxpayers. Its other advantages as a loss reduction technique are that it can be undertaken at the individual level and that it has the potential, through premium reductions and other techniques, to act as an incentive for adoption of mitigation measures.

The creation of the National Flood Insurance Program (NFIP) in 1968 marked a significant shift in U.S. public policy. The NFIP was the vehicle that brought floodplain management to the nation. The primary strength of the NFIP lies in the local-state-federal partnership it fosters, under which minimum land use management and performance criteria must be adopted and implemented by states and localities in order to be eligible for flood insurance and other continuing federal benefits.

Flood insurance can be a highly effective mechanism for fostering individual responsibility and building local self-sufficiency, thereby contributing to sustainable and disaster-resistant communities. From a federal policy perspective, flood insurance is attractive because it minimizes the amount of taxpayer funds that must go to "bail out" people who have chosen to live in hazardous areas, that is, to pay for disaster assistance to the homeowners, business owners, and renters whose property has been damaged by flooding. Instead of being paid with taxpayers dollars, flood insurance claims, just as with other types of insurance, are paid from a pool funded by the premium dollars paid by people who are taking the risk of living in floodprone areas.

However, Congress and the public should recognize that the NFIP, although modeled on an insurance company, is also a government program geared toward helping people. The flood mapping component of the NFIP needs federal taxpayer support, but also yields nationwide benefits beyond the provision of risk zones for flood insurance. The insurance-company characteristics of the NFIP have enabled the program to be self supporting (except for mapping) in all but catastrophic loss years. If this arrangement is no longer considered to be the best option, alternatives should be examined such as all-hazards insurance or a federal re-insurance framework that would enable private insurers to cover more risks.

Land Management / Flood Insurance Interaction

The premise of the NFIP is that the federal government will make flood insurance available to renters and property owners if the local government enforces land use and construction practices that minimize the threat of flooding. However, after nearly 40 years of the NFIP and numerous flood disasters, significant improvements to the NFIP are still needed.

Flood insurance is available at reduced rates for structures outside of mapped floodplains, but there are no management measures required of the community for these areas. Experience and claims history indicate, however, that many who purchase insurance in these unmapped floodplains are subject to an inherent flood risk, and accounted for up to 35% of all claims filed as of 2005 (Galloway, 2006, p. 36).

In most coastal areas, insurance is available; but the regulatory standards and management measures in place for those areas are inadequate to minimize losses effectively. In addition, premium payments do not account for the erosion that takes places in these areas, which not only can result in significant damage but also causes a drain on the flood insurance fund.

The higher-than-expected risk of flooding that is present outside of these and other areas generally identified as high risk requires a reassessment of some current policies and practices.

- Any structure for which a certain number of flood damage claims has been paid (perhaps two) should be mapped, managed, and insured as a floodplain property, without regard to its location with respect to the pre-flood boundaries of the Special Flood Hazard Area.
- In cooperation with its partners and others, the Federal Emergency Management Agency (FEMA) should establish a work group to review and revise the regulatory standards of the NFIP (see section on Nonstructural Mitigation Measures, above). The review should address a zero-rise floodway; freeboard above the base flood elevation to the first floor; elevation certificates for all new floodprone construction (including placement of manufactured homes); flood protection standards for critical use facilities; clear standards and procedures for determining substantial damage and improvements; and stronger construction standards for buildings in coastal A Zones.
- “Substantial improvement” should be redefined under the NFIP so that improvements made to a structure over time are calculated cumulatively, rather than being considered individually.
- In cooperation with its partners, FEMA should revise the NFIP regulations to require that determinations of substantial damage to a property be based on the replacement value minus depreciation.
- Flood claims information needs to be provided by FEMA to local administrators so that they can be alerted to potential problems with the administration of their floodplain ordinances.
- Any payment of an insurance claim for a substantially damaged or improved building should trigger a verification by appropriate FEMA or state personnel that the structure is compliant with NFIP requirements before insurance coverage is continued.
- FEMA should make it permissible to use Flood Mitigation Assistance program funds in limited circumstances for the “mitigation reconstruction” technique, by which a damaged building is demolished and then rebuilt in compliance with the local ordinance and NFIP requirements. If this use of funds proves successful, it should be extended to the competitive grant programs, such as the Pre-Disaster Mitigation program.
- The FEMA Director should be given discretionary authority to require local governments to use advisory maps and advisory base flood elevations for administration of their NFIP-related ordinances, based on input from communities and the state.
- FEMA should evaluate ways to eliminate the use of Letters of Map Revision (issued after the use of fill or the modification of a channel to alter the floodplain) to avoid the purchase of flood insurance. The most direct approach would be to discontinue the practice of waiving flood insurance after issuance of a Letter of Map Revision based on Fill. Properties for which a Letter of Map Revision based on Fill is issued would have insurance premium rates based on the flood risk, rather than being exempt from the

flood insurance requirement.

- Additional levels of risk zones should be instituted for floodways (analogous to V Zone ratings), be depicted on flood maps, and be the basis for additional levels of flood insurance rates.
- The NFIP should be modified to provide erosion/mudslide coverage only where those hazards are mapped and managed, possibly via a surcharge.
- Floodplain managers and the insurance industry should continue to improve their working relationships. State and local floodplain managers are in a good position to advise citizens about the basics of insurance availability and to promote the wisdom of the land management/insurance interaction of the NFIP. Continued efforts should be made to educate floodplain managers about the insurance aspects of the program, and insurance agents about floodplain management. One way could be to increase the number and distribution of floodplain-related workshops at the annual National Flood Conference (attended primarily by insurance partners) to encourage more floodplain managers to participate, as well as to further educate the insurance industry about this area. Likewise, the national and state floodplain management associations could encourage more coverage of flood insurance topics at their annual conferences.
- Encouragement and support should be given by federal agencies and states to the professional certification programs for floodplain managers, adjusters, agents, and others. Certification programs for administrators of the International Building Codes should be integrated with those for floodplain managers.

Flood Insurance Premium Discounts

A number of inequities persists with regard to current flood insurance premiums. Three types of discounts (categories of structures that are subsidized by the premiums paid on other structures) are notable. However, it must be remembered that all three are internal to the NFIP, that is, paid for by other flood insurance policyholders and not by federal taxpayers. An exception is that catastrophic events and losses are not factored into premium costs, thus the taxpayers do help fund the program in catastrophic loss years.

First, because the NFIP is a national program, the nationwide actuarial rates based on risk may not reflect the true risk in a given location. The effect is that, in certain areas of the floodplain, premiums may be either artificially lower or higher than the actual risk would dictate, because all flood hazards are not equal. Differences in precipitation patterns, flood depths and velocities, topography, and channel conditions produce differing ranges of hazardousness.

The second category of discount includes the “subsidized rates” that result in lowered premiums for structures that existed before the issuance of a community’s first Flood Insurance Rate Maps (“pre-FIRM structures”). For the purpose of determining flood insurance premiums, buildings are categorized and rated as either pre-FIRM construction or post-FIRM construction. The post-FIRM rates are for those structures built after flood hazard mapping was done and the communities or counties passed the necessary ordinances and instituted accompanying permitting systems with development standards. The pre-FIRM rates are for those structures that were built before

the community or county joined the NFIP. Usually these pre-FIRM buildings were constructed without taking into account the level of flood risk and may therefore be at higher risk than those constructed according to floodplain management regulations (post-FIRM construction). To keep the rates affordable in these circumstances, less-than-actuarial rates are charged; hence the National Flood Insurance Fund subsidizes the pre-FIRM insurance rates. The original idea was that over the long run the older buildings would reach the end of their design life and gradually be replaced by newer flood-resistant construction. In practice, this is taking longer than anticipated. Meanwhile, the expectation has grown that people who live in high-risk areas should pay actuarial insurance rates based on their exposure to risk. As an aftermath of Hurricane Katrina, there are renewed calls to determine the feasibility of ending these pre-FIRM discounts on certain categories of buildings, such as non-primary residences and non-residential buildings.

The third discount is the administrative grandfathering that occurs when a building is constructed in compliance with the local standards as based on the Flood Insurance Rate Map in effect at the time of construction. If the map is subsequently updated and the building's flood zone or base flood elevation is changed, the grandfathering rule allows the structure to continue to be rated according to its originally designated zone or base flood elevation. This rule therefore alleviates the financial penalty that would accrue for property owners when a map is changed, since they in fact had built their structure in compliance with the local regulations in effect at the time of construction. Now, due to the financial condition of the NFIP after back-to-back years of catastrophic losses, this discount is also being questioned.

There are several ways in which concerns about these discounts could be addressed.

- More stratification is needed in flood insurance rates to accurately reflect the variations in risk within individual zones.
- Subsidized insurance for pre-FIRM primary residences should be gradually raised to actuarial rates in order to encourage mitigation.
- The Federal Insurance Administration's grandfathering of flood insurance rates should be eliminated gradually, by means of an automatic reversion to current actuarial rates once a single flood insurance claim is paid for a structure.
- Flood insurance premiums for any building that is not a primary residence should be set at actuarial rates. This includes second homes, vacation homes, rental properties, and businesses.

Repetitive Losses

When insurance claims are filed again and again for flood damage to a single building, that building becomes known as a "repetitive loss structure." There are relatively few insured structures in this category, but they account for a disproportionately large share of all the flood insurance claims filed and paid. While estimates vary, it appears that 2% of the policies held under the NFIP since its inception have accounted for 32% of the losses and received 38% of the dollars paid out from the National Flood Insurance Fund. Geographically, many of these losses are concentrated in coastal areas.

The pre-1999 strategy for alleviating losses due to repetitively flooded buildings relied on the structure's being substantially damaged (damaged 50% or more of its market value), at which time it would be reconstructed, elevated, or floodproofed to prevent future damage. Unfortunately, due both to confusion about how "substantial" damage (or substantial improvement) should be measured, and also to a natural reluctance on the part of local officials to impose perceived hardships on owners of flood-damaged properties, communities have not been consistent in declaring structures substantially damaged when in fact they are. This has resulted, over time, in buildings' being repeatedly flooded because they are never declared by the community to be substantially damaged and thus are not upgraded. The failure to make these declarations also keeps their owners from qualifying for Increased Cost of Compliance payments under their flood insurance policies, which would help them pay for mitigation measures on the damaged structures. According to FEMA, between 1978 and 2004, 112,540 buildings nationwide had suffered four or more flood losses, or more than two losses that cumulatively equaled or exceeded the building's value during any 10-year period (King, 2005, p. 36).

FEMA has taken several important programmatic steps to craft, update, and implement its strategy for addressing repetitive loss properties nationwide, including incorporating special incentives into the Community Rating System for repetitive loss communities, distributing data to states and communities to help them address their repetitive loss properties, considering increased insurance rates for repetitive loss structures, and specifically targeting Flood Mitigation Assistance program funds toward repetitively flooded properties. The latter strategy would focus FMA funds on about 10,000 high-risk repetitive loss structures for mitigation, with an eventual estimated NFIP savings of \$65 million annually. Further, some states are using Hazard Mitigation Grant Program funding to implement mitigation measures for their repetitive loss properties. Needed policy changes include:

- FEMA should produce rules for a process by which repetitive losses could be financially neutralized by moving to actuarially based premiums and/or deductibles on such structures and adjusting coverage unless mitigation measures (including dry and wet floodproofing) are undertaken. If cost-effective and feasible mitigation options are refused by a property owner, premiums for that structure should be increased to actuarial rates. This incentive-based program, although formally approved in 2004, has yet to be developed by FEMA and must be implemented.
- FEMA should continue its work to refine the reliability of all repetitive loss structure databases and to include information on each building's location and the risk and reason for flooding.
- FEMA should share the information in all repetitive loss databases with its state and local partners. Congress should amend the Privacy Act as needed to make such sharing permissible.

**States with the Most
Repetitive Flood Loss Properties
(insured and uninsured)**
(King, 2005, pp. 34-35)

**Louisiana
Texas
Florida
New York
North Carolina
New Jersey
Missouri
Mississippi
California
Pennsylvania
Illinois**

Increased Cost of Compliance Insurance

New insurance coverage for Increased Cost of Compliance became effective in May 1997, authorized under the 1994 Flood Insurance Reform Act. This coverage reimburses a flood policyholder for at least part of the additional cost of rebuilding or otherwise mitigating the flood risk to a flood-damaged structure as needed to comply with state and local floodplain management laws. FEMA has set the maximum coverage available under Increased Cost of Compliance at \$30,000. However, it is estimated that the average cost of bringing a structure into compliance is between \$35,000 and \$60,000, depending on its geographic location within the United States.

The Increased Cost of Compliance provision could be made more effective by

- Increasing the coverage to at least \$50,000, which is the mid-range cost of elevating structures;
- Relaxing the eligibility requirements so more damaged structures could receive mitigation under Increased Cost of Compliance coverage, that is, structures not substantially damaged and those substantially damaged by a non-flood event (such as an earthquake);
- Implementing the third provision of the Increased Cost of Compliance law, which allows the Director of FEMA to required the use of Increased Cost of Compliance for mitigation when it is “beneficial to the National Flood Insurance Program Fund;” and
- Expanding FEMA’s efforts to publicize Increased Cost of Compliance coverage and to increase agent and adjuster understanding of its availability and function.

Residual Risk of Dams and Levees

The catastrophic losses that resulted from the levee failures after Hurricane Katrina have forced a re-evaluation of national levee policies. The fact is that levees, dams, diversions, and reservoirs do not eliminate the flood risk to individuals and structures behind them and in many cases, they create a significant and potentially catastrophic residual risk that may increase as conditions in a given region change or as the impacts of climate change begin to be felt. An evaluation of the residual flood risk below or behind such flood reduction structures should determine the proper policy governing insurance requirements and rates. Given the potential for catastrophic losses from failure, these residual risk areas might best be classified with something other than the standard B, C, or X Zones, i.e., AL zones. A special residual risk zone might provide for the implementation of the mandatory insurance purchase requirement, or might allow for appropriate rates, or both, to reflect the hazard. The following changes are needed.

- FEMA should define a new flood insurance zone for areas behind levees that provide 100-year protection and meet other requirements for recognition under the NFIP, that will reflect the level of flood risk faced by those behind the levees. This will help ensure that residents and public officials are aware of the risk.
- Flood insurance in the failure zones associated with all dams, levees, diversions, and reservoirs should be mandatory, with premiums at the preferred risk rate.

- FEMA, working with its federal, state, and local partners and levee sponsors, should develop and implement a public awareness and outreach strategy that will improve public official and citizen awareness and understanding of the hazards and risks associated with flood-reduction structures.

Increasing the Number of Flood Insurance Policies

After nearly 40 years of the NFIP, the number of flood insurance policies is still unacceptably low. Only about 50% of structures in Special Flood Hazard Areas nationwide are covered by flood insurance (Dixon et al., 2005, p. xiii). Yet the basic premise of using an insurance pooling mechanism to shift the risk of flood damage from all taxpayers to those that have chosen to live at risk remains a good public policy. As a point of comparison, an at-risk structure in a floodplain will have better than a 25% chance of being flooded by the 100-year flood at some time during its 30-year mortgage, but there is only a 9% chance that this same structure would have a fire. Yet few, if any, homeowners or lenders would even consider foregoing fire insurance. This is partly due to a lack of understanding of both the flood risk and the insurance that is offered and, until recently, minimal enforcement of the mandatory purchase provisions for flood insurance.

Unfortunately, until Hurricane Katrina there was little recognition of the exposure of individuals and the nation to catastrophic losses that can result because of the low proportion of buildings that have insurance coverage. Although the NFIP was able to compensate flood losses and pay out over \$20 billion in claims, uninsured property owners also received damage and a portion of them were located in high-risk areas. To help increase the number of homeowners, business owners, and renters that are protected by flood insurance, especially in high-risk areas, there needs to be (1) a broader area in which flood insurance is mandatory and stronger enforcement of that requirement; (2) better trained and informed insurance agents; and (3) a vigorous outreach program by FEMA. These approaches are discussed below.

Mandatory Purchase

The 1994 ASFPM review called for revision of the mandatory purchase elements of the NFIP to provide for the escrow of flood insurance premiums; imposition of penalties on lenders for noncompliance; withholding of disaster relief from those who willingly drop coverage; and establishment of authority for individuals and agencies to sue agents and lenders that fail to enforce the purchase requirements.

These suggestions were largely addressed when the National Flood Insurance Reform Act final rules for regulated lending institutions became effective in 1996. These provisions were largely responsible for increases in the number of policies from 2.2 million to 4.5 million (out of an estimated 9-11 million buildings in flood hazard areas nationwide) (Dixon et al., 2005, p. 2). However, supposedly only 60% of new mortgages are covered by federally regulated lenders (although some of the remaining 40% are sold on the secondary mortgage market and thus eventually must meet the requirement for flood insurance). Another concern is the large number of homes that are not mortgaged at all and thus are not required to be insured against flood risk. To encourage greater compliance and hence more properties in the high-risk area are protected,

- Flood insurance should be mandatory in 100-year floodplains, 500-year floodplains, in areas subject to coastal storm surge, and in the failure zones (residual risk zones) of dams, levees, diversions, and reservoirs.

- Steps should be taken to bring within the provisions of the mandatory purchase requirement the estimated 40% of new mortgages that are not federally regulated, such as those obtained through state banks.
- Compliance with the National Flood Insurance Reform Act's provisions for insurance purchase should be more closely monitored (e.g., after the loan's first year and when transferred to another lender), and stronger penalties put in place for non-compliance.
- Stronger language should be included in the regulations to require that, whenever there is a change in zone due to a new Flood Insurance Rate Map becoming effective, the regulations apply immediately and the lender does not have to be informed nor wait for borrowers to make, increase, renew, or extend their loans.
- Part of FEMA's outreach/marketing program should be targeted at property owners who live in high-risk areas but do not have mortgages, and therefore have not been required to purchase flood insurance.

Agent Training

After Hurricane Isabel hit the East Coast and states like Maryland and Virginia experienced a level of flooding they had not experienced for many years, the finger of fault for lack of flood insurance or adequate coverage for so many damaged homes was quickly pointed at the insurance agents. This event illuminated the need for insurance agents to be more fully trained, so that Congress added a provision to the Flood Insurance Reform Act of 2004. Unfortunately, FEMA was slow in implementing the Act's requirements. One challenge has been that the licensing and education requirements for insurance agents (like the insurance industry in general) are regulated by the states, not the federal government. Consequently, FEMA simply issued a sample agenda of what should be covered in an agent training seminar. This is not enough.

- FEMA, through its contractor who runs the Bureau & Statistical Agent, should update both its instructor-led training and web-based training to include sections on how floodplain management, map modernization, and mitigation can affect insurance. In addition, approval should be sought for awarding Continuing Education Credits for the web-based training in states where this is approved.
- FEMA should work more closely with state departments of insurance, NFIP State Coordinators, and state insurance legislators to promote the training of insurance agents as well as encourage each state to require a minimum number of hours of Continuing Education Credits from flood insurance training in order for agents to obtain and renew their property and casualty license. This initiative should be underway by the end of 2007.
- FEMA should expand its efforts to increase agents' and adjusters' understanding of the availability and function of Increased Cost of Compliance coverage and of the repetitive loss issues.

Outreach

With the advent of the Flood Map Modernization initiative, the catapulting of levees and their residual risk into media headlines, and the disastrous 2004 and 2005 hurricane seasons, the need to inform property owners and renters about their flood risk and to encourage the purchase of flood insurance is needed now, more than ever. Even with FEMA's ongoing marketing campaigns of the last decade, and the accompanying growth in new policies and renewals, an estimated 50% of homes in high-risk areas are still unprotected. With the modernization of flood maps, more properties are likely to be added to the higher risk zones each month. Added to this is the newly visible residual risk faced by people living behind levees and other flood reduction structures. All this demands a stronger effort in public awareness outreach, from the national down to the local levels.

- Additional funding needs to be appropriated for the NFIP, the Corps, and other federal agencies for their outreach efforts to not only explain flood risk to the public but also drive them to purchase a policy. Funding for this type of outreach also should be provided to help communities whose maps are being changed as well as those with levees.
- FEMA's flood insurance marketing campaigns should continue, with a focus on both new purchases and renewals.
- Flood insurance outreach needs to be continually strengthened among FEMA and state departments of insurance, NFIP State Coordinators, State Insurance Legislators, etc., with special emphasis on enforcing the NFIP requirement to identify and insure (through the NFIP or through self-insurance) state-owned insurable structures.

CONCLUSION

This report has described some of the key changes in federal floodplain management policy and programs over the last several years, and pointed out those areas in which deficiencies are hindering progress toward reduction of flood losses and protection of floodplain resources. Some of these deficiencies have persisted for years, while others have only lately become apparent. The ASFPM has also pointed out specific, achievable ways in which each deficiency can be remedied and how existing successes—of which there are many—can be shared, expanded, and applied to other activities, programs, or regions of the nation. Through this analysis, improvements have been identified that would help the nation move toward a future that includes sustainable floodplain lands and disaster-resilient communities.

The ASFPM believes that the implementation of these recommendations will help the nation cultivate a holistic perspective, spread responsibility more equitably, and foster sensible attitudes toward the use of hazardous and environmentally sensitive lands. These action items will be the focus of ASFPM effort over the next five years or so, in its work with state and local governments, federal agencies, the insurance industry, individual professionals and organizations in floodplain management and related fields, Congress, and its many other colleagues and partners in both the public and private sectors. The ASFPM invites all those who are dedicated to the future well-being of this nation to join in working toward an enhanced level of resiliency in the face of flooding, reduced overall flood losses, and a society with a sustainable relationship to its riparian and coastal lands.

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GLOSSARY

100-year flood—the flood having a 1% chance of being equaled or exceeded in any given year, also known as the “100-year” or “1% chance” flood. The base flood is a statistical concept used to ensure that all properties subject to the National Flood Insurance Program are protected to the same degree against flooding

advisory map, advisory base flood elevations—revised base flood elevations issued by the Federal Emergency Management as a result of new flood-frequency analyses conducted after Hurricanes Katrina and Rita. The advisory elevations are significantly higher than the previous ones, and extend farther inland. The advisory elevations, and the maps that depict them, are intended to give local officials more accurate data on which to base repair and rebuilding decisions

alluvial fan—an area at the base of a valley where the slope flattens out, allowing the floodwater to decrease in speed and spread out, dropping sediment over a fan-shaped area

arid regions—parts of the United States that receive an average of less than 20 inches of rain annually. The geomorphology, soils, and vegetation characteristic of these arid areas combine to produce flood problems that differ in many ways from those of more humid areas.

base flood elevation—the elevation of the crest of the base or 100-year flood, which is the level of flood that has a 1% chance of being equaled or exceeded in any given year. Also referred to as BFE.

Coastal Barrier Resources System—a set of “undeveloped coastal barriers” and “otherwise protected areas” along the U.S. coast (including the Great Lakes) designated by Congress under the Coastal Barrier Resources Act of 1982 (CBRA). Most expenditures of federal funds are prohibited within the Coastal Barrier Resources System.

Community Rating System (CRS)—a program developed by the Federal Emergency Management Agency to provide incentives for those communities in the National Flood Insurance Program that have gone beyond the minimum floodplain management requirements to develop extra measures to provide protection from flooding. Policyholders in CRS-participating communities receive up to 45% discounts on their flood insurance premiums

Corps—the U.S. Army Corps of Engineers

critical facilities, critical use facilities—structures or facilities that meet one or more of the following criteria: (1) produce, use, or store highly volatile, flammable, explosive, toxic and/or water-reactive materials; (2) hospitals, nursing homes, and housing likely to contain occupants who may not be sufficiently mobile to avoid death or injury during a flood; (3) police stations, fire stations, vehicle and equipment storage facilities, and emergency operations centers that are needed for flood response activities before, during, and after a flood; and (4) public and private utility facilities that are vital to maintaining or restoring normal services to flooded areas before, during, and after a flood

debris flow—a “river” of rock, earth, and other debris, saturated with water, which develops during and after intense rainfall and flows downhill, often at rapid rates and without warning

depth-damage functions—a mathematical relationship between the depth of flood water above or below the first floor of a building and the amount of damage that can be attributed to that water; used in cost-benefit analyses and other decisionmaking about flood damage

Digital Flood Insurance Rate Map—a flood insurance rate map [see below] that either has been converted to or was produced through an electronic format

Distributary flow system—a drainage pattern characteristic of some arid regions, in which channels of the waterway split and rejoin in a complex pattern; distributary flow is usually sheet flow with a strong channelized component

Elevation certificate—a form used by communities participating in the National Flood Insurance Program to certify the elevation of a building in relation to the base flood elevation

Emergency Management Assistance Compact—a Congressionally ratified organization through which states provide and receive mutual support in the form of personnel, expertise, and resources after a disaster

Emergency Support Function 14: Long Term Recovery—a subsection of the National Response Plan that provides a coordination mechanism for the federal government to assess the consequences of disasters and to coordinate the long-term recovery

Executive Order 11988—issued by President Carter in 1977, directing all federal agencies to avoid supporting, directly or indirectly, any long- and short-term adverse impacts associated with the occupancy and modification of floodplains; requires federal agencies to exercise leadership in reducing flood risk; minimizing impacts on safety, health, and welfare; and restoring and preserving natural values and functions of floodplains

Flood Insurance Rate Map—an official map of a community, on which the Federal Emergency Management Agency has delineated both the Special Flood Hazard Areas and the risk premium zones applicable to the community. Most FIRMs include detailed floodplain mapping for some or all of a community's floodplains. In most cases, the date of the first FIRM issued to a community is the date the community entered the Regular Program of the National Flood Insurance Program.

Flood Mitigation Assistance—created by the National Flood Insurance Reform Act of 1994 to provide grants to communities for projects that reduce the risk of flood damage to insurable structures

freeboard—an additional amount of height above the base flood elevation used as a factor of safety (e.g., 2 feet above the base flood) in determining the level at which a structure's lowest floor must be elevated or floodproofed

future conditions—the circumstances projected to exist within a community at a designated point in the future that will affect flooding; includes such factors as extent of urbanization, vegetative cover, population, stormwater capacity, sea level, impervious surface, etc.

GIS—geographic information system, a computer-based system for capturing, storing, analyzing and managing data and associated attributes that are spatially referenced to the earth

Hazard Mitigation Grant Program—authorized in 1988 by the Robert T. Stafford Disaster Assistance Act and administered by the Federal Emergency Management Agency, to provide grants to state and local governments to implement long-term hazard mitigation initiatives after a major disaster declaration

ICC—Increased Cost of Compliance, a flood insurance claim provision that helps fund the cost of bringing a flood-damaged building into compliance with floodplain management standards

LiDAR—light detection and ranging; a remote sensing system used to collect topographic data; a lidar system includes an active sensor similar to radar (usually mounted on the bottom of an aircraft), that transmits laser pulses to a target and records the time it takes for the pulse to return to the sensor receiver

Letter of Map Amendment (LOMA)—an amendment, issued by the Federal Emergency Management Agency in letter form, to the currently effective Flood Insurance Rate Map, which establishes that a property is not located in a Special Flood Hazard Area

Letters of Map Change (LOMC)—the set of ways by which the Federal Emergency Management Agency uses an official letter to make an amendment or revision to a Flood Insurance Rate Map; includes Letters of Map Revision and Letters of Map Amendment

Letter of Map Revision (LOMR)—an official amendment, by letter, to the currently effective Flood Insurance Rate Map; issued by the Federal Emergency Management Agency and changes flood zones, delineations, and elevations

Letter of Map Revision based on Fill (LOMR-F)—an official revision, by letter, to an effective National Flood Insurance Program map. A LOMR-F provides the Federal Emergency Management Agency's determination whether a structure or parcel has been elevated on fill above the base flood elevation and excluded from the Special Flood Hazard Area

Map Modernization—a multi-year initiative, funded by Congress beginning in 2003, to improve the nation's flood maps through digitization, updated techniques, and other methods

mitigation—the broad range of activities that can eliminate or reduce flood damage to existing or proposed land uses. Mitigation includes avoiding the impact, minimizing impacts, or compensating for impacts

Monte Carlo simulation—a computerized technique that uses computational algorithms to model the behavior of a physical or mathematical system

National Flood Insurance Program—The program of flood insurance coverage and floodplain management administered under the National Flood Insurance Act and applicable federal regulations promulgated in Title 44 of the Code of Federal Regulations, Subchapter B

NED—national economic development, "increases in the net value of the national output of goods and services, measured in monetary units;" specified in the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies as the objective of federal water resources projects

National Response Plan—establishes a comprehensive all-hazards approach to enhance the ability of the United States to manage domestic natural, technological, chemical, and terrorist incidents; specifies how and establishes protocols for the federal government’s coordination with state, local, and tribal governments and the private sector during incidents

National Streamflow Information Program—the U.S. Geological Survey initiative to operate and maintain approximately 7,300 streamgages nationwide to provide long-term, accurate, and unbiased information for water resources management

no adverse impact—a principle fostered in floodplain management by the Association of State Floodplain Managers that calls for advance consideration of the potential negative consequences of any proposed development or floodplain-related activity, and taking steps to avoid or mitigate such consequences

nonstructural measures—flood loss reduction approaches that address the susceptibility of people to flooding or modify the impacts of flooding

post-wildfire conditions—the changed status of a watershed or portions of it after a fire, including altered soils and lack of vegetative cover, that act to modify runoff and flow regimes

Pre-Disaster Mitigation program—administered by the Federal Emergency Management Agency to provide grants, on a competitive basis, to states, localities, and universities for hazard mitigation planning and projects before a disaster

pre-FIRM—for insurance rating purposes, a pre-FIRM building is one that was constructed or substantially improved on or before December 31, 1974, or before the effective date of the initial Flood Insurance Rate Map of the community, whichever is later. Most pre-FIRM buildings were constructed without taking the flood hazard into account.

Principles and Guidelines—the Corps of Engineers is required to follow detailed procedures for benefit-cost analysis as described in the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*, issued in 1983, which states that the federal objective in water resources planning is to “contribute to national economic development,” or NED. Contributions to NED are “increases in the net value of the national output of goods and services, measured in monetary units.” Note that the Federal Emergency Management Agency is required to follow a different benefit-cost analysis, set out in Circular No. A-20, issued by the Office of Management and Budget.

repetitive loss structure—any building that has suffered four or more flood losses, or more than two losses that cumulatively equaled or exceeded the building’s value, during any 10-year period

riparian—generally relating to the transition zone between aquatic (specifically flowing water) and terrestrial ecosystems within which plants are dependent on a perpetual source of water

risk-based analysis—a method of studying proposed flood damage reduction projects, similar to traditional approaches but allows uncertainties in the fundamental data to be quantified and explicitly included in the evaluations of project performance

special hazards, special flood-related hazards—features of the local terrain or climate that accompany or aggravate flooding, such as alluvial fans, closed-basin lakes, ice jams, subsidence, or uncertain flow paths

Special Flood Hazard Area—the base floodplain delineated on a Flood Insurance Rate Map. The SFHA is mapped as a Zone A. In coastal situations, Zone V is also a part of the SFHA. The SFHA may or may not encompass all of a community's flood problems

structural measures—flood loss reduction approaches that use constructed measures to prevent flood waters from reaching people or property

subsidence—the long term sinking of land level due to withdrawal of groundwater, draining of organic soils, or other causes

substantial damage—damage of any origin sustained by a building whereby the cost of restoring the building to its before-damage condition would equal or exceed 50% of the market value of the building before the damage occurred

substantial improvements—any reconstruction, rehabilitation, addition, or other improvement to a building, the cost of which equals or exceeds 50% of the market value of the building before the start of construction of the improvement

Technical Mapping Advisory Council—a committee of experts from various disciplines created pursuant to the National Flood Insurance Reform Act of 1994 to advise the Federal Emergency Management Agency on flood mapping standards, guidelines, and related issues

unique hazards—see special hazards

tsunami—a large wave caused by an underwater earthquake or volcano that can raise water levels on the ocean shore as much as 15 feet

watershed—an area of land surface that drains into a lake, stream, or other body of water

zero-rise floodway—the channel of the stream and that portion of the adjoining floodplain which is necessary to contain and discharge the base flood flow without causing any increase in the base flood elevation; will always include the floodway as delineated under the National Flood Insurance Program, which allows a one-foot rise



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