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**From Flood Damage Reduction to  
Flood Risk Management:  
Implications for U.S. Army Corps of  
Engineers Policy and Programs**

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**US Army Corps  
of Engineers®**



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# **From Flood Damage Reduction to Flood Risk Management: Implications for U.S. Army Corps of Engineers Policy and Programs**

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U.S. Army Corps of Engineers  
Institute for Water Resources

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Appendix A: Vocabulary of Flood Risk Management Terms (L. Shabman, P. Scodari, C. Kousky, and D. Woolley)

Appendix B: Review of Federal Reports on a Unified National Program for Floodplain Management, 1966-1994 (P. Scodari and L. Shabman)

Appendix C: Understanding Decision Making by Communities and Individuals that Affects Flood Risk (L. Shabman, C. Kousky, and D. Woolley)

Appendix D: U.S. Army Corps of Engineers Flood Risk Management Programs (P. Scodari)

## Acknowledgements

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The report was written by Leonard Shabman (Resources for the Future) and Paul Scodari (USACE Institute for Water Resources), with assistance from Carolyn Kousky (Resources for the Future) and Douglas Woolley (Consultant). The four stand-alone report appendices were written by different combinations of the individuals noted above. Laura Zepp (USACE Institute for Water Resources) provided study administrative management and research assistance.

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*The content of this report is solely the responsibility of the authors. The report does not represent the views of the USACE, Department of the Army, or the Executive Branch, nor does it imply any endorsement of the report content by those entities.*

## **Executive Summary**

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This report presents the results of a study to investigate policy and program changes that would allow the U.S. Army Corps of Engineers (USACE) to be more effective in sharing responsibility with other federal agencies, non-federal governments, and floodplain occupants in the management of flood risk. The report first presents a conceptual framework to make operational the call for shared responsibility in the design and execution of USACE flood risk management (FRM) programs. Development of the framework begins with an historical review of the overlapping roles played by the federal government in FRM, and perspectives on federal FRM objectives that have been articulated by different parties at different times in the nation's history. This history is presented in Chapter 2. Based on that history, Chapter 3 develops the logic and case for an explicit USACE and federal policy framework to promote risk informed and cost responsible (RICR) decision-making by communities (i.e., local governments) and individuals (i.e., landowners, households, and businesses) with respect to their choices on floodplain location and use and the adoption of risk reduction and management actions.

A RICR-based policy as the means to foster economically efficient uses of floodplains was first articulated decades ago in a seminal 1966 report by a federal task force chaired by Gilbert White, and stands in contrast to the frequent assertion that the federal FRM objective is to reduce the adverse consequences of flooding as an end in itself. With the promotion of RICR decision-making as the FRM objective, the USACE role would include intentional efforts to:

- Develop and communicate information on flood risk and risk reduction and management measures so that those who realize the benefits of floodplain use are “risk informed,” meaning that they are aware of the risks they face as well as actions they could take to reduce and manage those risks;
- Assure that floodplain communities and individuals are “cost responsible,” meaning that they assume responsibility for the legally-prescribed financial, risk, and environmental costs of their floodplain location and use and risk reduction and management choices, and;
- Continuously review USACE programs that communicate risk and allow for cost transfers and evaluate their influence on the choices made by floodplain communities and individuals and their implications for economic efficiency and social equity.

In Chapter 4, the RICR framework is used to organize and present practical and detailed recommendations for USACE FRM policy and program actions to advance risk-informed and cost responsible decisions by communities and individuals. The recommendations are organized under three broad themes:

- *Effective Provision of Risk Information:* Achieving shared responsibility requires development and dissemination of information that can increase the understanding by communities and individuals of: 1) place-based flood likelihoods and consequences; 2) the effectiveness and costs of risk reduction and risk management actions that they could take, and; 3) technical and financial contributions to flood risk reduction and management actions made available through USACE and other federal policies and programs. Specific recommendations are offered to promote this increased understanding.
- *Promoting Cost Responsibility in a Limited Budget Environment:* Attention to RICR as the federal policy goal, combined with recognition of limited federal authorities and budget resources, suggests specific changes to USACE project cost sharing, planning, and budgeting practices.
- *Continuous Policy and Program Evaluation:* The effectiveness of USACE programs to advance RICR should be continuously reviewed and evaluated. The recommendations suggest metrics for measuring RICR success and develop a protocol for evaluating USACE program influences on the choices made by communities and individuals.

The report includes four appendices that provide support for the content included in the main text. Appendix A presents a vocabulary of FRM terms that was developed for consistent use within the report in recognition that varied and inconsistent use of terms makes it difficult to have a coherent policy discourse on FRM. Appendix B describes the 1966 federal task force report that first introduced the RICR concept as a means to achieve the economically efficient use of the nation's floodplains and compares that report with the series of later federal reports on *A Unified National Program for Floodplain Management*. Appendix C provides an overview of floodplain location and use and risk reduction and management decision-making by communities and individuals, which is the context for the design of policies to advance RICR. Appendix D is a comprehensive review of current USACE FRM programs based on USACE policy documents, program authorities, regulations, budget data, and interviews with program staff.

There has been over a century of USACE and federal attention to flood risk management. Over that time there have been thousands of studies, reports, and recommendations relating to USACE and federal roles and objectives in FRM. This report makes no claim to offering a comprehensive review of that literature or wholly new ideas. Rather, this report is a combination of a historical retrospective, a USACE program status report, and a platform for making suggestions for effective and efficient USACE policy and program design and execution, in part by reclaiming and updating policy ideas from the nations' history of FRM reports.

## **Chapter 1. Introduction**

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### **1.1 Background**

The loss of life and property damages resulting from a series of major riverine and coastal flood events over the last several years reminded the nation of the reality of low probability, high consequence flood events. Notable events include Hurricane Katrina caused tidal flooding in the Gulf Coast states in 2005, river flooding in the Midwest in 2008, floods along the Mississippi River System and in the Missouri River Basin in 2011, and tidal flooding in the Mid-Atlantic region caused by Superstorm Sandy in 2012. Meanwhile, there is an increasingly vocalized belief among many commentators that the likelihood of extreme flood events is increasing in unpredictable ways (termed “non-stationarity” of the hydrograph).

This recent history has focused attention on the state of the nation’s flood hazard reduction infrastructure and more broadly on federal government FRM roles and objectives. Several federal agencies have programs and activities that touch on FRM, but the programs most associated with this public policy concern are found in the U.S. Army Corps of Engineers (USACE) and in the U.S. Department of Homeland Security, Federal Emergency Management Agency (FEMA). In recent years there has been an acceleration of FRM activities within these two agencies that were underway prior to Hurricane Katrina as well as the development and implementation of new, post-Katrina FRM initiatives.

USACE programs relating to existing USACE-built flood hazard reduction projects such as dams and levees have undergone significant changes over the last ten years. Prior to Hurricane Katrina, the USACE Dam Safety Program began moving to its current “portfolio risk management approach” for USACE-managed dams that defines a nationwide process for prioritizing dam rehabilitation resources based on relative risk for life safety. And after Hurricane Katrina, the USACE instituted a more rigorous process for the USACE annual inspection and rating of levee system operation and maintenance performed by non-federal project sponsors that is now part of the relatively new USACE Levee Safety Program (see Box 1-1).

The pre-flood FRM programs of FEMA have long been organized around conveying information about flood risk (most directly in the form of flood insurance rate maps and insurance policy premiums), and using “carrots and sticks” to induce communities and individuals to limit the exposure and vulnerability of their assets to flooding and to manage residual risk through insurance. In recent years, FEMA as well as other federal agencies have enhanced their efforts to assess and communicate information on place-based flood risks.

At FEMA, risk communication activities include completion of the agency’s “Map Modernization” (Map Mod) program to digitize and partially update flood hazard maps for the National Flood Insurance Program (NFIP), and initiation of the agency’s “Risk MAP” program that builds on Map Mod. The objectives of Risk MAP include ensuring that 80% of the nation’s flood hazard data is current, providing

updated flood hazard data for coastal areas, and continuing to update flood insurance rate maps as needed.

Meanwhile, FEMA efforts under the NFIP to require the re-accreditation of levees on updated flood insurance rate maps has led to broader discussions about NFIP design and requirements, including the affordability of flood insurance. And there is now increased attention to NFIP fiscal soundness, emphasized by the program's debt to the U.S. Treasury incurred as a result of the unprecedented level of insurance payouts following Hurricane Katrina.

**Box 1-1: USACE Post-Katrina Flood Risk Management Initiatives**

The USACE National Flood Risk Management Program (NFRMP) was established in 2006 to foster coordination and collaboration among the FRM programs and activities within the USACE and across other federal agencies, state and local governments, and the private sector. The program seeks to eliminate unintended conflicts among federal programs and improve state and local understanding of and access to federal FRM services. One example of an NFRMP-sponsored intergovernmental activity is the Silver Jackets program that operates at the state level.

The USACE Levee Safety Program (LSP), which the USACE began standing-up in 2007 as a national program, has as its mission "to work with others to assess, communicate, and manage the risks to people, property and the environment from inundation that may result from breach (either prior or subsequent to overtopping), or malfunction of levee system components." The LSP includes the development of a national levee database as well as various routine and non-routine processes that are part of the LSP portfolio risk management process. The routine processes, which are now being implemented, include: 1) a revised and more rigorous process for the annual inspection and rating of levee system operation and maintenance (O&M) that is the responsibility of non-federal levee sponsors; 2) a new "periodic" inspection regime that goes beyond the rating of levee system O&M to develop a preliminary understanding of potential project performance and safety, and; 3) risk screening and classification of levees according to their relative risks for life safety associated with potential levee failure, which is to be used for risk communication purposes and to guide and to prioritize potential further risk assessments and management actions.

The USACE Rehabilitation and Inspection Program (RIP) is a long-standing program that allows the non-federal sponsors of eligible levee systems enrolled in the RIP to receive federal funding assistance for the repair of these systems were they to be damaged by floods or coastal storms. The revised annual inspection process for levee O&M is now being employed to determine whether levee systems enrolled in the program can remain eligible for future federal rehabilitation assistance. Further, the USACE is now in the process of revising program rules that may introduce significant changes to RIP policies and procedures.

## **1.2 Study Objective and Focus**

This report responds to a request by USACE Headquarters for a policy study to investigate possible procedural and legislative changes that would allow the USACE to be more effective in working with other federal agencies, state and local governments, and stakeholders in the management of flood risk. It develops a conceptual framework to make operational the call for shared responsibility for FRM in the

design and execution of USACE FRM policies and programs. Shared responsibility for FRM was highlighted by a 2008 white paper authored by former Director of Civil Works, Major General Tom T. Riley (Riley, 2008), and is implicit in the mission statements for the USACE National Flood Risk Management Program and Levee Safety Program. Nevertheless, at this point the USACE emphasis on shared responsibility is largely more of a philosophical concept than an operational construct having clear expectations and requirements.

As an organizing principle, this policy study adopts the premise that shared responsibility in FRM can be made operational through a USACE and federal policy goal to promote economically efficient uses of floodplains by fostering risk informed and cost responsible (RICR) decision-making by communities (i.e., local governments) and individuals (i.e., landowners, households, and businesses) with respect to floodplain location and use and the adoption of flood risk reduction and residual risk management actions. In so doing it reaffirms the federal FRM objective and role articulated in a seminal 1966 report, *A Unified National Program for Managing Flood Losses* (also known as House Document 465), developed by a federal task force chaired by Gilbert White (U.S. Task Force on Federal Flood Control Policy, 1966). The RICR framework is used to make practical and detailed recommendations for USACE FRM policy and program actions that could advance risk informed and cost responsible decision-making by communities and individuals.

The recommendations focus on the management of flood risks associated with flood hazards from large river systems and their tributaries. The main sources of flood hazards include: 1) large rivers and tributaries flooding, 2) tidal surge flooding in coastal areas, and 3) small stream and catchment flooding (sometimes called “urban drainage” or “storm water”). While USACE authorities and missions relate at least to some extent to each hazard source, most USACE attention and budget are focused on rivers and tributaries flooding.<sup>1</sup> Such “slow rise” river flooding remains the main focus of USACE programs, with agency attention increasingly centered on developed areas along major river systems with existing USACE-built hazard reduction infrastructure, and the assessment, communication, and management of residual risk in those areas. Nevertheless, the recommendations outlined here may also be largely applicable to FRM with respect to coastal flood hazards.<sup>2</sup>

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<sup>1</sup> With respect to small stream and catchment flooding, USACE rules have long maintained that it is a non-federal responsibility to provide drainage systems to collect and convey local runoff in urban and urbanizing areas. And until relatively recently, tidal surge protection, such as that being provided for Southeast Louisiana, and shore protection projects, such as beach nourishment along the Atlantic coast in the aftermath of Superstorm Sandy, have been the exception rather than the rule for USACE attention.

<sup>2</sup> One differential characteristic of tidal flood hazards is that the reality of sea level rise will necessarily increase over time the potential for flooding and adverse consequences resulting from a coastal storm of any given magnitude.

### **1.3 Report Organization**

The report material is presented in three remaining chapters. Chapter 2 provides a brief historical review of USACE and federal roles and objectives in FRM. The evolution of federal FRM across three time periods in the nation's history is first presented. That is followed by an interpretive review of differing perspectives on the objectives to be served by federal FRM efforts that have been articulated by different parties at different times in the nation's history.

Chapter 3 describes and presents the case for defining the USACE and federal role in FRM as promoting risk informed and cost responsible decisions with respect to floodplain location and use and the choice of actions to reduce flood risk and manage residual risk, where the decision-makers are floodplain communities and residents. The argument is based on both the normative logic of House Document 465 as articulated in 1966, as well as recognition of the practical limits on the capacity of USACE and federal FRM programs to directly influence the use of non-federal lands.

Chapter 4 presents recommendations directed toward using RICR decision-making as the organizing principle for making USACE policy and program changes that would advance USACE efforts to share responsibility for FRM with other federal agencies, non-federal governments, and floodplain occupants. The recommendations are organized under three broad themes:

1. Effective provision of risk information;
2. Promoting cost responsibility in a limited budget environment, and;
3. Policy and program evaluation.

The recommendations build from current realities, including that changes to emphasize RICR must begin with adaptations to current USACE and federal FRM programs, and must recognize and accommodate dominant themes in the current FRM policy dialogue, such as climate change, natural and beneficial functions of floodplains, NFIP reforms, as well as the USACE new emphasis on life safety in the areas served by USACE-built levees.

### **1.4 Report Appendices**

The supporting materials used to develop the report contents are contained in four appendices that are written and provided as stand-alone documents. These were informed by a wide variety of information sources (see Box 1-2).

Appendix A presents a vocabulary of FRM terms developed for consistent use within this report in recognition that varied and inconsistent use of terms makes it difficult to have a coherent policy discourse on FRM. Its development began with a review of a glossary of risk analysis terms used by the Department of Homeland Security. This was followed by comparing these terms and definitions against those found in the contemporary literature on risk analysis, as well as the terminology now being used in the agency's application of uncertainty and risk analysis as well as in the USACE Dam and Levee Safety Programs. The risk analysis framework was then used to develop a FRM-specific vocabulary for use in

this report. The result is that new FRM terms emerge, some terms used in FRM programs are redefined within a risk analysis framework, and some common terms in the literature do not appear in this report.

The vocabulary has a particular logical flow that dictates that the terms not be listed alphabetically. Instead, terms are listed in an order that allows each definition to follow logically from and build upon the definitions that precede it. Readers are strongly recommended to read the vocabulary in its entirety and in the order that the terms appear before reading the remaining report chapters; however, a review of the key terms provided in Box 1-3 at the end of this chapter is sufficient if readers choose to move directly to Chapter 2.

Attachment B compares House Document 465 that in 1966 first introduced the RICR concept as a means to promote the economically efficient use of floodplains, with the series of later federal reports on *A Unified National Program for Floodplain Management* that argued for an alternative federal objective to secure “wise use of floodplains” through minimizing damages.

Attachment C provides an overview of floodplain location and use and risk reduction and management decision-making by communities and individuals, which is the context for the design of USACE policies to advance RICR. It also reviews findings from the behavioral science literature on how individuals understand and act on risk information, and the implications for the design, execution, and evaluation of risk communication programs.

Attachment D provides a comprehensive review of USACE FRM programs. Major component programs, activities, and budget trends are described. The review highlights that some significant component programs have only recently been introduced and are still in development, while other long-standing program elements are now being modified in significant ways.

**Box 1-2: Study Information Sources**

The FRM policy analyses, review of USACE and other federal FRM programs, and recommendations included in this report are based on detailed reviews of USACE and other federal agency policy documents, program authorities, regulations, and budget data as well as interviews with USACE and FEMA staff; reviews of current federal executive and interagency programs and initiatives, and; reviews of past federal task force and interagency reports on federal FRM. The insights offered on non-federal FRM capabilities and decision-making influences are based on a review of the available literature as well as case studies of the FRM challenges faced by three localities that are described in Appendix C. Also, during the study the report authors had access to the USACE daily news clip service and also used internet searches to identify additional news articles on the FRM challenges faced by localities around the nation. Those news articles provided the report authors with a further appreciation of community FRM capabilities and commitments, including meeting cost share requirements for USACE hazard reduction projects; understanding the interactions between USACE levee inspections and FEMA flood mapping for the NFIP; maintaining eligibility for PL 84-99 rehabilitation funding for flood-caused damage to levees; understanding flood risk, and more. In limited cases, the authors of this report conducted interviews with USACE staff familiar with the local situations described in the news articles as well as with local officials. Although the report contents and recommendations draw on insights gained from these news articles and interviews, none of the particular local cases reviewed in the articles are specifically cited in this report apart from the local case studies described in Appendix C.

**Box 1-3: Examples from the Vocabulary of Flood Risk Management Terms (Appendix A)**

**Flood:** A temporary condition of partial or complete inundation of normally dry land resulting from the overflow of inland or tidal waters or from unusual and rapid accumulation of surface runoff from any source.

**Floodplain:** Any land area that is susceptible to floods, which includes but is not limited to lands subject to a 1% or greater chance of flooding in any given year.

**Flood Hazard:** The predicted probability distribution of flood water surface elevations for different locations within a floodplain expected from all possible floods.

**Exposure:** The potential for people and assets to come into direct contact with flood water as a result of their location in a floodplain.

**Vulnerability:** The characteristics of people and assets that affect the likelihood that they will realize adverse consequences from exposure to the flood hazard.

**Resiliency:** The ability of people and assets to return to pre-flood conditions and functionality in the aftermath of realizing flood damage.

**Floodplain Management:** Policies and programs of federal and non-federal government directed to actions taken in advance of a flood that are intended to limit the exposure and vulnerability of people and assets to flooding.

**Flood Risk:** The likelihood and adverse consequences of flooding. Flood risk for people and assets at any location in a floodplain is a function of the flood hazard at that location and their exposure and vulnerability to the flood hazard.

**Flood Risk Reduction Actions:** Actions that are intended to reduce the likelihood or potential adverse consequences of a future flood. They include actions to reduce the flood hazard, reduce exposure, and reduce vulnerability.

**Residual Risk:** The level of flood risk realized by people and assets in a floodplain that remains after implementation of flood risk reduction actions.

**Residual Risk Management Actions:** Actions that increase the ability of people and assets to return to pre-flood conditions and functionality in the aftermath of realizing flood damage.

**Flood Risk Management:** The mix of federal and non-federal government policies and programs that influence the decisions made by communities and individuals relating to floodplain location and use and their choice of actions to reduce flood risk and manage residual risk. The term also covers the decisions actually made by all levels of government and by individuals to implement actions to reduce flood hazard, exposure, and vulnerability, and to increase resiliency.

## **1.5 References**

Riley, M.G. Don T. 2008. *Improving Public Safety – From Federal Protection to Shared Risk Reduction*. Unpublished White Paper. U.S. Army Corps of Engineers.

U.S. Task Force on Federal Flood Control Policy. 1966. *A Unified National Program for Managing Flood Losses*. 89<sup>th</sup> Congress, 2<sup>d</sup> Session. House Document 465. Washington, DC: U.S. Government Printing Office.

## **Chapter 2. A Brief History of USACE and Federal Roles and Objectives in Flood Risk Management**

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### **2.1 Introduction**

This chapter begins with a brief historical review of the overlapping roles played by the USACE and the federal government in flood risk management (FRM). That is followed by an interpretive review of differing perspectives on the federal objective to be served by federal FRM efforts that have been articulated by different parties at different times in the nation's history. Today, there appears to be no agreed-upon, overarching federal objective that provides operational guidance for the design and execution of USACE and federal FRM policies and programs in the 21<sup>st</sup> Century.

### **2.2 Evolution of Federal Roles**

The evolution of federal FRM roles across three time periods in the nation's history is reviewed below. As new federal responsibilities were added, they built upon existing responsibilities and the emphasis given to any particular federal role has varied over time.

#### **2.2.1 Post Civil War into the Early Twentieth Century**

From the nation's founding until the beginning of the 20<sup>th</sup> century, the federal role in "internal improvements" to support waterborne transportation (navigation) was vigorously debated. The post-Civil War era ushered in growing support for federal appropriations to implement federally-developed plans for internal improvements. By 1900, there was resolution on the constitutionality of this federal role and acceptance of the view that federal appropriations for internal improvements were necessary and appropriate.

During this same time period, the federal government increasingly came to view those who experienced adverse consequences from flooding as "victims" who might be entitled to federal relief (Dauber, 2005). Congressional debates over post-flood aid reflected concerns about whether the disbursement of federal aid was constitutional, about how to isolate those who were unsuspecting "victims" from those who took "foolish" risks, whether those who receive aid should work in return for that aid, and over the threshold level of damages that had to be passed before federal aid would be deemed justified. As early as 1811, Congress had enacted various laws that have been cited as precedents for federal disaster assistance, and in 1882, the USACE was given its first authority to participate in disaster relief efforts (Johnson, 2011).

Even as questions were raised and answered about federal roles in navigation improvements and post-flood relief, there was agreement between the Executive Branch and Congress that there was no direct federal role in flood risk reduction. During that period, flood risk reduction was deemed a non-federal responsibility to be paid for by the beneficiaries of that risk reduction. This was to be accomplished by states that could provide financial assistance and could authorize the creation of local drainage and levee districts that could raise funds for and implement local flood protection. However, the federal role did allow for land grants to promote land drainage and local flood protection works.

At the beginning of the 20<sup>th</sup> century, the Progressive Conservation Movement with its belief in “scientific management” began to influence the understanding of the federal role in water resource planning and development. Participants in an historic 1908 White House conference called for water control through dams and reservoirs and for reforestation of denuded hillsides in the name of water conservation (Shabman, 2007). Such water conservation was justified as promoting national prosperity, but flood hazard reduction (what was then called “flood control”) was deemed to be at most an ancillary benefit of water conservation projects pursued for other purposes. Nonetheless, some speakers at the conference suggested that reducing flood damages and fostering the expanded use of floodplains for farms and population settlements through flood control works would advance national prosperity. For example, Lyman E. Coolley, a prominent water resources expert at the time, in one of only a few talks at the conference that even mentioned flood control, expressed the following view on the benefits of multipurpose dams and reservoirs:

“Our surplus waters are next in value to the land; they are self-replenishing, renewing themselves in the seasons and throughout the years; they are part of the public domain which has never been segregated, and should be forever held for the use of the People in common...

Water conservation demands storage and 4 to 6% of the area in reservoirs will equalize the flow of streams. By fish culture, such reservoirs will have greater value than the lands taken. They add to the landscape, and make places of recreation for the People...

Floods will be abolished or mitigated, thus reclaiming the wealth and alluvial lands along the watercourses in making the valleys salubrious. The flow of streams will be equalized and made navigable throughout the year, even to the remote reservoir sites, and by improvement of these natural channels and by connecting the water systems advantage points, a great transportation agency will be evolved as a complement to our railway system, and as a necessity for our larger growth and complete development”(Conference on Conservation of Natural Resources, 1909; Pages 349-350).

Against this backdrop, the early 20<sup>th</sup> century saw the USACE leading the federal role in making navigation improvements by river clearing, dredging channels, and building levees. What has since been described as a “levees only” approach was adopted for supporting navigation on the lower Mississippi River and other large river systems. The levees only approach was founded on the expectation that levees would “train” river hydraulics to scour and maintain deep channels needed for navigation; overbank flooding would also be reduced as an ancillary benefit (Reuss, 1985).

Meanwhile, damaging floods on large rivers such as the Ohio and Tennessee in the early 1900s caught the attention of the nation. Some floods occurred where there were no levees, and in other places, levees that had been built by non-federal interests were routinely breached. The recurrence of frequent flooding fostered a national debate over whether there was a federal responsibility to construct flood hazard reduction projects to prevent suffering and promote national prosperity (Marshall, 1913).

In 1917, Congress passed the first federal flood control act that asserted a direct federal responsibility in flood hazard reduction. But that act applied only to the Mississippi and Sacramento Rivers that were then viewed as special problems; it did not authorize a general federal role in flood control.

### **2.2.2 Early Twentieth Century into the 1960s**

The Mississippi River flood of 1927 breached the massive federal levee system, challenging the levees only approach to water management. The images of flood victims standing on levees along the lower Mississippi River advanced the case for a federal role in building hazard reduction projects for the nation that would include dams and reservoirs as well as levees and channels.

In the midst of the Depression, New Deal leaders supported an expanded federal role in flood control, especially on interstate “navigable waters” to assure optimal river basin development (Wengert, 1981).<sup>3</sup> The Progressive Era vision of multi-purpose river development for hydroelectric power production, inland navigation and harbors, and agricultural irrigation for advancing national prosperity now included flood hazard reduction. A 1934 report of the federal National Resources Board captured the spirit of that time when it argued that “... in the interests of national welfare there must be control of the nation’s water from the desert trickle that may make an acre or two productive to the rushing floods of the Mississippi” (Natural Resources Board, 1934; Page 255).

Such “control of the nation’s water” would allow places where there were already settlements in flood-prone areas to prosper. The control of flooding in other places would turn undeveloped, flood-prone areas into economically-valuable lands that would allow for the expansion of agriculture, industry, and cities.

The Flood Control Act of 1936 established a general federal responsibility in flood hazard reduction. It stated:

“Section 1. It is hereby recognized that destructive floods upon the rivers of the United States, upsetting orderly processes and causing loss of life and property, including the erosion of lands and impairing and obstructing navigation, highways, railroads, and other channels of commerce between the States, constitute a menace to national welfare; that it is the sense of Congress that flood control on navigational waters or their tributaries is a proper activity of the Federal Government in cooperation with States, their political sub-divisions and localities thereof; that investigations and improvements of rivers and other waterways, including watersheds thereof,

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<sup>3</sup> An often cited justification for the federal role was that controlling flooding and enhancing navigation on interstate waters required a larger geographic perspective than what might be taken by states acting alone. This same argument also supported the creation of independent river basin authorities, but only the Tennessee Valley Authority became an operational entity.

for flood-control purposes are in the interest of the general welfare; that the Federal Government should improve or participate in the improvement of navigable waters or their tributaries including watersheds thereof, for flood-control purposes if the benefits to whomsoever they may accrue are in excess of the estimated costs, and if the lives and social security of people are otherwise adversely affected.”

The act called on the USACE to execute this federal responsibility. The initial focus of the USACE flood hazard reduction program was the construction of dams and reservoirs and other major flood control works on large interstate rivers. The program was later extended to constructing smaller-scale “local protection projects” for individual communities that were turned over to their non-federal sponsors for operation and maintenance and other management when construction was completed.

During this period there remained a concern that the control of runoff from smaller watersheds needed to be addressed (Person, 1936). To fill this need, the US Department of Agriculture (USDA) Soil Conservation Service (SCS) was given the authority to develop land treatment programs for small watersheds, and the USDA Forest Service created a program for reforesting those watersheds. By the late 1940s, the SCS had begun to partner with rural communities and landowners to construct small watershed hazard reduction projects. In 1954, a formal delineation was created whereby the USACE would have flood risk reduction responsibilities on interstate waters and in larger watersheds, and the SCS would lead the federal effort to build small-scale dams and related projects in smaller watersheds.

### **2.2.3 1960s to the Present**

Support for new federal flood hazard reduction projects diminished by the end of the 1960s (U.S. National Water Commission, 1973). The reasons that have been given for the diminished support are many. Most often cited is that the “best” projects (projects essential to national prosperity) had been built by the 1970s, as well as the rising influence of those who opposed water projects for aesthetic reasons and then later on environmental protection and restoration grounds (Shabman, 2007). Another cited reason was the drain on the federal treasury, since the federal government had primary funding responsibility for USACE and SCS projects.

The Water Resources Development Act of 1986 shifted a greater share of the costs for federally-authorized flood hazard reduction projects to non-federal project sponsors. This requirement reduced the demand for local protection projects and accelerated a decline in the USACE budget for flood hazard reduction (as well as USDA’s budget for small watershed projects). Today, the USACE construction budget for such work, as measured in inflation-adjusted dollars, is less than one-third its level in the mid-1960s, and the USDA small watershed flood hazard reduction program barely exists.

The legacy of the USACE construction program is hundreds of dams and thousands of miles of levees and channels built for the purpose of reducing flood hazards. This infrastructure has had the effect of reducing the flood hazard in many areas, but also introducing the potential for higher consequences if a flood that overcame the flood hazard reduction works were to occur. This flood hazard reduction infrastructure is now aging and concerns for its current reliability (structural integrity as well as the degree of protection provided) are focusing attention on assessing its state, communicating its condition

to affected communities, and where warranted and as budgets allow, rehabilitating it (National Committee on Levee Safety, 2009).<sup>4</sup>

Even as hazard reduction projects were the focus of USACE and federal FRM policy, there was an understanding that the potential consequences of flooding were the result of floodplain location and use decisions as well as risk reduction and management choices made by local governments and residents. There were frequent calls for land use regulation to accompany flood hazard reduction projects, but constitutional limits on the federal role in land use decision-making were clear.

The creation of the National Flood Insurance Program (NFIP) in 1968 established new federal incentives for communities to implement land use regulation. The NFIP provided floodplain occupants with the means to manage their residual flood risk through the purchase of federally-underwritten flood insurance in return for the commitment by participating communities to implement minimum floodplain management standards. These minimum standards were intended to reduce potential property damages (and thus insurance claims) by reducing the exposure and vulnerability of assets to flooding in the most risky locations.

One stated purpose of the NFIP was to provide an alternative to disaster aid; nevertheless, federal disaster assistance has grown substantially since 1990, and reached unprecedented levels in the years following the 2005 hurricane season. The expansion of federal post-flood aid over this time, relying mainly on emergency supplemental appropriations, has been driven by changes in the rules allowing for Presidential disaster declarations and by increased property value exposure to flood hazards. The increasing federal expenditures on post-flood aid have raised concerns about unpredictable future federal budget exposure. And there is a concern that the prospect of receiving federal disaster assistance may create a “moral hazard” by providing incentives for expanded development in high risk areas and disincentives for floodplain occupants to carry flood insurance (Lichtenberg, 1994).

## **2.3 Perspectives on Federal Objectives**

### **2.3.1 National Prosperity through Protection and Economic Development**

The Flood Control Act (FCA) of 1936 reflected the belief that an expanded federal role in flood hazard reduction would promote national prosperity by reducing human suffering and property damages as well as by promoting economic development. At the time of the 1936 FCA, the widespread expectation was that engineers could control hydrologic extremes and thus eliminate the flooding of floodplains. The result of such flood hazard reduction would not only be to reduce the threat of flooding in already developed areas, but also would allow for and even *encourage* the economic development of vacant,

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<sup>4</sup> For example, roughly one-half of the USACE FRM construction budget in fiscal year 2010 was devoted to the investigation and rehabilitation of USACE-managed dams.

flood-prone areas. The question was whether individual project investments could be justified following the justification standard set out in the 1936 FCA.

To implement that project justification standard, a metric for representing the “benefits to whomsoever they may accrue” was needed in order to compare with costs, and that metric needed to be consistently calculated for different prospective projects. The metric chosen to represent project benefits was the value of property damages avoided (White, 1939; Shabman, 1995).

Property damages avoided was easily appreciated as a benefit metric for its cost-effectiveness logic, although it always was recognized to be only a proxy measure for the broad national prosperity objective outlined in the 1936 FCA. Using this narrow metric of project benefits, investment in a flood hazard reduction project could be justified if the cost of the project were less than the present value of the stream of future property damages prevented. And importantly, the premise favoring economic development meant that estimates of project benefits could include property damages avoided for prospective future but yet unrealized land development.

Two years after passage of the 1936 FCA, the Flood Control Act of 1938 provided the USACE with the authority to modify the plan for any authorized project if construction costs could be reduced by the evacuation of people and structures in a portion or all of the area that would be protected by the project, and those costs savings were sufficient to cover all evacuation costs. This reflected a realization that, despite the national prosperity objective that encouraged economic development, the removal of existing floodplain development might sometimes be justified on efficiency grounds.

### **2.3.2 Economically Efficient Use of Floodplains through Human Adjustments**

In the early 1940s, Gilbert White was a young budget analyst in the administration of Franklin Roosevelt where he was engaged in the response to the 1936 FCA. After leaving government, White earned a PhD in geography from the University of Chicago.

In his PhD dissertation, *Human Adjustment to Floods: A Geographical Approach to the Flood Problem in the United States* (White, 1945), White argued that the federal focus on hazard reduction projects (mostly paid for by the federal government) was too narrow for a national policy toward flood risk. He argued for a broader approach relying on a mix of “human adjustments” that included, but was not limited to, hazard reduction projects. Among the other adjustments he identified were restrictions on certain land uses, flood proofing and other structural changes to buildings, warning and evacuation systems, as well as “bearing the loss” in order to realize benefits of floodplain use. But how should the nation think about floodplain use if flood damages inevitably accompanied the benefits of that use? Twenty years after his dissertation was published, this question was answered in House Document 465.

#### **2.3.2.1 House Document 465**

The 1966 report, *A Unified National Program for Managing Flood Losses* (U.S. Task Force on Federal Flood Control Policy, 1966), also known as House Document 465 (HD 465), was prepared by a federal

task force on flood control policy under the leadership of Gilbert White. In an interview many years later, Dr. White had this clarifying comment about use of the term “losses” in the report title:

“Although the group had been put together and I had first been asked to work on federal flood control policy, the title of the report was different from that which it had been intended to be...In fact, I would like to have had it speak on making best use of the floodplains. But people thought that was pushing it too far, that it would be a more attractive and supportable set of recommendations if the title were reducing or managing flood losses...” (Reuss, 1993; Pages 48-49).

HD 465 normatively asserted that federal policy should seek to promote economically efficient floodplain uses, meaning that the benefits to individuals and the nation of floodplain location and use decisions should outweigh the costs. Those costs include all possible damages that might be incurred by floodplain occupants, any financial and risk costs transferred to others, as well as any natural floodplain and related wetlands values lost (where the latter was described in HD 465 as “recreation and wildlife conservation values”). This objective for floodplain use was explained by HD 465 as follows:

“Use of floodplains involving periodic damages is not, in itself, a sign of unwarranted or inefficient development. It may well be that the advantages of floodplain location outweigh the intermittent cost of damage from floods. Further, there are some kinds of activities which can only be conducted near a watercourse. Principles of *national economic efficiency* require, however, that the benefits of floodplain occupancy exceed all associated costs, not merely those borne by the individual or enterprise that so locates. Total associated, or full social, costs include: 1) Immediate expenses of development, 2) Damage to be endured by the occupant or the expense of protective measures undertaken to reduce the frequency and extent of flood damage, and 3) Damages forced on others as a result of encroachment, and public costs involved in disaster relief and rehabilitation. Floodplain occupation in which benefits do not exceed the estimated total costs, or which yields lower returns than other uses such as recreation or wildlife conservation, is undesirable, because it causes an eventual net loss to society. Any public policy which encourages submarginal development adds to those losses” (Pages 13 and 14; italics not in original text).

One conclusion to be drawn from this quote is that the purpose of federal policy should not be to reduce damages and promote economic development as an ends in themselves. Rather, federal policy should seek to promote floodplain uses (and associated flood damages) that are economically efficient. HD 465 describes the federal role in securing efficient outcomes as follows:

“In its concern for the general welfare, the federal government has a proper interest in measures to hold flood damages to an *economic* minimum. It has a responsibility to discourage floodplain development which would impose a later burden on the federal taxpayer, which would benefit some only at the expense of others, and which would victimize unsuspecting citizens. It does not follow, however, that the federal government should be held solely responsible for success of a program to make wise use of floodplains. Attempts to resolve the problem of rising flood losses

within the framework of the Nation’s traditional value system should focus on promoting sound investment decisions by individuals, local governments, and states. They should concentrate on bringing the moral, legal, and fiscal responsibilities of all involved into effective alignment” (Page 15; italics not in original text).

The first part of this passage asserts a federal responsibility to reduce flood damages to an “economic minimum,” but not to zero. It also asserts a federal responsibility to discourage floodplain location and use decisions that would transfer risk or other costs to second parties.

The second part of the passage asserts, as a normative proposition, a federal responsibility to promote economically efficient floodplain location and use decisions made over time by “individuals, local governments, and states,” and implies that efficient use equates to “wise use” (See Box 2-1).

HD 465 recognized that the decision-making entities to be influenced by federal FRM policy are those who are closest to the choice problem. Specifically, the perspective on the federal role advanced by HD 465—to promote “sound investment decisions”—is grounded in the reality of a diffused process for floodplain location and use and flood risk reduction and management decision-making among communities and individuals. Those entities make choices on floodplain location and use as well as risk reduction and management based on their knowledge of the benefits and costs of their available alternatives, where costs include their expected future flood damages and the legally-prescribed costs of available flood risk reduction and management measures.

HD 465 argued that the primary focus of federal policy should be on ensuring that communities and individuals: 1) are provided with accurate information on flood risks, since those risks necessarily affect the expected private benefits and costs of floodplain use decisions, as well as information on available risk reduction and management measures that they could implement, and; 2) bear the costs of their floodplain use as well as their risk reduction and management choices, so that those costs are factored into their decision-making. Accordingly, the report’s recommended federal actions were grouped into the following five major themes:

1. “To improve basic knowledge about flood hazard,” which called for federal agencies to develop and communicate improved risk information.
2. “To provide technical assistance to managers of floodplain property,” which called for federal assistance and advice for local governments and residents on measures they could take to reduce their exposure and vulnerability to flooding.
3. “To coordinate and plan new developments in the floodplain,” which focused on federal encouragement and support for non-federal land use regulation.
4. “To adjust federal flood control policy to sound criteria and changing needs,” which called for increased cost share requirements for state and local beneficiaries of federal flood hazard reduction projects.

5. "To move toward a practical national program for flood insurance," which called for pilot testing and then implementing an actuarially-based flood insurance program.

**Box 2-1: Gilbert White on Efficient (Wise) Use of Floodplains**

Gilbert White has influenced generations of flood risk management (FRM) professionals. His writings on FRM are vast and are subject to selective interpretation. This chapter focuses on his leadership of HD 465 and on his publications from the period 1960 through the early 1970s, which normatively assert that the federal FRM goal should be to promote decisions by communities and residents that secure economically efficient floodplain uses. Contemporary FRM practitioners view Dr. White as the "father of floodplain management" but may fail to recognize that he argued for using the set of "human adjustments" encompassed by floodplain management in the service of economic efficiency. To illustrate how Gilbert White's own views at the time corresponded to the economic efficiency perspective advocated by the HD 465 task force, consider the following quotation from an earlier White publication entitled, *Making Wise Use of Floodplains* (White and Cook, 1962):

"Because...the toll of flood losses has continued to rise in the US, there has been increasing attention to the possibility of curbing future flood plain use so as to avoid unnecessary damage exposure. One of the more popular, but less sound, expressions of this view is that all flood plains should be reserved for park, forest, or other open-space uses which do not involve damage potential. This is a misleading view and one which needs to be combated wherever there is discussion of possible regulation of flood plains. It is not at all impractical to think of rather intensive use of flood plains, as indicated above for Pittsburgh, in circumstances that would lead to very slight flood losses. The problem is not one of prohibiting any kind of use of the flood plain, but of finding optimum use, taking into account not only the flood losses that would result, but also the benefits that would flow from such use. Land-use regulation can be developed to foster the wise choice of flood plain use, insisting upon careful consideration of the effects on both property owners and the community of permitting the more intensive uses."

In this passage, White and Cook dismiss the notion that rising flood damages is the flood risk management challenge, a position that was later mirrored in HD 465. The next to last sentence describes an economic efficiency goal for floodplain use, which is equated with "wise use." The last sentence reflects a view on how land use regulation can contribute to securing efficient use in consideration of the circumstances in any particular setting.

Further, HD 465 summarized the perspective of its authors on the appropriate division of roles and responsibilities for FRM as follows:

"An integrated flood loss management program which would satisfy the requisites of economic efficiency and social equity and make a realistic division of responsibility would entail:

- (a) Federal responsibility for collection and dissemination of needed data; provision of technical services to assist in intelligent application of data in local planning; construction of flood control

projects; management or supervision of an actuarially sound insurance program; and provision of credit, where needed, for local contributions to flood project construction.

- (b) State responsibility for establishing floodplain encroachment lines; granting of authority to assure conspicuous demarcation by state and local planners of flood hazard areas; and assisting local planning and project financing efforts.
- (c) Local responsibility for guiding desirable expansion and avoiding, to the fullest possible degree, use of high hazard areas for uneconomic activities; organizing flood project beneficiaries to pay for services rendered.
- (d) Individual responsibility for careful weighing of the costs and advantages of developing and occupying alternative sites; willingness to assume financial responsibility for new locational decisions.” (Page 17)

### **2.3.2.2 Federal Project Planning**

Also during the 1960s, the federal objective for water resource projects shifted from protection and economic development to economic efficiency as informal policy. This was spurred in part by the emerging field of neoclassical welfare economics and involvement by academicians in the Harvard Water Program.

The economic efficiency objective does not ask whether water project investments can increase the size of the economy, and it does not begin with the premise that existing development in the floodplain should remain there. Rather, the efficiency objective asks whether the floodplain lands are being put to their best use, and whether the costs of an investment to reduce hazard, exposure, or vulnerability can be justified by the increased value attributable to that investment. Following the new welfare economics, investment value was defined as project beneficiaries’ willingness to pay for the expected benefits of the investment.

In 1972, project beneficiaries’ willingness to pay for water resource investments was formally established in federal project planning guidance as the conceptual basis for flood project benefits analysis, and was later included in the 1983 *Principles and Guidelines* (P&G) that guides project planning today (U.S. Water Resources Council, 1983). However, these planning guidance documents retained the property damages avoided metric as the preferred benefit measure for flood hazard reduction projects, declaring it to be an acceptable proxy for willingness to pay. Thus, even as the logic for defining the objective of project investments was altered significantly, the metric used for measuring project benefits remained unchanged.

Further, the 1972 and 1983 guidance documents included land development benefits (what the P&G calls “location benefits”) as an allowable benefit category, since under certain conditions they can represent economic efficiency benefits. However, by the 1970s there was an increasingly voiced view that federal actions should not encourage the development of floodplain lands. That concern was given federal policy emphasis in President Carter’s 1977 Executive Order 11988 on floodplain management,

which directed that federal agencies should, to the extent possible, avoid actions that could directly or indirectly support development in the base (100-year) floodplain.

In the early 1980s, annual USACE budget guidance began to disallow the claiming of project benefits for such induced land development. Then, in 1990, formal USACE policy restrictions were established on the use of land development benefits for justifying USACE flood hazard reduction projects (U.S. Army Corps of Engineers, 1990).

### **2.3.3 Wise Use of Floodplains through Minimizing Damages**

As outlined above, the metric for representing the benefits of federal hazard reduction projects has always been property damages avoided, even as the stated federal objective for such projects shifted over time from protection and economic development to economic efficiency. Perhaps at least partly because of the continuing focus on this benefits metric, starting in the 1970s certain federal advisory groups and task forces began to assert that avoiding flood damages was itself the federal FRM objective. That is, the goal of federal FRM began to be seen as minimizing damages as an end in itself rather than in the service of overarching economic or social objectives.

This is illustrated by the series of federal reports entitled, *A Unified National Program for Floodplain Management* (UNP Reports). Section 1302 of the National Flood Insurance Act of 1968 (PL 90-448) stipulated that “the objectives of a flood insurance program should be integrally related to a unified national program for floodplain management and...the President should submit to the Congress for its consideration any further proposals necessary for such a unified program...” Accordingly, separate reports were published in 1976 and later revised in 1979, 1986, and 1994. The 1976 report and the 1979 revision were prepared by the U.S. Water Resources Council; the 1986 and 1994 reports were prepared by a “Federal Interagency Floodplain Management Task Force” chaired by FEMA (see Appendix B).

The UNP reports asserted that reducing flood damages (adverse consequences of all types) is the goal for federal FRM policy. Starting in the 1979 report, this goal statement was augmented by adding a second goal of “protecting and restoring the natural and beneficial functions of floodplains” to reflect concern for the preservation of natural floodplain values expressed in the 1977 Executive Order on floodplain management. These dual federal goals, deemed by the reports to be compatible, were offered as a definition of “wise use of floodplains.” The 1994 report defined wise use as follows:

“A floodplain is being put to wise use when the activities that take place on it are compatible with *both* the risks to human life and property from floods *and* the risks to the floodplain’s natural functions posed by the human activities ... This definition of wise use provides its own self-test. In theory, floodplain decisionmakers can ask themselves, ‘If this development (or other activity) is located in a floodplain, is it possible to minimize the loss of life and damage from flooding?’ If the answer to this is, ‘No,’ then the activity may not be a wise use of the floodplain land. If the risk to life and property can be mitigated, there is a second question, ‘Does locating this development in the floodplain allow for maintaining the floodplain’s natural functions?’ If it does not, then the activity may not be wise use of the floodplain, even if the first test was met.

In other words, the answer to both questions must be ‘Yes’ ...’ (Federal Interagency Floodplain Management Task Force, 1994; Page 9; italics in original text)

This passage argues that wise use of floodplains means *minimizing* damages to people, property, and the environment, presumably pushing toward zero, although the word “minimize” is never given operational meaning.<sup>5</sup> However, following the above passage the 1994 report states, “Thus, a wisely used floodplain is the product of a challenging process of evaluating and balancing the costs and benefits of sometimes competing uses...” which implies an economic efficiency perspective, although the parties who would do the balancing and decision-making are not identified. Similar references to the relevance of the benefits of floodplain use are also made in the earlier UNP reports. Nevertheless, the main normative proposition made throughout the UNP report series is that the federal FRM goal is to minimize damages to people, property, and the environment.

Other high-level federal policy documents issued coincident with the UNP reports also articulate a federal goal to reduce adverse consequences of all types. A 1992 report by a National Review Committee (chaired by Gilbert White) charged with reviewing a 1992 federal assessment report on floodplain management describes a federal FRM goal to “reduce the vulnerability of all Americans to the danger and damage of floods” and “to preserve and enhance the natural values of the nation’s floodplains,” and laments that “the rising toll of average annual flood damages has not been reversed” (National Review Committee, 1992). Similarly, the 1994 *Sharing the Challenge* report on the 1993 Midwest floods echoed a federal objective to reduce vulnerability and preserve the natural values of floodplains (Interagency Floodplain Management Review Committee, 1994).

And importantly, the view that wise use of floodplains equates with minimizing damages continues to be expressed today. One example is a statement on “unwise use of floodplains” made in 2012 by the Federal Interagency Floodplain Management Task Force, which was reconstituted in the Obama Administration. It states, “Unwise use refers to actions that unnecessarily increase or transfer flood risks that can result in adverse impacts to human health, safety, welfare, property, natural resources, or functions of floodplains” (Federal Interagency Floodplain Management Task Force, 2012). This statement of unwise use mirrors the definition of wise use set out in the UNP report series that equates wise use with minimizing damages, and like the definition in the UNP reports, it does not give operational meaning to key terms, in this case the word “unnecessarily.”

In recent years the federal policy discourse has increasingly focused on how to continuously reduce the likelihood and/or magnitude of adverse consequences from flood events, measured primarily as the

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<sup>5</sup> Other key terms are not well-defined in the UNP report series. For example, the 1994 report includes the following imprecise definition of the areas to which the wise use concept is applied: “Floodplains are the relatively low areas adjacent to rivers, lakes, and oceans that are periodically inundated” (Federal Interagency Floodplain Management Task Force, 1994; Page 7).

value of property damages, number of human fatalities, and extent of environmental degradation. This is the case despite the economic efficiency focus of HD 465, and despite mentions in the UNP reports that the benefits of floodplain use might be a relevant consideration. As minimizing damages in and of itself has increasingly come to be viewed as the federal FRM goal, critics of federal FRM programs in general and the USACE hazard reduction program in particular have questioned whether those programs have been successful, pointing to increasing damages over time as evidence (Association of State Floodplain Managers, 2008).

A parallel normative assertion expressed today by some groups is that flood hazard reduction projects should be an action of last resort for reducing damages, and only when fully funded by their local beneficiaries (Association of State Floodplain Managers Foundation, 2007). The reasons given are varied and include the argument that the projects create a false sense of security and the argument that the projects have unacceptable environmental consequences. If new and upgraded hazard reduction projects were to be used only as actions of last resort, however, this would leave exposure and vulnerability reduction actions as the preferred alternatives for reducing risk. But as a practical matter this would severely restrict the federal role in flood damage reduction, since there are significant legal and budgetary limits on the ability of the federal government to reduce the exposure and vulnerability of people and assets to flooding.

## **2.4 Looking Ahead: Federal Roles and Objectives in the 21<sup>st</sup> Century**

The federal government now plays several roles in FRM through a wide variety of federal agency programs that are constrained in what they can achieve by both legal authorities and budget limits. At the present time there does not appear to be any agreed-upon, overarching federal FRM objective to guide the design and execution of these programs in the 21<sup>st</sup> Century. Meanwhile, the USACE is now stressing the need for shared responsibility for FRM among all levels of government and stakeholders. The next chapter presents a conceptual framework to make operational the call for shared responsibility in the design and execution of USACE and federal FRM programs. That framework adopts the perspective of HD 465 and focuses on an explicit policy goal to foster risk informed and cost responsible decision-making by communities and individuals as the means to promote economically efficient floodplain uses.

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## **Chapter 3. A Contemporary Framework for USACE and Federal Flood Risk Management Policy**

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### **3.1 Introduction**

In this chapter the fundamental ideas of HD 465 are employed to propose a foundation for a USACE and federal FRM policy objective to foster decisions that are *risk informed and cost responsible*, or RICR. In 1966, HD 465 highlighted the need for communities and individuals to understand the flood hazard, exposure, and vulnerability dimensions of their land use decisions and to bear the financial, risk, and environmental costs of the decisions they make. In this way the efficient use of the nation's floodplains would be advanced. More than four decades have passed since HD 465 was published, but its core principles remain relevant for today. A contemporary RICR policy can employ those principles to guide USACE and federal FRM efforts within the context of changes in policy and programs and their effects that have taken place since HD 465.

### **3.2 HD 465 Modernized: Risk Informed and Cost Responsible Decision Making**

The basic principles of, as well as the context and case for, a RICR-based federal policy objective for FRM are outlined below. A RICR policy would focus on influencing community and individual choices made throughout the entire floodplain, which includes all lands in any area that are potentially susceptible to flooding.

#### **3.2.1 RICR in Brief**

The starting point for RICR policy is recognition that communities and individuals are the key decision-makers with respect to choices that affect flood risk. Decisions on whether to locate in and use a floodplain area as well as choices on actions to reduce flood risk and manage residual risk are made by individuals (i.e., landowners, households, and businesses) within the context of community (i.e., local government) choices relating to local hazard reduction investments and land use regulation. With this set of decision-makers in mind, the basic principles of RICR are defined below.

**Risk Informed:** To assure that communities and individuals located in floodplains are fully risk informed requires that they:

1. Have access to the same information about the likelihood and consequences of flooding as that available to technical experts;
2. Have access to information on actions they could take to reduce risk and manage residual risk, and;
3. Understand the current capacity of federal and non-federal government programs to provide pre-flood risk reduction and management assistance as well as post-flood assistance.

The imperative of RICR is that federal policy and programs should maintain the most current information on place-based flood risk and opportunities for risk reduction and management and

communicate it to the public. Further, RICR demands continuous assessment of whether that information reaches and is understood by decision-makers.

**Cost Responsible:** To assure cost responsibility requires that the floodplain location and use decisions and risk reduction and management choices made by communities and individuals comply with all legal and regulatory rules that define the parties responsible for bearing decision costs.

This concept of cost responsibility is related but not identical to the concept of “no adverse impacts” (NAI) that has been proposed by some as an objective for FRM policy (Association of State Floodplain Managers, 2008). Those who advocate for NAI note that floodplain occupants may transfer to others some of the financial, environmental, or induced flood risk costs of their floodplain location and use and risk reduction and management choices. They then argue that when such cost transfers are identified, legal and regulatory regimes should be changed to require floodplain occupants to bear the full costs of their choices. By contrast, cost responsible choices are defined in this report as choices that comply with the existing legal and regulatory regimes in place at the time that the choices are made, which recognizes that the rules that establish cost responsibility may allow for the transfer of some share of decision costs from decision-makers to other parties.

Of course, at any given time policy reform proposals to change the allocation of decision costs can be proposed and implemented, and such proposals might argue for changing cost distribution in either direction. For example, ability-to-pay concerns might be used to defend increased levels of federal subsidies for those places where local budget constraints and circumstances stand in the way of cost responsibility. For example, policy might allow for lower non-federal cost shares for USACE local protection projects that serve low-income communities, while requiring higher cost shares for local protection projects that serve wealthier communities. That is one way that a RICR policy could help to, in the words of HD 465, “satisfy the requisites of economic efficiency and social equity.”

At the same time, the RICR framework demands that the federal government maintain a comprehensive inventory of federal programs that allow for cost transfers, and continuously evaluate the potential influence of costs transfers on the choices made by communities and individuals. This is the necessary foundation for making and evaluating proposals for program changes that would change cost allocations.

### **3.2.2 The Context for RICR**

The current FRM programs of the USACE as well as FEMA and other federal agencies can be largely understood as external influences on decisions relating to floodplain location and use and the adoption of risk reduction and management actions made by communities and individuals. Those choices are made in complex decision settings in which flood risk is only one of many concerns and influences (see Appendix C). That complexity includes “path dependency,” meaning that the available choice set may be constrained by past decisions that led to the existing development patterns in the floodplain as well as the risk reduction and management actions already in place. Past choices often serve to constrain or otherwise influence subsequent choices.

For example, past choices to locate in and develop a flood-prone area in order to take advantage of fertile soils or access to water transportation may limit future possible adjustments to flood risk. Moving structures and utilities on a large scale can be very costly and is typically judged by localities to be impractical or undesirable. Instead, other adjustments to flood risk might be pursued, such as the construction of a levee. If a decision to construct a levee is made, that would then influence future flood risk reduction and management actions. Those future actions may be in response to changes in the economic value of the land located in the floodplain, changes in the population settled in the floodplain, or changes in the hydrology that have altered the flood hazard. The important point is that each choice is influenced by and builds upon past choices.

The choice context for different decision actors is the setting for a RICR-based USACE and federal FRM policy. With an understanding of these decision contexts, general hypotheses can be made and then tested about the determinants of decisions and the effectiveness of federal policy and programs intended to promote risk informed and cost responsible decision-making.

### **3.2.3 The Case for RICR**

A RICR policy can be justified on both normative and practical grounds. The normative argument for RICR accepts that knowledge of the fullest range of benefits and costs of land use choices is decentralized to those who are closest to the choice situation; therefore, the “best” decisions will be made by non-federal actors. What is required is that these decision-makers understand flood risks associated with their choice opportunities so that they can assess the “true” range of benefits and costs associated with each choice, and so that they bear the costs of their choices consistent with the cost allocation established by current laws and regulations. The practical argument for RICR is an accommodation of current reality—specifically, that the federal government lacks the authority to restrict or directly influence how non-federal lands can be used, and also lacks funds to support ever more and larger levees and other hazard reduction works or widespread local investments in exposure and vulnerability reduction actions.

Further, RICR principles are in broad agreement with contemporary expressions of desired FRM outcomes. One example comes from a recent report by the National Resource Council (2012) that argues that the FRM objective for the nation and federal policy should be to secure “resilience,” which it defines as “the ability to prepare and plan for, absorb, recover from or more successfully adapt to actual or potential adverse events.”<sup>6</sup> This concept is about all pre- and post-flood decision-making and calls for a dynamic process of prediction, action, learning, and reaction. The preface to the report states, “The nation needs to build the capacity to become resilient, and we need to do this now. Such capacity building starts with individuals taking responsibility for their actions and moves to entire communities

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<sup>6</sup> In this report, by contrast, the term “resiliency” is defined more narrowly as the ability of people and assets to return to pre-flood conditions in the aftermath of realizing flood damage (see Appendix A).

working in conjunction with local, state, and federal officials, all of whom need to assume specific responsibilities for building the national quilt of resilience.” As a practical matter, the RICR concept as defined here provides the means to secure this notion of “resilience.”

To illustrate the agreement between RICR and the NRC resilience concept, imagine a household that is fully informed about flood risk in some location within a NFIP base floodplain and adheres to all the laws and regulations governing the building of a home in that location. The household builds a home that is elevated above the base flood elevation (in conformance with community floodplain management standards required by NFIP rules), purchases insurance to cover some share of potential property damages, and stands willing to accept flood losses that are beyond what is insured. Further, the household has a planned evacuation strategy that includes alternative escape routes and means if a flood does occur. The household in this example has recognized its exposure to flood risk and is bearing all of the legally-required costs of its land use decisions and risk reduction and management choices in consideration of the benefits of those decisions. Thus, this household can be viewed as meeting the desired outcomes of RICR policy as well as the NRC resilience concept.

### **3.3 Implementing RICR**

#### **3.3.1 Risk Communication for Risk Informed Decision Making**

A RICR policy requires enhanced federal efforts to assess place-based flood risk in different areas of the country. Those assessments must then be effectively communicated to floodplain occupants in order to inform their choices. Federal efforts to increase public understanding of flood risk must be built on careful consideration of the decision-makers who are to receive the risk information. This consideration includes understanding not only their choice contexts, but also the ways in which the decision-makers “think about” flood risk.

The past three decades have brought new understanding of how people receive risk messages and then act on that information. This behavioral science literature is reviewed in Appendix C, and two general points from that literature are highlighted here. First, it is now suggested that any single individual can employ two different “systems” of thinking depending on the context. One system is deliberate and analytical and the other relies on mental short cuts, called “heuristics.” Experts who are professionally engaged in flood risk assessment evaluate flood risk in a deliberate and analytical way, but individuals who are subject to flood risk may not be similarly analytic about an event that has a low probability of occurring (except maybe right after a flood has occurred or if the person has a keen intellectual interest in the subject).

Knowing which system of thinking will be employed and by whom is essential for designing programs to increase understanding of flood risk. Also, without regard to the system of thinking employed, different individuals presented with the same risk assessment could make different floodplain use and risk reduction and management choices. Thus, because of the complexity of the decision setting, risk communicators cannot assume that a decision to locate in a flood-prone area is a sign that a risk communication effort has failed to improve the decider’s understanding of flood risk.

This leads to a second implication of the behavioral science literature—risk communication can be designed to influence choices in a particular direction, or what some authors call “nudges” (Thaler and Sunstein, 2008), rather than to simply provide data and information to inform choices. That nudge might be in a direction that the experts believe is in the best interests of the decision-makers and FRM generally. Indeed, sometimes the viability of a particular policy and program may depend on people making particular choices; for example, a flood insurance program requires a high level of policy purchases in order to effectively spread risk. Risk communication programs need to determine whether the purpose is to simply inform choice or rather to nudge individuals toward making particular choices.

A final point is that risk communication programs should include more than information on flood hazards faced and potential consequences. Information transfer must also include descriptions of USACE and other federal FRM programs, how they distribute the costs of the available risk reduction and management services, and the supply of federal financial and technical assistance relative to the demand for that assistance. Federal policy based on RICR must report on federal FRM program missions and capabilities as part of risk communication efforts so that floodplain decision-makers have a realistic basis for determining how program services may affect their available choice opportunities and costs.

### **3.3.2 Review of Rules that Establish Cost Responsibility**

RICR acknowledges the reality of cost transfers and defines cost responsibility in terms of whether choices are made in compliance with existing laws and regulations. However, RICR does demand that federal policies that currently result in a transfer of some share of the costs of floodplain location and use as well as the costs of risk reduction and management actions be made the object of continuing public policy discussion as an exploration of the efficiency and equity effects of federal law and regulation.

The efficiency argument against allowing for cost transfers is that the ability to shift costs creates incentives for floodplain development where costs exceed benefits, and is a disincentive for floodplain occupants to take risk reduction and residual risk management actions (Lichtenberg, 1994). However, the extent to which federal programs that allow for cost transfers do in fact influence risk-taking behavior is unclear, both logically and from a review of the empirical record.

There are always hypotheses offered about the extent to which particular federal laws, regulations, and programs allow for cost transfers and how the resulting cost allocation affects the decisions made by floodplain occupants. For example, it is often asserted that because NFIP policy does not require the purchase of flood insurance for structures located outside the base floodplain (the area subject to flooding from the 1% or greater annual chance flood event), individuals located outside that area mistakenly believe that they are safe from flooding. It is true that many local government decisions on the level of hazard reduction to pursue are targeted to avoid NFIP regulatory requirements, including mandatory insurance purchase for structures within the base floodplain. However, it is not necessarily

the case that people think that they are safe if they reside in areas mapped outside of the base floodplain. That is a leap of logic that does not conform to all available evidence.<sup>7</sup>

The normative call of RICR is that it is the responsibility of federal policy to maintain a comprehensive inventory of federal programs that allow for the transfer of decision costs, to assess the extent of that cost transfer, to critically evaluate the influence of that cost transfer on choices, and to determine whether the costs of making policy changes are justified. A rigorous assessment of whether such influences are present is needed so that effective policies can be designed, as opposed to building policy and program changes on speculations about the effects of policies on choice behavior.

An example can help illustrate the need for continuous review and evaluation of the influence of federal policies and programs on the choices made by floodplain occupants. By design, a federal policy that provides post-flood disaster aid shifts some of the costs of floodplain location and use from floodplain occupants to general taxpayers. If the policy goal were to ensure that floodplain residents more fully bear the costs of their choices, then efforts to reduce disaster aid would be warranted solely on the basis that disaster aid programs transfer costs from the entities damaged by flooding to the general taxpayer. From the RICR perspective, however, the test of cost responsibility would be whether the disaster aid programs were being administered consistent with the laws and regulations governing their execution. But RICR would also demand an assessment of the extent to which disaster aid might influence choices that bear on cost responsibility, such as floodplain occupants' decisions on whether or not to purchase flood insurance. That same analysis would describe how decisions on insurance purchase were affected by disaster assistance. Only then might policy changes be recommended; further, the recommended policy changes might relate to the NFIP or to risk communication programs rather than to disaster aid programs (Kousky and Shabman, 2012).

### **3.4 Evaluating RICR**

With RICR as the goal of federal FRM programs, the challenge for policy and program evaluation is that the desired outcomes of RICR—individual and community choices based on an improved understanding of flood risk and an “appropriate” bearing of the costs of floodplain use—must be measured and reported on. Such measures will be much different than the metrics currently used for FRM program

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<sup>7</sup> For example, non-federal entities in some locations along major rivers are building hazard reduction projects to control flood stages associated with the 0.2 % annual chance event (see Chesterfield example in Appendix C). Similarly, in California the 1% annual chance flood event is not the governing standard for the minimum level of protection to be provided by levees in urban areas, but rather the 0.5% annual chance event (FloodSafe California, 2012). And in some localities characterized by risks from both big river flooding and small stream flooding, the 1% standard is applied to areas along smaller streams where flooding from less frequent events would not be catastrophic, but a higher standard is applied to areas along larger rivers (See Denver example in Appendix C).

evaluation that are largely based on trends in realized damages and estimates of damages prevented by FRM actions.

Indeed, the metrics needed to evaluate RICR policy success will direct attention away from damages and damages prevented. Changes in historical trends in adverse consequences (value of property damages and loss of life attributable to floods), sometimes adjusted for changes in population or inflation, have historically been used to judge the success of FRM programs. Critics of these data interpretations note the limitations of the data or the failure to index damages to the benefits received from the occupation of flood-prone areas (Pilkey et al., 2002). And there are significant limitations on the damages prevented metric that the USACE uses to evaluate the success of USACE-built hazard reduction projects (Comisky, 2005).

An alternative approach to interpretations of trends in available data on damages and estimates of damages avoided has emerged with the rapid advances in number and kinds of databases, computer modeling, and GIS data management, analysis, and mapping. Rather than relying on interpretations of often incomplete historical data on damages and estimates of damages prevented, these tools have been proposed as a way to define and map areas of flood risk and then to track and predict changes in the determinants of that mapped risk over time. It will be tempting for policy analysts to try to use these new capabilities to measure hazard, exposure, and vulnerability across different areas of the country in order to develop a national risk assessment report. However, as with trends in realized damages and estimates of damages avoided, such metrics are not a relevant measure for judging the success of a RICR-based policy.

### **3.5 RICR Implications for USACE Programs**

For both practical and normative reasons, it makes sense for USACE and federal FRM policy to explicitly focus on fostering RICR decision-making to promote the economically efficient use of floodplains. For the USACE specifically, RICR can give operational guidance to the agency's emphasis on "shared responsibility" in the design and execution of USACE FRM programs.

The USACE Levee Safety Program, for example, calls for shared responsibility with local governments and floodplain occupants in reducing and managing life safety risk in areas served by USACE-built levees (e.g., expectations for local attention to implementing and assuring the effectiveness of emergency evacuation plans). Nevertheless, at this point the USACE emphasis on shared responsibility is more of a philosophical concept than an operational construct having clear expectations and requirements (that is, other than the project requirements now in place for project cost sharing, non-federal project O&M and other management, and for community participation in the NFIP).

Shared responsibility leads to a USACE and federal policy goal of assuring risk informed and cost responsible decision-making (RICR) by communities (i.e., local governments) and individuals (i.e., landowners, households, and businesses) with respect to their floodplain location and use as well as risk reduction and management choices. With RICR as the FRM goal, communities and individuals are expected to take responsibility for flood risk reduction and residual risk management, and in so doing

may include the FRM program services of the USACE, FEMA, and other federal agencies in their risk reduction and risk management choices.

Operationally, RICR means that USACE and federal policies and programs should be designed to:

1. Inform those located in areas of inundation risk about: a) flood likelihoods and potential consequences; b) the effectiveness and costs of risk reduction and risk management actions they could take, and; c) the contributions of the USACE and other federal agencies to flood risk reduction and management.
2. Promote cost responsibility by assuring that the legally-required costs of floodplain location and use as well as risk reduction and management choices are borne by those who benefit from those choices, while targeting monetary assistance to those areas where local budget constraints and circumstances stand in the way of cost responsibility.
3. Review USACE programs that allow for cost transfers and evaluate their influence on the choices made by floodplain communities and individuals.

### **3.6 Starting Point for RICR**

There is a legacy of USACE and federal FRM policy language and program structures that represent the starting point for any clarification of the federal goal as fostering RICR decision-making. In fact, despite the continuing rhetorical commitment to and the proximate focus of FRM programs on reducing flood damages, the pre-flood FRM programs of the USACE as well as FEMA and other federal agencies that exist today can be largely understood as seeking to advance the understanding of flood risk and to promote cost responsibility among communities and individuals in floodplain areas.

It is recognized that while a RICR policy must be built on existing programs, the RICR framework might not easily apply to some programs. For example, questions on how to set budget priorities for the rehabilitation of USACE-managed dams will not be answered by appealing to RICR decision-making by communities and individuals.<sup>8</sup> However, as the report recommendations in the next chapter illustrate, the RICR framework suggests a wide array of new USACE policy and program initiatives that could be built upon the foundation of existing agency programs.

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<sup>8</sup> In this case, the RICR concept as it relates to the choices made by communities and their residents may not be relevant. However, the RICR logic is evident with respect to the USACE's own decisions relating to the rehabilitation of USACE-managed dams, which relies on a portfolio risk management approach that defines a nationwide evaluation and management process for prioritizing the allocation of resources based on the potential risk of dam failure for human life.

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## **Chapter 4. Recommendations for Improving the USACE Contribution to Flood Risk Management**

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### **4.1 Introduction**

USACE FRM policies and programs were viewed through the lens of Risk Informed and Cost Responsible (RICR) decision-making to develop, organize, and add specificity to the recommendations for change presented below. The recommendations are organized into three categories:

1. Effective Provision of Risk Information.
2. Promoting Cost Responsibility in a Limited Budget Environment.
3. Policy and Program Evaluation.

The discussion for each includes review and comment on the current state of USACE and other federal agency FRM programs that provides contextual background for the recommended actions.

### **4.2 Effective Provision of Risk Information**

Since Hurricane Katrina in 2005, the USACE as well as FEMA and other federal agencies have developed new programs and accelerated existing programs to assess and communicate flood risk related data and information to communities. The expectation is that such information will motivate flood risk reduction and residual risk management actions by non-federal governments and floodplain occupants. These efforts are generating an increasing array of information on place-based flood hazards, levee conditions, and potential levee performance for reducing hazards. And there is new emphasis on combining information on hazards, levee performance, and exposed populations and assets in order to develop indices and estimates of potential place-based flood consequences. FEMA information efforts relate primarily to its implementation of the National Flood Insurance Program (NFIP) and mitigation planning programs, while USACE information efforts primarily relate to its evolving Levee Safety Program.

RICR requires that federal agency experts have a coordinated approach to the development and dissemination of information that increases the public's understanding of: 1) place-based flood likelihoods and potential consequences; 2) the effectiveness and costs of risk reduction and risk management actions that they could take, and; 3) available federal program technical and financial contributions to flood risk reduction and management actions. The recommendations that follow are directed toward those ends.

#### **4.2.1 Develop a common vocabulary for use throughout USACE programs and in communications with the public**

A frequently noted concern with federal FRM programs expressed by the professional community is the lack of consistency in use of FRM-related terms within and across agencies, and the use of different terms to describe the same concepts. The agreement on a vocabulary for use within the USACE would assure consistent use of terms within the agency as it moves forward to standardize and increase the effectiveness of agency risk communication efforts. A USACE “engineer pamphlet” that lists FRM terms and their definitions could then be prepared and shared throughout the agency.<sup>9</sup>

For several reasons, the vocabulary presented in Appendix A to this report provides a foundation for such an effort to promote a common vocabulary for use within the USACE. First, the vocabulary is grounded in the literature on risk analysis and promotes the USACE emphasis on risk informed decision making. Second, it promotes the current agency desire to shift risk communication messages from flood damage reduction to flood risk management. Third, it creates a specific terminology for flood risk management that is in line with terminology used by the Department of Homeland Security for defining and communicating about all hazards and threats. And it has already been checked against the terms and concepts used in the USACE Levee Safety Program and Dam Safety Program, thus creating an immediate opportunity to gain agreement inside the agency on a basic FRM vocabulary.

#### **4.2.2 Report biennially on USACE flood risk reduction and management authorities, policies, and program services and availability**

When making floodplain location and use and risk reduction and management decisions, communities and individuals take into consideration not only information on the flood hazard, but also the availability and possible levels of USACE and other federal program assistance. However, the multiple and often complex FRM programs of the USACE, FEMA, and other federal agencies are not now well-communicated to non-federal governments and the public in a manner that promotes deep understanding. Meanwhile, many USACE programs have recently been under extensive review and revision.

A risk communication program for the USACE should not only describe flood hazards and potential consequences, but also should include comprehensive and accurate descriptions of the authorities, policies, budgets, and related capabilities of USACE programs. This would help to ensure that non-federal interests have realistic expectations about the USACE budget for pre-flood project planning and implementation and for post-flood aid. As one example, the USACE budget for the construction of flood damage reduction projects for individual communities is much more limited than many communities may realize.

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<sup>9</sup> According to USACE policy, “EPs are used to distribute general information within USACE or to the public. EPs never establish requirements; that is done in other publications” (ER 110-2-1150).

The USACE should consider developing a strategy for documenting and disseminating to the public descriptions of its FRM programs. The USACE could use its NFRMP website<sup>10</sup> as a repository for program descriptions, while exploring approaches to building such information into its risk communication programs. In addition, the USACE could work with FEMA and other federal agencies to create an interagency “Biennial Report to the Nation on Federal Flood Risk Management Programs” to describe the scope and capabilities of all federal FRM programs. The format used to describe USACE programs in Appendix D could serve as a template for such program descriptions.

Such an interagency report could usefully explain how USACE programs relate to those of other federal agencies that have related but different purposes. For example, FEMA flood hazard mapping is used for communicating the area of the floodplain subject to the 1% annual chance flood and where purchase of flood insurance may be required. Meanwhile, the USACE Levee Safety Program (LSP) communicates the possibility for levee failure and the resulting potential consequences for human life. Both messages are reported as “flood risk,” yet they reflect quite different assessments and the risk measures reported are different. The result can be to confuse rather than advance risk understanding by the general public unless each agency can explain its own risk message and contrast it with that of other agencies. These differences might be discussed in the proposed report. However, this recommendation is only a call for improved communication about different but related federal program authorities and capabilities, and should not be viewed as a call for program “alignment” (see Box 4-1).

#### **4.2.3 Recognize research in behavioral science in the design of risk communication programs**

Innovation in flood risk communication often is associated with new technologies for securing data, analyzing that data, and then using modern modeling and GIS tools to transform the data into risk information.<sup>11</sup> Such tools can enhance the technical accuracy and availability of flood risk assessments and contribute to risk communication. But an effective risk communication program will go beyond improved analytical tools and measurements.

The challenge for risk communication is to convey risk information in ways that that effectively contribute to the recipients’ understanding of the likelihood and adverse consequences of different flood events so that flood risk can be weighed against other considerations when choosing to occupy a floodplain area or invest in risk reduction and management actions. Meeting that challenge requires that risk communication efforts must be attentive to the role played by decision heuristics, or “mental shortcuts,” in how recipients interpret and act on the risk information they receive. An effective risk

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<sup>10</sup> <http://www.nfrmp.us>

<sup>11</sup> A distinction is drawn between data and information. Data include measurements of physical phenomena and may extend to objective descriptions of policies and programs. Information is created by the interpretation of data. For example, historical measurements of stream flow are data, but a stage-frequency curve that relies on that data is information.

communication program will appreciate not only the complexity of the choice-setting for those who receive the risk information—including their financial constraints, perceptions of location benefits and costs, and location path-dependency in long-established communities situated along rivers—but also how heuristics may influence decision-making.

**BOX 4-1: Limits to Interagency Program Alignment**

A frequent recommendation made over the last several decades has been to improve the ability of the suite of federal programs to work together for flood risk management. This was the theme of the series of federal reports, each titled “A Unified National Program for Floodplain Management,” published between 1976 and 1994 (see Appendix B). More recently, the recommendations report by the National Committee on Levee Safety (2009) included several recommendations for “aligning existing federal programs to promote effective mitigation in levee areas.”

One example of where greater alignment is now being advocated involves the USACE LSP and the NFIP that is administered by FEMA. Congress has responded to complaints by localities about their costs for securing levee certifications needed for NFIP map accreditation by seeking to leverage information produced by USACE inspections of levee O&M for use in meeting local NFIP certification needs.\*

While there may be opportunities to adjust the USACE levee inspection process to better align the information produced with required NFIP certification elements, the different purposes of the USACE inspections and the NFIP certifications constrain the alignment of levee accreditation requirements and USACE inspection results. The purpose of USACE annual levee inspections is to evaluate the adequacy of project O&M performed by non-federal sponsors (while the USACE periodic inspections go beyond this limited purpose to develop a preliminary understanding of levee performance and safety issues). The inspection results are used by the USACE to determine whether a project can remain eligible for repair assistance under the USACE Rehabilitation and Inspection Program were it to be damaged by future floods or coastal storms, and also feed into the USACE risk screening and classification of levees in the USACE portfolio (see Appendix D). The purpose of NFIP levee certification and accreditation, by contrast, is to determine whether an area is subject to NFIP insurance purchase and floodplain management requirements and for determining insurance premiums.

\* The Biggerts-Waters Flood Insurance Reform Act of 2012 (PL 112-141) called for a task force to develop a process so that the data and information collected in USACE levee inspections is “sufficient to satisfy the [NFIP] protection structure accreditation requirements,” and directed that the task force “shall consider changes to” the information collected during USACE inspections as well as changes to accreditation requirements, and “shall gather and consider...recommendations from interested persons in each region.” The USACE and FEMA convened the task force and its report is now under review inside FEMA.

Toward that end, ongoing efforts to revise an existing USACE engineer pamphlet (EP) on risk communication could draw on Appendix C to this report. That appendix includes discussion of the factors that are relevant to risk communication program design and that makes observations for building an effective program, drawing heavily upon the behavioral science literature. However, that

literature has been rapidly evolving with ever-changing insights that can inform and improve risk communication programs. So as the USACE continues its effort to advance its risk communication efforts in a revised EP and as part of other efforts in the LSP, it should involve the participation of outside experts to ensure that the latest knowledge is being applied in communication program design. The EP should be periodically updated (e.g., perhaps every two years) to take into consideration the most recent experiences of the agency, changes in agency programs, as well as new findings in the behavioral science literature.

**4.2.4 Recognize that risk communication is a specialized skill best executed by technical experts in engineering, hydrology, and planning who also are trained in risk communication and public engagement**

A commitment to shared responsibility for FRM calls for blending new initiatives in risk communication and public participation in USACE planning. Risk communication within the USACE is the responsibility of any agency person who is expected to explain the merits and limits of a project plan or an existing project to the affected public, including staff having primarily technical risk assessment responsibilities. Therefore, an appreciation of the current “best practices” in risk communication is needed throughout the agency.

Meanwhile, the USACE has a long-standing commitment to improve its procedures for public participation in its decision-making, but in practice public participation remains largely at the level of the USACE technical experts speaking to local governments and residents, as opposed to engaging those entities in mutual decision-making. A recent report has made recommendations for ways that the USACE could improve public participation in the context of the new emphasis on shared responsibility for FRM (Creighton et.al, 2010). The central message of that report is that USACE public participation programs should move from the one-way transmission of information to engaging affected stakeholders in "mutual problem-solving."<sup>12</sup>

The USACE should consider a staff training course that integrates risk communication with public participation for mutual problem-solving. The course would target all subject matter experts who are engaged with non-federal project sponsors, other federal agencies, or the general public in presenting information about USACE FRM policies, programs, and projects. That course could be offered through PROSPECT in an online format so that it is accessible to all who would benefit from its content.

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<sup>12</sup> That report notes, “Based on this review, the team concluded that there were a number of examples of innovative programs designed to communicate information to the public.... But there were relatively few programs designed to provide the public the opportunity to participate--with two-way communication and interaction--in flood risk decision making”(Creighton et al., 2010; page 32).

### **4.3 Promoting Cost Responsibility in a Limited Budget Environment**

The USACE program for planning and constructing flood and coastal storm damage reduction (F&CSDR) projects has focused on reducing flood damages to people and assets primarily through hazard reduction measures such as dams and reservoirs, levees and floodwalls, and the channelization of rivers and tributaries. The program has a long history, originating with the construction of dams and other major water control works on large, inter-jurisdictional river systems, and later extended to constructing hazard reduction projects for individual communities (hereafter referred to as “local protection projects”). Under current rules, the non-federal sponsors of local protection projects are required to share the costs of project planning and construction, and then once construction is complete, assume responsibility for project management (defined by the USACE to include project operation and maintenance as well as repair, replacement, and rehabilitation).

The existing local protection projects that the USACE planned and constructed for individual communities often included at least some project components intended to reduce the vulnerability of people and assets to flooding, such as flood warning and preparedness systems and flood-proofing of selected structures. But USACE projects have infrequently included primary project components that focused on reducing the exposure of structures to flooding, such as the permanent removal of structures from flood-prone areas. It has been FEMA rather than the USACE that has been the main federal promoter and source of financial assistance for local government efforts to reduce the exposure and vulnerability of structures to flooding (see Box 4-2).

#### **Box 4-2: FEMA budget limits for exposure and vulnerability reduction actions**

FEMA has provided funds through five mitigation grant programs to assist state and local government efforts to plan for and take actions to reduce structure exposure and vulnerability, with the intent to reduce future flood damages and thus insurance claims. Eligible activities for grant funds include property acquisition and structure demolition or relocation as well structure elevation, flood-proofing, and retrofitting. The programs include the Hazard Mitigation Grant Program (HMGP), the Pre-disaster Mitigation Grant Program (PMGP), and three other grant programs that were recently consolidated into one program called the National Flood Mitigation Fund (NFMF). Two of the grant programs rolled into the NFMF historically focused on reducing future damages to so-called “repetitive loss properties,” which represent only about 1% of NFIP policies but account for roughly 16 percent of all policy claims.

Total grant funds available through these programs are modest, however, and are spread over states and localities nationwide. The HMGP is funded through supplemental appropriations made available to FEMA following a presidential disaster declaration, and amounts vary according to a formula based on total disaster funds provided. Funding for the PMGP has been stable at roughly \$100 million annually, and the new NFMF is to be funded at \$90 million per year. By way of perspective, if the roughly \$190 million in regular annual grant funding were fully allocated to the acquisition and removal, elevation, or flood-proofing of structures on flood-prone properties at any average cost of \$100,000 per structure, then only 1,900 structures could be addressed each year. This compares with the roughly 5.6 million NFIP policies now in force.

Historically, the USACE F&CSDR program was widely viewed as the centerpiece of federal responsibility for flood damage reduction; however, the budgetary importance of the program as measured in constant (inflation-adjusted) dollars has fallen significantly over time. The level of regular appropriations allocated for projects in 2010 was less than one-third the level received in the mid-1960s. Moreover, while the USACE F&CSDR construction funding has increased somewhat over recent years, it is entirely due to sharply increased funding for the rehabilitation of USACE-managed dams as part of the USACE Dam Safety Program. In 2010, about one-half of the roughly \$1 billion in regular appropriations provided for F&CSDR construction was allocated for dam modifications, with the other half spread thinly over more than 100 local protection projects. Given that the USACE has identified hundreds of USACE-managed dams that may require some level of rehabilitation, dam modification projects may continue to command a large and perhaps growing share of limited USACE F&CSDR construction funding in future years. Meanwhile, the growing backlog of congressionally-authorized local protection projects for which federal money has yet to be appropriated carries an estimated total cost that is many times the level of annual USACE F&CSDR construction funding.<sup>13</sup>

The implication is that in the current federal budget environment, new requests by localities for the USACE to plan new local protection projects and upgrades for aging projects, particularly relatively high-cost projects, would face very uncertain prospects for future federal construction funding (see Attachment D). Attention to RICR as the USACE and federal policy goal, combined with recognition of limited federal authorities and budget resources, suggests specific changes to USACE project cost sharing, planning, and budgeting practices, as outlined in the recommendations below.

#### **4.3.1 Employ RICR to adjust cost share policies to address affordability concerns**

The reality of a limited USACE budget combined with a policy goal to promote cost responsibility has implications for establishing cost share requirements for non-federal partners in USACE local protection projects. By RICR logic, federal policies should, whenever practical and appropriate, avoid the transfer of the costs of floodplain location and use decisions to other parties or to the general taxpayer if the ability to transfer costs may encourage uneconomic floodplain use.<sup>14</sup> However, exceptions to this “beneficiary pays” principle are made in current federal programs in recognition of several considerations, including the possible need to subsidize, when the intent is to encourage, certain decisions (e.g., purchase of

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<sup>13</sup> The US Department of Agriculture (USDA) is the federal agency that historically has helped agricultural communities and landowners to plan and construct small-scale dams and levees in rural watersheds. Since the late 1940s, the USDA Watershed Program has partnered with local sponsors to construct over 11,000 watershed dams, and in the year 2000 the USDA Watershed Rehabilitation Program was established to help communities to upgrade or decommission aging dams. Both programs have been under severe budget stress in recent years, however, and available program funds have fallen well short of demand for program services.

<sup>14</sup> Even if there is no incentive effect of cost transfers (i.e. no efficiency consequences), there may still be a fairness argument for reducing cost transfers.

flood insurance), and the limited ability of many communities located in flood-prone areas to pay for flood risk reduction and management measures entirely on their own (e.g., federal cost sharing for hazard, exposure, and vulnerability reduction projects and actions).

The exceptions noted above focus in part on affordability barriers to strictly applying cost responsibility for certain communities and individuals. An affordability barrier exists when income and asset values limit the capacity of communities and individuals to afford risk reduction and management actions, which can limit their ability to be cost responsible. In fact, the level of cost share required from communities for USACE participation in a flood damage reduction project already can vary according to affordability, as authorized by the WRDA of 1996 (Section 202b), and the USACE already has an affordability rule in place that largely reflects equity considerations.

The USACE could revisit its affordability policy in order to promote cost responsibility for relatively wealthy communities that have less need for federal funds while recognizing that less well-off communities may face barriers to being cost responsible. The objective of a RICR-focused policy would be to assure that in the limited federal budget environment, well-off communities bear a greater cost responsibility relative to poorer communities for USACE-built local protections projects.

To implement this policy, the USACE would affirm that the existing cost share rules apply to all communities, but would accept proposals from local sponsors who can make an affordability case for a lower cost share for project plans involving significant life safety benefits. Guidelines would be issued that describe how the USACE would evaluate requests for such exemptions.<sup>15</sup>

#### **4.3.2 Establish funding and financing mechanisms for the rehabilitation of existing USACE-built local protection projects**

The USACE in recent years has upgraded the routine O&M inspection criteria, procedures, and rating system for levee systems within the USACE portfolio, which includes USACE O&M levee systems, federally-authorized/local O&M levee systems (i.e., USACE-built local protection projects that are the management responsibility of their non-federal sponsors), and non-federal levee systems enrolled in the Rehabilitation and Inspection Program (RIP). And in 2009 the USACE created a new “periodic inspection” process that is now being conducted on all levees within the USACE portfolio except non-federal levee systems. The periodic inspections are to be undertaken every five years and include but go beyond the routine O&M inspection focus to develop a preliminary understanding of potential project performance and safety, and to identify system features that may require further engineering evaluation and monitoring over time. The new USACE inspection regime reflects an agency strategy to minimize life

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<sup>15</sup> In order to ensure that increased federal subsidies go only to those communities truly in need, affordability should be assessed in the inundation area and not in the community at large, and the affordability determination must be based on the income and wealth of the landowners in the inundation area rather than that of renter-occupants.

safety risks in areas served by USACE-built levees by ensuring that non-federal sponsors properly operate and maintain those systems and are made aware of potential levee performance and safety issues.

A budget strategy that takes into account federal budget limitations could be for the USACE to prioritize construction funds for the rehabilitation of existing USACE-built hazard reduction projects (as justified) that are the primary focus of the USACE inspection program. The Budget Engineer Circular (EC) would explain that USACE budgets for flood risk reduction will emphasize evaluating and then maintaining the authorized capabilities of existing projects, with the highest priority accorded to projects for which the USACE has O&M and other management responsibility. In so doing, the EC would clarify which USACE authorities could be employed for project rehabilitation and describe budget availability or other considerations that will define USACE obligations and capabilities to reduce the assessed risk. Examples may be offered, and the readers of the EC would be directed to available reports on individual program authorities and capabilities. Also, the EC should explain that USACE budgeting for major improvements to increase the degree of protection afforded by existing local protection projects, or for new local protection projects, would be difficult to justify without higher than traditional non-federal contributions to the costs of implementation. Further recommendations to advance the repair and rehabilitation of local protection projects follow below.

#### **4.3.2.1 Facilitate budgeting for locally-planned repairs to USACE-built local protection projects**

After prioritizing funding for the rehabilitation of USACE-managed dams and levees, the remaining construction budget is small enough that any one of several large local protection projects now being planned or already authorized, if funded, could absorb that budget for several years at a time. This would leave no funding for large numbers of existing projects that may need only repair or minor rehabilitation to restore their expected performance or to make a meaningful increase in the degree of protection provided.

For this reason, the USACE could establish a repair fund for USACE-built local protection projects under its CAP authorities, and allocate a share of the FRM construction budget toward this fund for the repair of projects that require USACE funding levels below some threshold amount (e.g., \$10 million in federal cost). The fund allocation criteria and procedures should seek to motivate RICR and advance shared responsibility.

Support for such a new program might come from communities whose USACE-built levee systems cannot be certified for NFIP map accreditation, or for continued active status in the USACE Rehabilitation and Inspection Program (RIP), but for which a modest investment would bring the systems back into alignment with the requirements of those programs. From the perspective of the USACE LSP, the agency might focus its funding under this program on levee systems that have high-risk (levee safety action classification) designations.

The following are possible general features for such a program:

- The USACE would allocate a set amount per year from its FRM construction budget to the program, adjusted periodically for inflation, and limit the USACE budget commitment to a set sum per project.
- Non-federal interests would prepare an application for funding that includes a proposed project plan.
- The USACE would publish guidelines that a) define the engineering and other analyses it would expect as descriptions of the problem to be addressed and the proposed repair or rehabilitation plan, and b) define budget priority criteria (e.g., giving higher priority to significant life safety risk associated with breach prior to overtopping). The USACE might also provide technical support for the preparation of an application as allowed by its current authorities and resources.
- The following would be expected:
  - Each applicant would propose a local cost share. Consistent with affordability guidelines issued by the USACE (see recommendation 4.3.1) proposals to contribute less than the cost share currently required by law would be considered.
  - The actions proposed for USACE funding would be limited to investments in existing USACE-built projects, but proposals would need to show how risks to human life would be maintained at current levels or reduced through a planned combination of community hazard, exposure, and vulnerability reduction actions. Funding commitments from other government programs (federal or non-federal) for hazard, exposure, and vulnerability reduction actions would be a consideration in setting priority for USACE budgeting.
  - All projects would be expected to continue to be enrolled in the RIP program.
  - The Project Partnership Agreement would record the federal and non-federal commitments, and compliance with those commitments would be reviewed during the non-routine project inspections conducted by the USACE (see recommendation 4.3.3).

#### **4.3.2.2 Encourage and support increased non-federal project cost responsibility and funding mechanisms**

The nation needs to develop a new financing and funding<sup>16</sup> strategy for the major rehabilitation and improvement of local protection projects that involve significant costs. The USACE could rely on the logic

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<sup>16</sup> *Funding* refers to the sources of long-term monetary support for a project, while *financing* refers to the means by which funding sources are leveraged to provide sufficient upfront resources for project construction.

of RICR and shared responsibility to prepare initiatives for consideration by the Administration and Congress.<sup>17</sup>

First, the USACE could offer technical support to provide information and assistance to non-federal entities who wish to raise local revenues through value increment taxation or locally-based general revenue funding, such as increments to general sales taxes. At a minimum, a comprehensive review of national experiences and lessons learned should be compiled, published as background papers, and made available on the USACE NFRMP website.

Second, it must be recognized that only non-federal interests have the authority to raise local revenues through such funding sources; and since the USACE is not able to directly “capture” such local revenues, increased local contributions to project costs can only be realized by increasing the non-federal project cost share. Therefore, the USACE could propose cost share policy reforms that encourage non-federal interests to increase their share of total project implementation costs (perhaps in return for expedited federal project authorization and budgeting).

Third, the USACE could support local interests’ ability to finance (through debt instruments) their project cost shares. The USACE could develop financial analysis procedures for local interests, and agency capability to help localities to implement those procedures. The USACE would then be in a position to help the non-federal entity with any financing (loan) application by providing a financial analysis showing how the funds advanced would be repaid with a combination of local and other funding sources.

Of perhaps greater value to non-federal interests, the USACE could be responsible for affirming to the financing entity that the prospective action to be financed is environmentally acceptable. The USACE could retain the responsibility for completing analyses needed for establishing the environmentally acceptable project, considering compensatory mitigation requirements, and then issue any necessary Clean Water Act and other USACE-issued permits for the project. The ability to navigate the environmental regulatory process in ways that will expedite decision-making is a reason for maintaining a USACE role in planning locally-funded and implemented project upgrades.

Fourth, the USACE could prepare a report that evaluates the advantages, disadvantages, as well as opportunities and barriers to the creation of federal or non-federal public infrastructure banks that could make loans or provide credit enhancements to localities for project financing.

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<sup>17</sup> At the present time, the USACE “infrastructure strategy” is examining alternatives to traditional project financing, funding and delivery. That effort could contribute to the execution of this recommendation.

#### **4.3.3 Establish expectations in Project Partnership Agreements and other FRM agreements and programs for shared responsibility for flood risk reduction and management**

In the case of local protection projects, the Project Partnership Agreement (PPA) records non-federal sponsor commitments to project operation and maintenance and other management, including their commitment to repair, rehabilitate, and replace the entire project or a functional element at no cost to the federal government.<sup>18</sup> Further, pursuant to USACE Policy Guidance Letter 52 (PGL 52) on Floodplain Management Plans, the PPA must include non-federal sponsor commitments to participate in the NFIP and prepare and implement a floodplain management plan designed to reduce the potential consequences of future flood events in the project area. There also can be non-federal commitments to implement other risk reduction and management measures, such as developing emergency evacuation plans and promoting the purchase of flood insurance by community residents.

Following the principles of RICR and shared responsibility, the PPA should also include a formal record of agreement with the non-federal project sponsor on acceptable residual risk and the responsibilities of each party to implement specific risk reduction and management measures necessary to achieve that acceptable risk (see Box 4-3).

Four specific actions might be taken to further expectations for shared responsibility in PPAs. First, the content of PGL 52 (which is now more than a decade old) could be reviewed and expanded to assure that new PPAs include specific and measureable descriptions of federal and non-federal responsibilities to reduce risk and manage residual risk (with a focus on life safety) in floodplain areas, both within and outside the NFIP base floodplain.

Second, the USACE could create a process for incorporating those requirements into PPAs developed for 1) USACE participation in project rehabilitation, and 2) USACE Section 408 permitting of non-federal sponsor plans to make locally funded and implemented project upgrades (see recommendation 4.3.4 below).

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<sup>18</sup> An exception to non-federal cost responsibility for project management involves the USACE Rehabilitation and Inspection Program (RIP); for qualifying projects enrolled in the RIP, the USACE will repair flood-damaged projects to their pre-flood conditions at full federal expense (see Appendix D).

**Box 4-3: Informed consent and shared accountability as tenets of shared responsibility**

The codes of ethics of professional engineering societies include a basic principle that the engineer will hold paramount the safety of the public. This ethical imperative has been at work in the USACE design and construction of hazard reduction projects and in agency FRM programs generally. However, in every instance choices must be made in project design and construction in consideration of cost as well as reductions in risks to life and property. Those choices will affect the level of residual risk following project implementation.

For example, the height of a structurally-sound levee system can define the degree of protection (DOP) that it provides. The DOP that will be provided by a prospective levee project will be chosen in consideration of the technical constraints on size as well as the costs and reduced risk of life loss and reduced damages to property of higher structures. As another example, the decision on whether to armor the landside of a levee in order to increase the structure's ability to withstand overtopping without breaching will need to compare the cost of armoring with the reduced likelihood and adverse consequences of a breach after overtopping.

To be sure, engineers have a high responsibility when compared with the average citizen and experts in other areas when decisions on levee design levels, armoring, or operation and maintenance standards are made, because engineers will better understand the limitations of engineered structures and the potential consequences of structure failure. However engineering is not an exact science and even professional engineers may disagree on such matters. And the affected locality will necessarily weigh such project considerations in terms of the expected benefits and costs to them.

It is in this context that the concept of informed consent has received attention in the engineering ethics literature (Broome, 1996; Martin and Schinzinger, 2000). Informed consent stresses the responsibility of experts (here experts within the USACE) to offer their best advice by engaging in discussion with non-federal sponsors and stakeholders to assure their understanding of the risks to life and property posed by engineered structures and the costs of reducing them. In this way decision-making responsibility is not vested only in the USACE expert. Informed consent highlights the responsibility of those who receive the engineer's advice to make their own decisions in consideration of their own circumstances, perceptions of costs and benefits, and willingness to accept residual risk.

A PPA that employed the principle of informed consent would expand the meaning of the agreement from one of shared responsibility to one of shared accountability. Shared accountability requires that non-federal sponsors formally affirm their acceptance of project residual risks and their commitments to implementing project elements for exposure and vulnerability reduction and residual risk management, as well as USACE oversight of those commitments.

Third, to encourage non-federal sponsor compliance with its commitments, the PPAs could require non-federal sponsors to issue an annual report to landowners and residents in the project area that describe the execution of both the USACE and non-federal responsibilities called for under the PPA. This report could also be provided through the USACE to the Administration and Congress. As part of its on-going non-routine (periodic) levee inspections, the USACE could record whether those local reports have been

issued and also whether the USACE has honored its own commitments. Finally, the USACE could supplement USACE levee inspection staff with experts who are trained and have the resources to evaluate non-federal reports on the status of PPA commitments.<sup>19</sup>

#### **4.3.4 Expedite Section 408 permitting of non-federal proposals to locally plan, fund, and implement upgrades to USACE-built local protection projects**

Given current federal budget limits, non-federal project sponsors will increasingly be on their own with respect to planning, funding, and implementing the rehabilitation and improvement of aging USACE-built local protection projects. While some localities may not have the financial and technical capability to implement project improvements without federal assistance, other localities have demonstrated that they have both the motivation and means to do so. Indeed, in recent years some non-federal project sponsors have begun to plan, fund, and implement improvements to local protection projects that were built by the USACE, motivated by their desire to obtain NFIP levee accreditation and/or to meet locally perceived protection needs

When a non-federal interest is willing and able to make the full investment in the rehabilitation or improvement of a USACE-built local protection project, the non-federal interest must first obtain Section 408 permit approval from the USACE. Under current USACE policy, permit approval requires a USACE determination that the proposed alterations “will not impair the usefulness of the project and will not be injurious to the public interest.” However, the USACE has infrequently been called on in the past to exercise its permitting authority for significant project alterations and may not be ready to assume that responsibility on a larger scale.

USACE permitting policy and procedures have been changing in recent years and remain unsettled.<sup>20</sup> Current policy says that two categories of Section 408 approvals will be employed—minor and major. A minor 408 is applicable to “minor, low-impact modifications,” which are to be reviewed and approved at the district level. All other project alterations that involve “significant changes to the project scope, purpose, or functioning” require major 408 approvals, which are to be made at the headquarters level.

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<sup>19</sup> The USACE may not have authority to enforce non-federal compliance with commitments relating to flood risk reduction and management; however, the USACE may be able to enforce the public reporting requirement proposed here by making it a condition for maintaining active status for a project in the USACE Rehabilitation and Inspection program (see recommendation 4.3.5).

<sup>20</sup> The USACE has two different permit authorities for non-federally funded and implemented project modifications. One authority is 33 U.S.C Section 208.10 (Section 208), which pertains to minor modifications relating to project operation and maintenance responsibilities. Another review and approval authority for more significant project alterations is 33 U.S.C. Section 408 (Section 408). A series of USACE Headquarters memorandums to the field issued between 2006 and 2010 established that Section 408 will be the sole USACE authority used, and introduced new policy and procedural guidance for permit review and approval. Further USACE guidance for permit application, review, and approval is now being developed.

Under the new policy, proposed modifications intended to address project deficiencies such as levee seepage and loss of height would appear to meet the criteria for major Section 408 approval.

Several non-federal sponsors who are now in the process of planning improvements to federally-authorized levee projects have complained about the new policy. The affected non-federal sponsors contend that the policy forces applicants to undergo multiple layers of time-consuming and costly evaluations and reviews, and has created significant uncertainty for USACE districts and permit applicants as to which process (minor or major) is required for the review and approval of proposed project alterations. The concern is that the new policy will frustrate non-federal plans to make timely project improvements within local budget capabilities.

Presumably, in formulating and evaluating plans to make project upgrades, the non-federal interest would be expected to employ planning and analytical protocols that that USACE would employ if it were doing the planning, design, and construction work, or employ analogous procedures. This means that the USACE must develop and clearly articulate the analytical procedures and models that are required of the non-federal interest, and make clear whether those requirements will differ according to whether 1) the non-federal sponsor plans to seek federal reimbursement for the work (in situations where there are ongoing USACE investigations for prospective USACE-led project modifications), and 2) whether the proposed work is intended to increase the degree of protection beyond the original federally-authorized level. And importantly, the USACE must clearly communicate to non-federal interests the specific standards by which it will judge whether a proposal is potentially “injurious to the public interest.”

#### **4.3.5 Facilitate advanced planning for alternatives to the repair of flood-damaged projects in the Rehabilitation and Inspection Program**

Since the 1950s, the USACE Rehabilitation and Inspection Program (RIP) has funded and implemented the repair of federally-authorized (USACE-built) hazard reduction projects when those projects have been damaged by floods and storms. Eligible project elements include levees, flood control dams, channels, retention basins, and some underground tunnels constructed for flood hazard reduction, among others. In the 1980s, enrollment in the program was extended to certain non-federal projects (designed and built by non-federal entities) that meet specific criteria. Program enrollment currently includes USACE-built projects that encompass roughly 13,000 levee miles, and non-federal projects that encompass 2,000 levee miles. The program is intended to ensure that projects continue to provide hazard reduction while also providing incentives to non-federal project sponsors to properly operate and maintain them, which is a condition for repair assistance.

For eligible projects (defined below), the RIP implements structural repairs that restore project conditions to those immediately prior to the flood, and pays the full costs for USACE-built projects and

80% of costs for non-federal projects.<sup>21</sup> For any project, structural repair must be shown to have positive net economic benefits as determined by a USACE assessment of estimated future property damages avoided (the benefits) and estimated repair costs.

Projects enrolled in the RIP must maintain “active” status in order to be eligible for repair assistance; that in turn requires that a project continue to receive “acceptable” inspection ratings for project operation and maintenance (O&M) performed by the non-federal sponsor, as determined by the USACE in routine annual O&M inspections. Soon after Hurricane Katrina, the USACE changed the routine inspection criteria, procedures, and rating system, so that the inspections are now more rigorous than those conducted in the past. As a result, over the last several years hundreds of levee systems have been placed in inactive status for failure to maintain acceptable O&M ratings, meaning that they became ineligible for repair assistance at least temporarily until O&M deficiencies were corrected.

While the RIP commits the USACE to repair damaged projects that meet program eligibility conditions, the current program structure does not facilitate a rethinking of whether structure repair is the best option in light of current circumstances faced by a particular project and the community it serves. Under long-standing program rules, a project sponsor could request a “nonstructural alternative project” (NSAP) instead of structural repair. The principal stated purposes of a NSAP are floodplain restoration, restoration or expansion of floodways, and reduction of damages and repair costs to structural projects. Toward those ends, a project sponsor could obtain program assistance to acquire land; remove and relocate structures, highways, and utility connections; total or partial removal or razing of existing levee reaches and bank protection structures, among other actions. However, in the past a project sponsor would request a NSAP only if a project failed to meet the net economic benefits test for structural repair funds (there is no economic justification test for a nonstructural alternative), and to date only a few NSAPs have been funded. One reason that such alternatives to repair have not been more widely pursued is that they require significant advanced planning that had not previously been undertaken, so that even if a project sponsor wanted to consider a NSAP, such a plan was not ready for implementation at the time that RIP funds were made available.

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<sup>21</sup> Project repairs are funded through the USACE Flood Control & Coastal Emergencies (FCCE) account, and when FCCE funding has been provided by Congress in recent years, it has been through supplemental rather than regular appropriations to the USACE. Largely as a result of the 2005 hurricanes, the USACE received over \$11 billion in FCCE funds during the period FY2006 through FY2009, most of which was applied to project repairs. The average annual amount received for project repairs during this period was over \$2.5 billion, or roughly two and half times the amount the USACE received in regular construction appropriations in FY 2010 for new and modified flood damage reduction projects.

The USACE is now revising regulations for the RIP and is considering various program changes that could potentially affect the program's cost exposure (see Appendix D).<sup>22</sup> Among the currently proposed policy and procedural changes to the RIP regulations is the call for pre-flood event investigation of alternatives that may be implemented in lieu of repairing an eligible RIP-enrolled structure to its previous condition were it to be damaged by floods or storms.

The changes needed to promote alternatives to project repair can be organized into four areas. First, there needs to be a process that combines project knowledge within the USACE districts, available mapping tools, and information in the National Levee Database to identify places where study of alternatives to structure repair might be initiated. One screening criterion might be to identify levee projects with active status that have low intensity land uses behind the levees. The logic of this criterion is to target projects where landowners behind the levee might be open to receiving a payment for a flowage easement if the damaged levee were left breached or realigned to open up the floodplain. Another criterion might be to focus on projects with high expected annual maintenance and repair costs, such as channels where sedimentation rates are increasing, or levee segments located on bends of rivers where the levee toe is subject to continual scour.

With these projects identified, the non-federal project sponsors would be approached about their interest in a study to evaluate the relative merits to the nation and to the local area and landowners of structure repair versus alternatives to repair in the event of future flood damage to the structure. The study would be conducted at full federal expense; however, in-kind contributions of time and staff by the non-federal sponsor would be expected. The USACE could encourage interest in such studies by drawing upon its risk assessment and risk communication programs (see recommendations in Section 4.2) to increase the sponsors' and affected landowners' understanding of project capabilities and limitations, stressing the likelihood of future inundation and of the full array of federal programs that could be employed for implementing an alternative to structure repair.

Second, the USACE "planning modernization" process for feasibility studies could be adapted to the formulation and evaluation of alternatives to repair; however, analytical procedures specific to the needs of the RIP would need to be developed. For example, there might be a standard USACE evaluation to establish if there is a federal interest in an alternative to repair. In addition, there would need to be a financial analysis, as distinct from an economic analysis of social costs and benefits, in order to compute the budget requirements necessary for implementing an alternative to repair.

Also, the ability to practically implement any alternative to structural repair would need to be evaluated. For example, purchase of flowage easements would be essential to plans that call for levee system realignment or breaching levees. The plan would need to specify the terms of easements, the payment

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<sup>22</sup> The federal government cost exposure for funding project repairs may be increasing as levee projects enrolled in the RIP continue to age and become more susceptible to flood damages.

structure, what entity would buy and hold the easement and verify compliance with the easement terms, and assure that landowners are aware of the easement when property ownership is transferred. Under current laws, acquiring and overseeing easements is a non-USACE responsibility, but that might need to be reevaluated.<sup>23</sup> Meanwhile, landowners would need to be able to assess what level of easement payment is acceptable to them. The USACE could prepare a landowner decision support spreadsheet program to allow landowners to compare the financial returns from accepting payment for a flowage easement against the potential financial consequences of their increased exposure to flood risk.<sup>24</sup>

Third, there would need to be strategies for keeping non-repair plans and implementation agreements updated, and then for securing funding for such plans in the immediate post-flood environment. If there were a plan with an up-to-date cost estimate, then that cost estimate could be used in the USACE analysis and when making the emergency supplemental appropriation request. At present, the amount of money that could be spent on a nonstructural option is capped at the cost of structural repair; this limitation may need to be reconsidered.

Finally, analytical challenges could be addressed with modern planning tools and by relying on the long-standing USACE experience in planning flood hazard reduction projects. However, a greater challenge would be identifying and securing changes in the authorities to allow the process described above to be implemented. Two examples were noted. One was that there may need to be a new authority for the USACE to acquire easements with emergency supplemental appropriations. As another example, under the RIP authority the agency may not be able to make major modifications to a levee system, or even agree to a plan to decommission that system, without specific Congressional authorization; however, normal feasibility study initiation and authorization processes would not serve this program. Therefore, for the intent of this recommendation to be realized, authority questions would need to be identified and addressed in parallel with the development of appropriate study procedures and analysis tools.

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<sup>23</sup> The USDA is a federal agency that currently buys easements.

<sup>24</sup> Another need is to address the “holdout problem” for acquiring flowage easements under a willing seller system. For example, consider a situation where some but not all landowners would be willing to sell flowage easements so that a different levee alignment might be possible as part of post-flood levee modification. Under that situation, if the USACE analysis finds that the federal interest plan is “realign and repair” and that also is the locally preferred plan, implementation would require signing a new sponsor agreement under the RIP. In this case, those who do hold out and prefer the structure to be repaired without realignment may oppose any new agreement.

#### **4.4 Continuous Policy and Program Evaluation**

RICR demands continuous review and evaluation of: 1) USACE risk communication programs and their effectiveness for informing decisions, and; 2) USACE policies that result in the transfer of costs from floodplain occupants to others, and how such transfers affect the choices of floodplain occupants. With regards to the latter, cost transfers can be in the form of changes in flood risk borne by others, payments from general taxpayers in the form of public expenditures on hazard, exposure, and vulnerability reduction and for increased resiliency, or as reductions in floodplain environmental services. The following recommendations focus on RICR-based policy and program evaluation.

##### **4.4.1 Develop a rigorous protocol for evaluating the effectiveness of policies and programs intended to convey risk information and establish cost responsibility**

There are multiple, interacting influences on community and individual floodplain location and use and flood risk reduction and management choices. Seeking to isolate the influence of any single federal program on those choices requires a carefully designed analytical approach. This is required, because it is difficult to design and evaluate policy reform options without a better understanding of the actual influence of federal policies and programs on the choices made by decision agents.

Assertions are often made that federal FRM policies and programs affect community and individual choices in ways that increase flood risk (see, for example: Association of State Floodplain Managers, 2007). However, there has been little rigorous empirical work that evaluates these assertions. Sometimes the assertions made are based on a failure to appreciate the details of the specific programs they implicate. Sometimes assertions are based on correlation analyses that are not grounded in an underlying causal model; for example, a correlation showing increased development behind a levee after the levee is built is assumed to be a result of the levee building itself.

Accordingly, the USACE should support the design and application of a protocol for evaluating USACE program influences on the choices made by communities and individuals that bear on flood risk. While the protocol is being proposed for use by the USACE, it could have wider applicability for evaluating any government policy or program.

The proposed analytical protocol for evaluating the impact of USACE FRM programs on the choices made by communities and individuals has the following steps:

1. *Describe the program(s) of interest:* Before research into a program's effects on choices is initiated, careful documentation of how the program is actually implemented at the parcel and community levels is needed. Program implementation includes legislative mandates, budgets and flow of funds, program eligibility requirements, and other factors.
2. *Develop a conceptual model:* A mental model is needed to frame the hypothesized effects of a program on decision-making. The hypotheses should be predictions of the relative influence on choices of USACE program effects on risk understanding and/or cost shifting, all other considerations held constant.

3. *Choose an empirical approach:* First, ask what ideally would need to be known to evaluate the hypothesis. Are there observable choices that individuals make in response to the program that can be examined? If so, is the data to do so available? If there are such data, standard statistical techniques can be employed to analyze choices. In some cases what is needed (instead of or in addition to) is an understanding of individual perceptions. In this case a survey must be undertaken; such surveys would need to conform to best practices in the social sciences.
4. *Undertake analysis:* Based on 3 above, rely on research methods, including anecdotal observations of actual decisions, surveys, statistical analyses of large data sets, and computer simulations of hypothetical decision situations.
5. *Evaluate internal and external validity:* Evaluations should include program administrators and perhaps community leaders (plausibility test) as well as standard research review processes.
6. *Propose reforms based on the findings:* Based on the findings, propose changes in legislative mandates, budgets and flow of funds, program eligibility requirements, and other factors that could increase community and individual understanding of flood risk and cost responsibility for their choices.

#### **4.4.2 Develop program evaluation metrics for measuring success in promoting risk informed and cost responsible decision making**

With RICR as the USACE and federal FRM goal, the challenge for policy and program evaluation is that the desired end state—an improved understanding of flood risk and an “appropriate” bearing of the costs of floodplain use and risk reduction and management on the part of communities and individuals—must be measured and reported. Measures of progress towards these end states will differ from the metrics currently used to evaluate USACE FRM program and project level success, which focus on historical trends in adverse consequences (property damages and loss of life attributable to floods) and estimates of damages prevented by projects.

Possible measures of the success of policies and programs in fostering RICR are listed below; these are suggestive, as data to make the measurements may not be available or may be too costly to obtain. The USACE could initiate a process to design and develop RICR evaluation measures and ways to collect the data to make such measures for reporting on the success of RICR-focused policies and programs.

##### Category 1: Measures of Risk Informed Decision Making

- Assessments of the degree of protection (DOP) provided by USACE-built hazard reduction projects.
  - Number of levee miles with DOP estimates less than 10 years old
  - Percentage of population located in leveed areas with DOP estimates less than 10 years old.
- Date of last update of descriptions of authorities, budgets, and budget priorities of USACE flood risk reduction and management programs.

- Number of communication and distribution vehicles for program information dissemination.
  - Single-source federal FRM site for non-federal access.
- Flood inundation map accuracy and distribution
  - Square miles for which there are up-to-date flood maps for the full floodplain.
  - Percentage of population located in floodplain areas having up-to-date flood maps.
- The change in understanding by communities and individuals of residual risks in areas served by USACE-built flood hazard reduction projects, as established through properly designed and applied survey instruments.
- Community reports prepared and distributed to community residents that describe the residual risk in local leveed areas.

#### Category 2: Measures of Cost Responsibility

- The extent to which communities pay for flood damage reduction projects out of local funds.
- The use of non-federal, beneficiary-based value increment taxes to pay for local flood risk reduction and management measures.
- Federal disaster payments received by a locality as a proportion of total local flood damages.

#### Category 3: Combined Measures of Risk Informed Decision Making and Cost Responsibility

- Number of NFIP policies in effect as a proportion of all properties in the floodplain.
- Annual NFIP premium revenues in relation to annual expected property damages.
- Annual participation in the NFIP Community Rating System (CRS) and change in number of CRS qualifying actions.
- Number of active cost share partners for USACE project studies and construction.

## 4.5 References

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